

SOYBEAN PRODUCTION AND FOOD SECURITY FOR SMALL
AND MEDIUM SCALE FARMERS
- A STUDY FROM SANTA CRUZ, BOLIVIA

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Map 1.1: Soybean field, Santa Cruz, Bolivia. Source: Ivo Kuljis (2013)

Declaration

I, Astrid Een Thuen, declare that this thesis is a result of my research investigations and findings. Sources of information other than my own have been acknowledged and a reference list has been appended. This work has not been previously submitted to any other university for award of any type of academic degree.

Signature.....

Date.....

Abstract

This thesis investigates how soybean production contributes to and constrains food security for small and medium scale farmers in three communities (San Pedro, San José and San Julián) in Santa Cruz, Bolivia. The research employs a theoretical framework based on the food system framework concept to investigate soybean production, and its effects on food security. The analysis are done by looking at the wider drivers that affects the food system, such as environmental, social and economic factors, and how these contribute to food security. Here, food security encompasses components of availability, access and utilisation. Findings suggests that the main environmental drivers affecting the soybean production are extreme weather such as reoccurring floods and droughts, more frequent erratic and unpredictable rainfall, and a trend of increasing temperatures. Further, the socio-economic drivers have created the soybean cluster, in which companies and institutions are providers of important products, such as financial services, machinery, materials etc. The participation of small and medium scale producers in this cluster takes place usually by acquiring loans for covering the necessary investments for soybean production. Following, the socio-economic and environmental drivers are discussed in the light of its effect on food security, through looking at access, utilisation and availability. The findings show that soybean production has to various degrees influenced food security. In terms of availability, soybean has replaced other crops amongst the farmers, which might have influenced the availability of locally produced foodstuffs. Soybean production have led to an increase of income for most farmers, still the economic situation is characteristic by uncertainty. In terms of utilisation it's noted that even though soybean is the main crop in production, it is noticeable that its consumption is limited.

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List of abbreviations

ANAPO	-	Asociación Nacional de Productores de Oleaginosas y Trigo <i>National Assotiation of wheat and oilseed producers</i>
AoA	-	Agreement on Agriculture
CBF	-	Bolivian Development Corporation
CECAFS	-	Global Environmental Change and Food Systems
CEDLA	-	Centro de Estudios para el Desarrollo Laboral y Agrario <i>Centre for Labour and Agricultural Development Studies</i>
EMAPA	-	Empresa de Apoyo a la Producción de Alimentos <i>Company of Help for Food Producers</i>
ENSO	-	El Niño Southern Oscillation
ESF/COST	-	European Science Foundation/European Cooperation in Science and Technology
FAO	-	Food and Agricultural Organization
GDP	-	Gross domestic product
GM	-	Genetically modified
GMO	-	Genetically modified organisms
IGC	-	International Grain Council

ILO	-	International Labour Organisation
IMF	-	International Monetary Fund
IPC	-	International Planning Committee for Food Sovereignty
IPCC	-	Intergovernmental Panel on Climate Change
MAS	-	Movement Towards Socialism
NGO	-	Non-governmental organisation
PROBIOMA	-	Productividad, Biósfera y Medio Ambiente <i>Biosphere, Productivity and Environment</i>
SENAMHI	-	Servicio Nacional de Meteorología e Hidrología <i>National Service of Methereology and Hydrology</i>
UN	-	United Nations
UNCCC	-	United Nations Framework Convention on Climate Change
UNCTAD	-	United Nations Conference on Trade and Development
UNU-WIDER	-	United Nations University World Institute for Development Economics Research
USAID	-	United States Agency for International Development
WB	-	World Bank

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1. Introduction

Food security, defined as when “*all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preference for an active and healthy life*” (World Food Summit, 1996), and an issue of political importance in literally all countries in the world (Ericksen, 2007). The last decades of increased productivity and efficiency in food systems have contributed to the relief of hunger and improved food security for millions of people.

The increase in agricultural production created optimism that the issue of food security could be solved in the 20th century; however this has not been the case (Lang and Heasman, 2004). In 2013, it is estimated that 845 million people do not have sufficient access to food (FAOSTAT, 2013). In fact, it is becoming increasingly clear that the efficiency increase have led to negative and sometimes unintended harmful consequences on food systems. These consequences have, to various degrees, posed threats to social, economic and environmental goals and thus undermined the food security of farmers (Ericksen, 2007).

The efficiency increase has happened in a rapidly changing food system. Powerful actors are progressively entering the food system, with multinational companies entering and controlling the food chain (Shaw, 2007). The food is to a larger degree produced by fewer commercial growers, which has led to many farmers becoming contractual farmers (Maxwell and Slater, 2003). Small and medium scale farmers are facing a more difficult trading environment, with different demands of quality and quantity of produce. Furthermore, the food system is characterised by a move away from consuming staple crops towards more consumption of processed food, often referred to as the “nutrition transition” (Popkin, 2001). This infers that farmers are increasingly becoming production units, delivering raw material to food industry, instead of growing food for direct consumption (Pinstrup-Andersen, 2013).

In addition to the altered trading context, a range of novel environmental issues are emerging. These include warnings about the consequences of new technology, the effect of pesticide use, and the risks resulting from mono-cropping, amongst others. The more recent

debate on genetically modified organisms (GMO) concerns effects both on the environment and its social cost. Considering all these aspects of this “new food system” (Maxwell and Slater, 2003), it becomes clear that the effect of the transformation of the food system on farmers’ food security is ambiguous.

In this process, often referred to as the move from “traditional” to “modern” agriculture (Ericksen, 2007; Maxwell and Slater, 2003), the production of so called cash crops have been an important factor for the productivity growth. Cash crops refer to agricultural crops grown for sale, in contrast to subsistence crops grown to feed the farmer’s own family. Cash crops are often produced in a mono-culture, where the producers focus on producing one single crop in large quantities.

Soybean production is an example of a cash crop that has had a large growth, especially during the last 30 years. Commonly referred to as the “green gold”, soybeans have been promoted in many countries as a multifunctional crop. Much of the growing demand is due to its use as animal feed; the demand for meat and dairy products has increased and is expected to double between 2000 and 2050 (Steinfeld et al., 2006). Further, soybeans can be used for biofuels, for technical industry and for human consumption.

Bolivia is one of the world’s soybean producing countries. Here, the growth of soybean production has increased by 376 % from 1991 to 2010 (Catacora-Vargas et al., 2012). Soybean production, which is increasingly becoming an important part of the country’s economy, is being promoted as a strategy to ensure food security, both by the Bolivian government and by actors involved in the soybean industry, such as The Soybean and wheat producers association of Bolivia (ANAPO). The introduction of soybean production in Bolivia has created a structural context in which the soybean production is taking place, referred to as “the cluster of soybean” (Suarez et al., 2010). To be able to see how soybean production affects food security for the small and medium scale farmers, this structural context needs to be examined.

Thus, this research will employ a theoretical framework based on the food system framework concept (Ericksen, 2007) to investigate soybean production and its effects on

food security. The analysis will be done by looking at the wider drivers that affects the food system, such as environmental, social and economic factors, and how these contribute to food security for small and medium scale farmers. Here, food security encompasses components of availability, access and utilisation.

This thesis is a qualitative study which investigates how soybean production contributes to, or constrains food security for small and medium scale soybean farmers in three communities (San Pedro, San José and San Julián) in Santa Cruz in Bolivia. The empirical data for this research was gathered during a fieldwork in Santa Cruz from 23rd July to 5th October 2012. The primary data collection methods during the fieldwork were semi-structured interviews, including both single and group interviews, and observation. Four key interviews were carried out; two with farmers' leaders in the communities, in addition to interviews with two Bolivian organisations. Further information on the methodology is discussed in chapter four.

1.1 Objectives and research questions

Accordingly, the main research question guiding this thesis is: *How does the food system of soybean production contribute to or constrain food security for small and medium scale soybean producers in Santa Cruz, Bolivia?*

In order to answer this question two interlinked sub-questions will be addressed;

- i) *What environmental and societal drivers affect small and medium scale soybean producers in Santa Cruz?*
- ii) *How do the farmers experience their own situation in terms availability, access and utilisation of food?*

The concept of *systems* can be a tool to address complex problems which consists due to several independent components (Ericksen, 2007). By looking at food security as an

outcome of food systems it is possible to examine the different environmental, social and economic components that affect the food system and their interaction.

Several authors have differently described linkages between the social and ecological aspects in food systems. Norgaard (1986) put forward a co-evolutionary framework, which provided a link between ecological and economic paradigms that “emphasizes how man's agricultural activities modify the ecosystem and how the ecosystem's responses provide cause for subsequent individual action and social organization” (Norgaard, 1986). Holling (2001) further explained the complexity of living systems which contains of both people and nature. To understand the interactions of a system, the ecological, social and economic components need to be examined. A system approach adds value to research on food security, as it considers the human-environment interactions, even though these interactions are far from straight forward in most cases.

The food system framework approach presented by Ericksen (2007) can be used to understand the complexity of food security though looking at the different drivers and interactions amongst them (Ericksen, 2007). In this research the approach gives an “analytical lens” (EFS/COST, 2009) to examining how food security is linked to the different drivers and also how food security feeds back to its drivers. There is a need to address food systems holistically and not as distinct components where issues of agriculture, nutrition, health and markets are looked at separately (Ericksen et al. 2009:373). Hence, this thesis aims to examine food security in an interdisciplinary manner.

1.2 Structure of the thesis

This thesis is divided into eight chapters. The first chapter gives an *introduction* to the thesis based on the research questions and the objectives. The introduction chapter is followed by the *methodology*, where the study area is presented. The chapter further outlines and discusses the research approach adopted for collecting and analysing the data. Additionally, an overview of challenges, limitations and ethical considerations, as well as how they were addressed, is included.

Chapter three, *background*, is focused on the history of Bolivian agriculture and describing the contextual setting and social structure of the three research communities (San José, San Pedro and San Julián). It also explains the trajectory of soybean production in Bolivia. The fourth chapter outlines the *theoretical framework* used to approach the research questions and analysing the empirical findings. Thus, this chapter provides an overview on the concept of food security and the current debate on the topic.

Following this, the two analytical chapters are presented. Chapter 5, *environmental and socio-economic drivers*, discusses the first sub-question of the study according to empirical findings from the interviews with farmers and institutions, complemented with secondary data. The chapter aims to study soybean production as a food system and present and discuss the environmental and socioeconomic factors that either contribute or constrain the food security of the farmers. The environmental drivers influencing food security are firstly discussed, followed by a presentation and discussion on the socioeconomic drivers. The chapter argues that different factors need to be considered when analysing the achievement of food security, to be able to get a holistic understanding of the issue, and that these drivers affect the food security of different communities.

Food security and small and medium scale farmers, chapter six of the thesis, is the second analytical chapter. It addresses the second sub-question of the study, i.e. how the farmers experience their own situation in terms availability, access and utilisation of food. For this purpose it examines and discusses empirical data emphasising farmers' experiences regarding their own food security. Chapter seven, *the discussion*, build on the findings of both the previous chapter and aim to answer the main research question of this thesis on how soybean production contributes to or constrain food security for small- and medium soybean producers. The analysis of the findings are structured according to the three pillars of food security proposed by FAO in 1996; availability, access and utilisation.

Chapter eight is the *concluding chapter* of the thesis. It summaries the findings and discusses how this research contributes to new insight on the relationship between food security, small and medium scale farmers and soybean production.

2. Methodological approach

This chapter will outline and discuss the methodological approach used for this study, together with data from the study area. The first part contains a more detailed description of the three communities, including information on climate and vegetation, together with a description of the two zones used for the research. Further, this chapter will outline and discuss the methodological approach employed to study the food security situation for small and medium scale farmers in the three communities in Santa Cruz. *Methodology* is a term which includes the whole research process and the strategy that is used to answer the objectives of the research. Methodology includes the procedures and strategies used, such as the choice of methods for collecting the data and analysis. *Methods* refer to the specific tools and techniques used for data collection and analysis, such as focus groups, interviews and observations (Sumner and Tribe, 2008). Thus, this chapter will describe the complete process of data gathering and analysing, including the choice data collection methods and how they were applied. In the last part the ethical considerations taken during the research is outlined, together with the potential limitations.

2.1 Study area

The research was carried out in in three communities, San Pedro, San José and San Julián. The two first communities are located in the municipality of San Pedro and the latter in the municipality of San Julián. Both municipalities belong to the Department of Santa Cruz, which is the largest region in Bolivia, located to the east in the country.



Map 2.1: Location of research area. To the left Bolivia, to the right the departments in Bolivia (Source <http://commons.wikimedia.org/wiki/File:Bolivia-Pos.png> and <http://www.mapsopensource.com/bolivia-departments-map.html>)

2.1.1 Vegetation and Climate

San José, San Pedro and San Julián are communities located in the in the central region of the department of Santa Cruz. The area is an alluvial plain and the climate is generally hot due to the tropic location. In region, Santa Cruz de la Sierra, the mean winter temperature is 21.7 °C, whist the summer temperature is 26.4°C. There are, however, periodic cold fronts that come from the south that leads to a night-time drop in temperature to around 10°C in the summer and in the winter the temperature can reach 5°C (Barber et al. 1996; Ronchail, 1986 in Steininger et al., 2001).

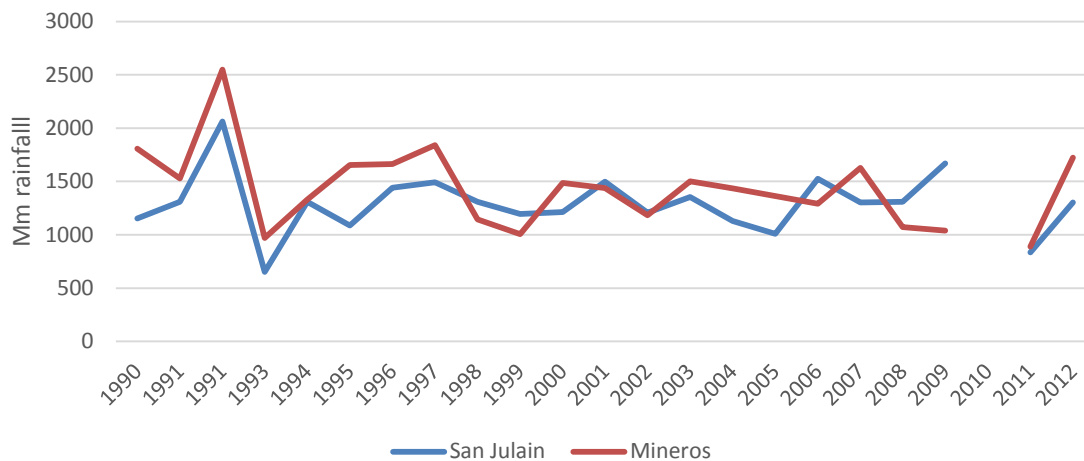


Figure 2.1: Annual precipitation in mm. 1990-2012 in San Julián and Mineros. No available data for 2010 (Authors work based on SENAMHI, 2013)

The rainfall has large local variations, and close to the city of Santa Cruz it varies between 900-1400 mm per year (Barber et al. 2002). As seen in Figure 5.1, the annual precipitation of San Julián, San Pedro and San José is somewhat higher than that of Santa Cruz. San José and San Pedro do not have a meteorological station, hence the data is taken from a station in Mineros, 42 and 53 km further north, respectively. The month with highest rainfall is January, referred to as the rainy season (Bounoua et al. 2004), together with November, December and February, whilst the driest months are July and August (Figure 2.2). This climate permits the farmers to grow two crops per year in the Northern Integrated zone, where San Pedro is located. In the summer (from November to May), soya, maize and cotton are usually grown, whilst in the winter (from May to September), the most common crops are soya, wheat, sorghum or sunflower (Barber et al. 1996).

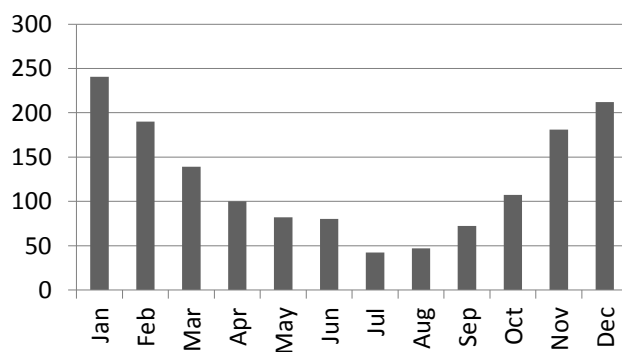


Figure 2.2: Mean annual rainfall, Mineros 1980-2012. (Authors work based on data from SENAMHI, 2013)

2.1.2 North and East zone

Soya is mainly grown in two zones in Santa Cruz; Integrated Northern Zone and Extended Eastern zone. San Pedro and San José are located in the Integrated Northern Zone, and San Julián is located in the Extended Eastern zone. In both zones intense processes of internal migration occurred; however, these processes differed both in terms of time and local conditions.



Map 2.2: Map of the Department of Santa Cruz. The black dots indicating research areas (Source: <http://entelsms.com/mensajesentel/index.php/mapas-de-bolivia/mapa-de-santa-cruz>)

The Integrated Northern zone

The Integrated Northern zone is located northwest of the department capital, Santa Cruz de la Sierra. San Pedro and San José are located between the rivers Pirai and Río Grande. The area experienced migration from the 1960's (Solem et al., 1985), with people coming from

the highlands and valleys in search of opportunities in the growing agribusiness sector. Many organised in agricultural unions, through which they obtained land of up to 20-30 hectares. However, there were also cases of immigrants who did not obtain land to cultivate (Suárez et al., 2010).

When the immigrants first arrived to the Integrated Northern Zone, the majority started with rice production, due to both high prices and the very fertile soils. With the rice production commenced the mechanisation process, which was widely adapted in this zone. Many farmers first hired a tractor for carrying out ploughing and harrowing, however from the 1980, the larger scale farmers in the area started to purchase their own machinery. Initially, the mechanisation of small scale farmers was not seen as a justified pathway, especially around the difficult economical year 1985. However, despite there not being an institutional plan, a range of factors altered the profitability, such as improved seeds, better harvest and increased weeds control (Thiele, 1992).

In 1988, the price of soybean on the world market reached an all-time high at 327 US\$ per tonnes, making it far more profitable than rice. This, together with the decrease in rice prices, the ongoing mechanisation process in the zone and more local markets, made the majority of the farmers gradually start with soya (Suárez et al., 2010). In 1988, soya was introduced as a winter crop, yet due to the high prices, it was also grown by many in the summer of 1989. In only 2-3 years, a mono-cropping system of rice was replaced by a mono-cropping system of soybeans. As soybean is a fully mechanised crop, it further fuelled the mechanisation in the zone, making it feasible to grow for parts of the small and medium scale farmers (Thiele, 1992).



Map 2.3: Aerial view of San Pedro (left circle) and San José (right circle). (Source: Google maps 22.01.2013)

The Extended Eastern zone

The Extended Eastern zone is located northeast of the department capital. San Julián is one of the oldest zones of immigration and consist of three large parts; San Julián Centro, Brecha Casarabe and San Julián Sur (now an area called Cuatro Cañadas).

The initial immigration started in early 1970's; still in the late 1970 the zone was largely unpopulated. The immigration accelerated in the 1980's, particularly due to the promotion of the expansion of commercialised crops (especially soybeans) by the World Bank through the Eastern Lowlands Project, implemented in the late 1980's and early 1990's (Steininger et al., 2001; Hecht, 2005). The area was attractive for three main reasons. Firstly due to the good rainfall levels, secondly because of its flat land, and thirdly due to its close distance to Santa Cruz de la Sierra (Soria, 1996 in Suárez et al., 2010:46).

In San Julián, immigration families were given up to 50 hectares of land; however they did not get any economic aid and technical advice, as promised by the colonisation programmes. At the same time as the governmental colonisation plan was carried out, spontaneous settlements led to a triplicate of the rural population in this area. This led to difficulties in

dividing the land, infrastructural problems and a larger demand for sanitation, education and health services (Suárez et al., 2010).

After arrival, many of the new settlers got together and created a “*nucleo*”. A *nucleo* commonly exist of around 40 families which are centralised around a well (Figure 2.3). The nucleo made it possible for farmers to live on the land they cultivated, in addition to living close to the well. It also provided security as families lived closely together (Solem et al., 1985). However, the soil in the area has some limitations such as poor drainage causing floods and limited fertility. Therefore, many *nucleos* have since been abandoned by the immigrants (Suarez et al., 2010).

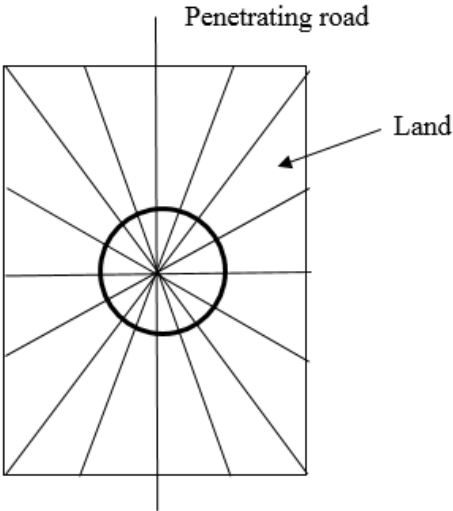


Figure 2.3: “Nucleo” settlement design. Well located in the middle and farmers houses located within the circle. (Own elaboration based on Solem et al., 1985).

The soybean production arrived later to the Eastern zone than to the Northern zone. While the northern zone has had widespread soybean production since the mid-1980s, the growth started in the eastern zone around 5-10 years ago. Before that immigrants mainly came to work as temporary labour workers, especially at the sugarcane fields.



Map 2.4: Aerial view of San Julián. Black dot indicate research area (Source: Google maps 22.01.2013)

2.2 Methodological approach

As the thesis aims to understand how soybean production affects the food security of small and medium scale farmers, and look at the environmental, social and economic drivers affecting the food system, a qualitative methodological approach was selected as-deemed to be the most appropriate.

The use of a qualitative research strategy was suitable as it enabled more insight into how farmers experienced their food security, and communicating with and observing local farmers. The concept of “food security” is complex, and the literature reports various definitions and interpretations. A qualitative method will be able to give a more “explicit treatment” (Bryman, 2008) of the issue and might therefore be suited to address such a complex topic as food security. A joint study effort between United Nations University World Institute for Development Economics Research (UNU-WIDER) and FAO emphasise that “a major advantage is that qualitative measures incorporate as essential elements the perceptions of food insecurity and hunger by the people most affected” (Guha-Khasnobis et al. 2007). The possibility of examining human experiences is a strong feature of qualitative

research (Silverman, 2010), and it provided context for the farmers view on the issue of food security. It allowed for a rich description of the issue and to get a broad understanding of the context in which the soybean production happens.

To provide answers for the objectives and research questions, the study was located in three communities, San Pedro, San José and San Julián, where the two first are located in the municipality of San Pedro and the latter in the municipality of San Julián. All communities are in the Department of Santa Cruz, Bolivia. The location was chosen due to accessibility and the availability of local contacts. The latter facilitated interviewing access to local people. Additionally, the two municipalities have different trajectories on soybean production. The three communities represent some differences because San Pedro and San José have had production of soya for 15-25 years, while San Julián is a community where the soya arrived 5-10 years ago. Most of the producers in these areas are small (less than 50 hectares) and medium scale (from 51 up to 1000 hectares) farmers. Additionally the agricultural dynamic is different between the two municipalities, due to the difference in weather conditions.

This research consists of qualitative research to generate primary data, in addition to the use of secondary sources. The primary data were collected, between 23rd July and 5th October 2012 through semi-structured interviews and observation. Altogether, 29 interviews were carried out, both single interviews and group interviews with 2-4 people, together with an appraisal of household food consumption (appendix 3) and more informal discussions. All primary data collection was carried out in Spanish. Secondary sources were both in English, Norwegian and Spanish.

2.3 Data collection methods

The choice of data collection methods is related to the research question in this thesis. To be able to investigate how soybean production contributes to or constrain food security for small and medium scale farmers, this thesis employs three data collection methods; interviews, observation and use of secondary sources. These were chosen in order to give a contextual understanding of the research question, and be suitable to assess the different

drivers that affect soybean production and thus how the food security of small and medium scale farmers was affected.

2.3.1 Interviews

Qualitative semi-structured interviews were applied as the main data collection method. This research focuses on how the target group (small and medium scale producers) describe different issues related to food security; hence semi-structured interviews allowed for insight into the social life of the farmers, their thoughts and feelings regarding their own situation as soybean producers and what they experienced as important for their own food security (Boeije, 2010).

In total, 25 interviews were carried out with soybean producers located in the three communities. An interview guide (appendix 1) was prepared, which contained 25 questions asked to the farmers participating in the research. Several of the questions had sub-questions. In order to obtain the feeling of a conversation, contra a formal interview setting, the questions were asked in the most appropriate order in accordance with the development of the interview, and follow up questions were frequently added to make the farmers elaborate on interesting topics. The question about how the farmers had experienced the recent weather events often led to elaboration and gave to possibility for further questions on for example what thoughts they had about the future in relation to climate change.

The assessment through interviews focused on the following topics; availability of food, experience of weather events, area under soybean cultivation, crops produced, type of varieties cultivated, access and availability of agricultural inputs, land tenure, food expenses, self-consumption of soybeans and foodstuff regularly consumed. The information generated information was qualitative, but also quantitative. The qualitative information and analysis dealt with feelings and opinions on topics such as availability of food, weather events, changes in food prices and reasons for consuming some types of foods over others. The topics characterised through quantitative analysis aimed to provide information about number of hectares produced with soybean and other crops, company used for seeds and inputs, use of income on food and typically food consumed.

In addition, four key informant interviews were carried out; two with farmer union leaders and two with Bolivian organisations, which were asked additional questions (see appendix 1). They were chosen as key informants because they were believed to be able to give useful information and insight into the research topic (Bryman, 2008).

The two leaders of the farmers came from San Pedro and San José. In addition to the questions discussed with the other soybean farmers, the two key informants provided further geographical information about community size, main livelihood and division of land. They also provided more qualitative reflections around the division of land, political attention given to the issue of food security and their thoughts on how habitants in their community related to own food security. The information provided a more complete picture of the community, and since the interview of the farmer union leaders were conducted prior to interviews with the other farmers, it allowed for the preparation of more appropriate follow up questions.

Further, key information interviews were carried out with two Bolivian institutions; Biosphere, Productivity and Environment (PROBIOMA, according to its name in Spanish) and Centre for Labour and Agricultural Development Studies (CEDLA, according to its name in Spanish). A separate interview guide was developed for this purpose (see appendix 2).

PROBIOMA is a NGO which started 22 years ago with the main office located in Santa Cruz. Their work is within the fields of biotechnology with biological control as a base for agroecology, sustainable use of biodiversity, policy-making concerning development, sustainability and food security and public information. They offer services such as training, technology transfer, analysis of soils and seed production. They are engaged and have done research on soybean production in the relevant areas (PROBIOMA, 2013; interview).

CEDLA is a NGO which started in 1985 with their main office in La Paz. It is a centre that conducts investigation and that works with labour unions, small scale farmers, indigenous villages and other grass-root groups. They work in two lines of research: macroeconomics and specific-sector research, such as agriculture. CEDLA also works on polity, public policies and the impact these have on various groups in the society. The organisation is

engaged in agricultural policies, land reform issues and the current government work on food security (CEDLA, 2013; interviews)

These institutions provided information about the terms of food security and food sovereignty in a Bolivian context, and how they see these terms as political issues. Further, a more indebt analysis of the situations of small and medium scale farmers in Santa Cruz was given together with the land tenure issues, characterised by an increasing amount of foreign land owners. The two institutions provided knowledge on the legalisation of GM soybean in 2005 and how they see it affecting the physical environment and human health. PROBIOMA has carried out research on the soybean farmers, about GM soybean, but also had information related to weather, prices etc., in the three communities where the research was carried out.

All the interviews were carried out in Spanish, with a research assistant present at all interviews, except with the two institutions. Additionally, a recorder was used during all interviews in order to ensure accuracy of the information obtained. Prior to initiating the interview, consent was obtained for recording the session. Whilst there is no direct evidence that the presence of the recorder did not affected the interviews and the data collected, the interviewees appeared fully comfortable with the arrangement.

Sampling procedure

For this research a non-probability sampling frame was used, also called “purposive sample” or “strategic sampling”, which is concerned with sampling of relevant participants (Bryman; 2008). This method needs a flexible design of the research and data collection which are characteristics of qualitative methods and is argued to be the most common qualitative sampling technique (Marshall, 1996; Bailey, 2007; Bryman, 2008;). A non-probability sample aims to interview participants who are tied to the research question and people thought to have more insight and knowledge about the topic (Marshall, 1996). In other words, “the researcher samples on the basis of wanting to interview people who are relevant to the research question” (Bryman, 2008:458). Additionally, it is important to mention that random sampling of a population is often not possible when conducting qualitative fieldwork (Marshall, 1996), because the setting might be complex and difficult. The current sample frame was small- and medium soybean farmers, due to the nature of the research question.

Non-probability sampling consists of three main components; snowball sampling, quota sampling and convenience sampling, and a mixture of the three were used for this research. *Snowball sampling* is a type of purposive sampling method by which relevant participants or groups can recommend other possible candidates (Marshall, 2007; Bryman, 2008). This became an important sampling method for this research, and several of the participants included in the research were interviewed due to recommendation of another farmer previously contacted. Further, *quota sampling* was used. This refers to when participants are chosen in order to ensure relative proportions within various criteria. In this research the aim to have a quota of half male and half female; however it was not possible to get an exact equal share. The aim of including both male and female participants was maintained however, as they might provide different views and opinions on the issue. Additionally, *convenience sampling* was to some degree used, meaning that relevant respondents were chosen according to availability (Bryman, 2008). This was done by visiting houses, which were known to belong to soybean farmers. This emerged as a suitable strategy to recruit female respondents, as they often stayed in the house during the daytime, whilst the husbands worked in the field.

In this research the *population* was defined as the adult soybean farmers living within the study area; San Pedro, San Julián and San José. To determine a *sample size* within the population, data saturation was used. This is referred to as when “the number of required subjects usually becomes obvious as the study progress, as new categories, themes or explanations stops emerging from the data” (Marshall, 1996:523). During the fieldwork, the analysis was carried out simultaneously to the data collection in order to identify the different themes and explanations provided by the interviewees. When the topics mentioned started to be repetitions of previously encountered topics, the data collection stopped.

A final number of 29 interviews were conducted (Table 2.1). The sample size of the research is appropriate for qualitative research and allows for the description of experiences of the farmers in relation to issues tied to their food security. Sample size in qualitative research is often small (Marshall, 1996; Bailey, 2007), until research on general characteristics is requires; however, this research did not aim to make generalisations.

Table 2.1 show the composition of the interviews conducted. Out of the 29 qualitative interviews conducted, 25 were semi-structured interviews with individual farmers, two were key interviews with farmers' leaders and two were with organisations.

Qualitative semi-structured interviews conducted		
Individual interviews		25
Key informant interviews	Farmer leaders	2
	NGO's	2

Table 2.1: Number and type of conducted qualitative semi-structured interviews

2.3.2 Observation

The aim of carrying out observation during the fieldwork was to get a broader insight to people's actions rather than their stated intent (Corbin and Strauss, 2008). As the research was conducted in a novel environment, observing became important in order to see the participants in their own environment (Hoyle et al. 2002), a key strength in observation. For example, in order to investigate the participants' consumption of food; what type of food was consumed, where it was accessed and how it was prepared, observations were made regarding what type of food that was available, both in the local restaurants and the mini-markets in addition to covering these topics during the interviews.

Seeing is important in observation, however observation through listening and informal discussion was another source of information (Kearns, 2010). Listening to the farmers talk or discuss among themselves provided valuable information, additionally to the information obtained from the interviews. For example, several times I listened to the farmers talk about the weather conditions. At one occasion I informally discussed with a farmer which at the time of the research experienced that his soybean seeds was not germinating. These observations provided a better insight into the issues important to the farmers.

I had many informal chats in different settings, e.g. when eating in restaurants or being invited to farmers' houses for coffee, travelling to and from the villages, visiting the fields etc. Hence, the findings of this research result not only from the interviews, but meeting

people with various views and opinions. This provided a larger understanding of the context in the communities of the study.

Observations can be divided between participant and non-participant observation. Participant observation is often related to ethnography where the researcher spend a longer amount of time in the field (Bryman, 2008), even though it is also widely used in other qualitative research. Contrary, non-participatory observation is when the researcher does not actively take part in the social setting and the life of the people observed (Bryman, 2008). In this research is it difficult to draw a line between the two, and I will argue that both participant- and non-participant observation were used. For example, at times I just sat in one of the local restaurant observing the people, whilst other times I went with the farmers to the soybean field, or they showed me around in the nearby areas.

Observation also became important as a tool for triangulation. It allowed for further data to emerge, in addition to interviews. In this way different types of data have been used to examine the issue to be investigated (Corbin and Strauss, 2008). For example, farmers where asked to explain about the weather conditions the last 4-5 years. Later this was checked with data from the local metrological station.

2.3.3 Secondary sources of information

It was consulted secondary sources of information on Bolivian history, agricultural policies and about the communities that I was working in. This was done before the fieldwork, but also during and after the fieldwork was carried out. I reviewed ethnographies (Postero, 2007) statistical data from FAO, FAOSTAT, National Institute of Statistic, newspapers such as the Bolivian newspaper “Cambio” and various scientific articles, both in Spanish and Norwegian. Some examples of the literature review prior to the field work are about the agrarian revolution in 1952 (van Dijck, 1999) and agricultural politics and food security discourse in Bolivia (Ormachea, 2009), information about soya production both with economic, social and environmental issues (Suárez et al., 2010, Catacora-Vargas et al, 2012; Brenes et al., 2001), looking at organisations working with soybean farmers (ANAPO). It was also necessary to look into GMO literature since over 90% of the soybeans produced in

Bolivia are genetically modified since 2012 (Catacora-Vargas et al., 2012; Fukuda-Parr, 2007)

2.4 Data analysis

All interviews were transcribed, as it allowed for reviewing the details of each interview. Furthermore, it simplified the process of identifying trends and comparing answers across participants for a given question. Secondly, it allowed for reviewing the information provided through each answer as many times as necessary. Thirdly, it makes the data more available for others, increasing the validity and reliability of the research. The transcriptions started while the data collection was still carried out in the field, as it is a time consuming process. As in the case of the simultaneous data analysis, parallel transcriptions allowed me to review the answers and, consequently, follow up on unclear information and adjust the interview format by adding questions. Additionally, it allowed for further development of questions for interviews and guided the remaining data collection.

When I left the field I continued with the data analysis. To analyse the interviews I used an approach that has elements from qualitative content analysis. This is an analysis of documents and texts which aim to have a careful and systematic examination (Berg and Lune, 2012), often with predetermined categories (Bryman, 2008). One example of a category is “*unstable climate*”, another example is “*availability of food*”. Still, several categories that were not predetermined emerged as the analysis was carried out, such as “*scepticism toward consumption of GM soybeans*”. For the coding I used a colour coding system where different categories and themes were assigned different colours. This approach is used to condense large amounts of data (Saldana, 2009), break it down into categories and make it easier to extract the findings within each category.

Narrative analysis was to some extent used during the analysis. This was used to get an impression of how the individuals make sense of their own situation (Bryman, 2008) and how they experience events, for example weather events (e.g. the flooding that struck the area in 2008) or perspectives on varieties used (e.g. information about the spread in the area

cultivated with GM soybean varieties). It was made in an attempt to see the different situations and how these narratives are produced and how they affect the social and political sphere. Quotes were used to support the findings, and used to illustrate people's feelings and opinions. The quotes show the general view from most of the informants, but also some of the more uncommon views are presented. This was done to gain an objective view with a variety of the opinions.

Excel was used to consolidate and analyse part of the data generated through the interviews, e.g. land size, crops produced, self-consumption of soybean and other parameters.

Field work procedures: The first stage of the fieldwork entailed to get an overview of the areas. The three communities were visited together with a local research group. I was introduced to a number of small and medium scale farmers and a leader of the local farmers union, which gave me access to useful contact information. I returned to the communities on a number of occasions during the fieldwork, staying there 3-5 days at the time. Second stage of the fieldwork was to present my planned research to the farmer union leader and other selected farmers in San Pedro, and I was given the permission to carry out fieldwork. I was given names of some farmers it was possible visit, but when I got more familiar random houses was also visited with an aim to have a more random samples. Third stage included the carrying out of the interviews, first in San José and San Pedro, then in San Julián. In the last stage of the research, the interviews with the two organisations were carried out. These were conducted last because a better understanding of contextual background was obtained before, helping to develop appropriate questions.

Before travelling to Bolivia I was provided with a research assistant, whose job was to accompany me to the field. Having a research assistant was crucial for several reasons. Firstly, he had knowledge about the production in the area, further he was familiar with many of the farmers and the direction in the villages. Secondly, for safety reasons, as some of the zones are marked as red zone meaning that one should be careful travelling. Thirdly, he assisted with parts of the transcription when I experienced language problems.

A daily log was kept with ideas, thoughts and observations made because I felt it was important to keep good track of the whole research process in the form of field notes, questions and transcribed interviews. Keeping complete records of all the phases of the research helped to insure the quality of the research, increasing the validity of the work (Lincoln & Guba, 1985; Bryman, 2008). It also became useful in the writing up process because it was possible to look back at details that would otherwise be forgotten. After each interview a front page was made where I noted the main points from the interview which would make it easier to go through the interviews at a later stage.

2.5 Challenges and ethical considerations

The challenges encountered during the research were of two sorts. First, there were some challenges related to the information gathering, notably language issues and the fact that interviewing as a data collection method is connected certain limitations. Second, there were some more practical limitations, with accessing local people in the three communities, and the time period in which the research was carried out. The challenges and limitations and how they were dealt with are further outlined under, whilst the ethical considerations are explained in the latter part of the chapter.

Language: A challenge throughout this research was the language. Even though I speak Spanish I encountered difficulties with dialects and local expressions made by the participants. Here it is important to point out that for the farmers in the three communities, Spanish is not the native language of immigrants. This imposed a further challenge in the communication from both sides, in regards to both expressing options and understandings each other. However, this was made easier by having my research assistant with me during all the interviews, as Spanish is his mother tongue. On the other side, having the assistant's presence might have affected the data, but he was already known to many farmers in the three communities, making the access easier. Also I see it as an advantage to not have an interpreter, as this can lead to incorrect interpretation and misunderstandings between researcher and interpreter about what is important. A further challenge related to language was reading literature in Spanish due to the often academic language. Yet, this was

minimised by using accessible translating services online, the research assistant and dictionaries.

Challenges of interviewing: I had little practice with interviewing before carrying out the fieldwork. Talking to people might lead to misunderstandings, and the fact that one rely much on verbal behaviour (Bryman, 2008), can led to misinterpretations of the words or the social meaning. To minimise this and getting better familiarity with interviewing, two “practice interview-rounds” were carried out before starting the actual interview rounds. This helped develop more confidence and getting used to the interview setting. Additionally, I had a research assistant with me during all interviews, to reduce the issue of language.

Another challenge I was aware of was that I would have to analyse the answers given during the interview rounds. This demands objectiveness, and that personal views are not used inappropriately in the analysis. To avoid this, I have been aware of this possibility, and tried my best to avoid letting my opinions affect the analysis. Further, people with knowledge about the three communities have assessed the work, as a triangulation.

Difficult access to local people: Gaining access to the participants in the research was partly challenging. In San Julián the access became particularly important because not long before I arrived to the communities a person claiming to be a researcher gained personal information from some of the farmers and used it for personal gain. This incident naturally made the local leader more alert and permissions were needed from the farmers, but also from the ANAPO. After visiting the community several times without the possibility to meet with the leader, I asked to interview other soya producing farmers who were not member of the farmers’ organisation I first planned to work with.

Beginning of summer season agricultural activities: The research was carried out in a time where most of the farmers worked long hours during the day by preparing the lands for summer cultivation. This made them less available which was a more general challenge when it came to getting access. This might lead to less representation of the poorer farmers as they have to work from early to late at night, as the many have a secondary source of

income in addition to farming. However, the interviews were carried out from 06.00 to 20.00 in attempt to minimise this risk.

Triangulate specific information gathered during the interview: Many of the questions asked during the research tackled the personal opinion and experience of respondents; therefore, the information obtained was difficult to triangulate. However, other questions have better possibility to be cross-checked. One example is the question related to local food availability, which was easily observed later. Another example is when participants were asked if they could find what he or she *needs* to prepare food. This question does not have the same triangulation possibilities.

2.5.1 Ethical considerations

In relation to ethical issues, I had to be aware of ethical situations that might arise during the fieldwork, and to be aware of having a “research status”, that some people may find intimidating. All the participants got an explanation about the research and that I was a student collecting data for my thesis. I tried to be very careful not to give any false impressions or hopes to the informants, making informants believe that I’m able to change anything about their situation. I had to be aware that I was interacting with a variety of people, with different economic status, ethnicity and language, which is related to responsibilities and ethical behaviour.

Regarding informed consent, I made sure all participation to the project was voluntary and I got consent from all the people interviewed. This was done orally with all the farmers where they got information about the project and were asked whether they wanted to participate. I have made all the participants anonymous, to minimise the risk of anyone being negatively affected by my work. It is crucial that their anonymity is kept confidential as interviewees provide most of the data for this thesis. This is also important to make sure it is equally easy for other researchers to enter the area with trust and confidence. However the names of the representatives from the organisations are available.

I strive to make some sections of my thesis available to informants. I told the informants that sections of the thesis will be available for them in Spanish, mainly the results/findings chapter, which for them is of most of interest. I have contact with a research group carrying out a project in the same municipalities which have agreed to present my results when ready, making it easier to “give the results back” to the informants.

3. Background

This chapter looks at the history of Bolivian agriculture and describes the contextual setting and social structure of the municipalities in Santa Cruz (San José, San Pedro and San Julián). It will also describe the trajectories of soybean production in Bolivia and look at the land distribution, the relevance of soybean production and the emergence of the technological package within soybean production.

3.1 Economic and agricultural development in Santa Cruz

3.1.1 “Colonisation”: The migration process from the high to the Low Lands of Bolivia

The extraction from the mines contributed to Bolivia developing contact with the globalised world in the late 19th century (Suárez et al., 2010). A further economic activity, in addition to oil and gas, which prompted Bolivia to the globalised world, was large-scale industrial agriculture. This was shaped upon the Bohan Plan (1941), a United State (US) development proposal aiming at colonising the low lands of Bolivia for establishing industrialised agriculture, and to diversify the economy largely dependent on mining activities (Mackey, 2011). The recommendations from this plan were implemented by the government after 1952 (Suárez et al., 2010).

Still, in the years after the 1952, mining played an important part in Bolivian economy, but an expansion of the national agricultural sector became a goal (Suárez et al., 2010). A consequence was the development of the program “Marcha hacia el Oriente”¹, leading to the so called “colonisation”, or the migration from the Highlands to the Lowlands (mostly of Santa Cruz) located in the east part of the country. In 1953 the Bolivian Development Corporation (CBF, according to its name in Spanish) with the help of United Nations (UN) moved 53 immigrant families to Cotoca, a community in Santa Cruz. During the 1960s the

¹ Translates to “March to the East”,

goal was to resettle 100.000 people and the government granted 25.000 hectares of land to the program. The movement of the families was financed by the Development Inter-American Bank and the United States Agency for International Development (USAID). In 1965 this work was taken over by the National Institute of Colonisation.

The aim of this policy was to move people from the west side of the country and resettle them in the east, to be able to develop the industrial agricultural sector. It was first mainly organised by international bodies and later by the government (Steininger et al., 2001). This program became a legal and economic strategy which facilitated for the agro-industrial sector and the agricultural companies to carry out this development of the agriculture (Suárez et al., 2010).

Simultaneously, the government introduced other policies central to agricultural development in Santa Cruz, such as the building of roads, railways and by making credits easily available for companies and industries. In 1972 Santa Cruz benefitted from 66% of the total credits given by the Agricultural Bank in Bolivia (Suárez et al., 2010). However, the programs supporting the migration to the Lowlands lasted a limited time due to the economic crisis in the 1980s, with growing debt and political instability (Steininger et al., 2001). Then after 1985 the State reduced its involvement in the agricultural sector. In the absence of governmental support, the small and medium scale producers pursue their own “capitalisation” by acquiring debts and investing in land and machinery to be able to integrate in the emerging agro-industries, such as rice, cotton and eventually soybean.

Despite the efforts made after 1950s in relation to the immigration from the highlands to the lowlands, the process of large-scale migration did not get properly started before the 1980 and 90s. It was kick started by the structural adjustment programs introduced in the mid-1980s, in addition to the closure of mines in the highland area around the same time.

3.1.2 The agroindustrial production model implemented

During the 1980s Bolivia experienced a serious economic crisis. The country had a large debt due to international loans. A sudden drop in prices of minerals, which had been the

traditional export commodity from Bolivia, then led to a national crisis (Andersson, 2009) with hyperinflation and decrease in GDP. In addition, a drought in 1983 worsened the situation (Lømo and Eldby, 2004). As a result, the so-called “model” (Postero, 2007) was introduced in Bolivia, which refers to the neoliberal economic model and the introduction of the structural adjustment programmes. This happened as a result of collaboration between the government lead by Victor Paz Estenssoro and the International Monetary Fund (IMF).

The introduction of the structural adjustment programme in Bolivia was the first of its kind in Latin America, and was implemented to deal with the high inflation. The aim was to create incentives for export and that the growth in export then would lead to general growth and free labour which could be transferred to other industries. The main measures were cut in public spending, liberalisation of trade by lifting trade barriers, and the removal of agricultural subsidies (Mackey, 2001; Lømo and Eldby, 2004). The national government, international organizations and development agencies focus on cash crops for export to fuel the economy. In 1990 the World Bank started the “Eastern Lowlands Project”, investing in the expansion of large scale agriculture. This project started in Santa Cruz with support to soybeans agribusiness (Mackey, 2011). Later, the area of the project implementation was called the “Expansion Zone” (Hecht, 2005).

The neoliberal model implemented in the 1980s had consequences for the Bolivian agriculture, such as its opening to the international free market, less public support in terms of infrastructure and closure of the national agricultural bank. However, the neoliberal model has been criticised for failing to improve the living standard for most Bolivians (Lømo and Eldby, 2004).

3.1.3 Land distribution

It is clear that the policies following 1952 contributed to uneven distribution of land and production resources. Government employees and political and economic elites benefited the most (Lømo and Eldby, 2004). Especially during the military government (1964-82) land was often offered to selected families, officers and their friends. These groups have arguably

benefited more than others “from the neoliberal policies that has dominated the country since 1985” (Kohl and Bresnahan, 2010: 6).

The current president in Bolivia, Evo Morales, was elected in 2005 and entered into office early 2006 as the first indigenous president in the country. Morales, leader of the Movement Towards Socialism (MAS) has campaigned against the neoliberal economic model (Postero, 2007). An important policy during his precedency has been the redistribution of land. Redistribution is meant to benefit the poor and landless population by giving them land which does not fulfil a “social function” or a “social-economical function” (Assies, 2010; Mackey, 2011). After the election of Morales a new law, the “*Ley de Reconducción Comunitaria de la Reforma Agraria*”² was passed in congress, which was a modification of, “*Acto Nacional para la Reforma Agraria*”³, a law from 1996 (Assies, 2010). The law deals with the aspect of social-economic function, and where these functions are not met, the land will be returned to the state. With the new law the government wanted to broaden and further democratise the distribution of land to make it more efficient. It also includes lands that are not under cultivation by the owner.

The reforms met significant protest, especially from the larger landowners in Santa Cruz and parts of this elite mobilised against MAS and Evo Morales and his redistribution reforms. The mobilisation led to claims about autonomy, particularly by the lowlands agricultural elites. The claims for autonomy gathered large support, but around 2008 much as lost due to a series of corruption cases and violent acts. In the later years, Morales and the MAS have gathered more support in the lowland areas. Further, Morales appears to have entered into dialogue with large agribusinesses in the lowland area.

² The Community Reconduction Law of the Agricultural Reform

³ National Institute of Agrarian Reform (INRA)

3.2 Implications of soybean production

Soybeans are an oleaginous crop which multiple usage possibilities. The largest parts of soybeans are used for animal feeds, as a result of the high quality protein. Yet the processing of soybeans results in soymeal, oil and lecithin. This makes soybean suitable for a variety of industrial uses, such as in food for human consumption, in cosmetics, and technical industry (Denofa, 2013). The demand for soybeans is growing, especially as feed and for industrial use. The growing demand leads to expectations of continuous elevated prices, despite that a record in terms of total production is expected for the season 2013/14 (FAO, 2013).

3.2.1 The economic relevance of soybean production

In Bolivia the area planted with soybean increased 376 % between 1991 and 2010, and the total area of planted soybean were in 2010 near 1 million hectares. The production was close to 1, 9 million tonnes in the same year (Catacora-Vargas et al., 2012:8). 25-30% of this production is consumed domestically as oil and for animal feed, whilst 70-75 % is exported, mainly to Colombia and Venezuela (Lømo and Eldby, 2004).

Soybeans has increased its importance in the country's economy since the 1980's and has gradually become one of the country's main export products. In 2008 soya was the 2nd largest export product measured in volume in Bolivia with close to 1, 3 billion kilo, and the 3rd largest in monetary value with almost 400 million (US\$) and a percentage of 8,2 % (IBCE, 2008 in Suárez et al., 2010:12). The export of gas is clearly the biggest export product in Bolivia with 15 billion kilo.

3.2.2 The technological package

When the immigrants came to Santa Cruz they initially started with slash and burn agriculture system. In the 1970s a wave of mechanisations took place in the area, which became an interesting option for many famers. The mechanisation was firstly introduced into the production of rice, the first commercial crop. In the 1980's the typical famers hired machinery to be able to plough and harrow. Yet during that decade a number of the larger

scale farmers invested in own machinery which contributed to an increase in the ownership in tractors (Thiele, 1992).

By mechanising the rice production, it was produced with no rotation, in contra previous practice. This led to the need for better weed control, which further reinforced the continuous mechanised production. It was into this context the soybean production started to accelerate in the late 1980's and 90's and the soybean together with wheat and sunflower developed with mechanised double cropping technologies (Hecht, 2005). The technology was a key factor in this development of this industrialised production system, and "new varieties, inoculants, pest control agents, post-harvest technologies and cultural practices made growing soybeans more profitable in [...] Bolivia and stimulated their expansion" (Kaimowitz and Smith, 2001). Soybean production took over for rice as a monoculture during a short period of time in the late 1980's (Thiele, 1992). This type of mono-cropping system is dependent on a high use of external synthetic inputs.

Most of the soybeans in Santa Cruz are grown in a no-tillage system, meaning that zero of the land is tilled during production. In the mid-1990s Bolivia reported to have just over 100 000 hectares of no tillage, in the cultivation of rice, maize and soya. Since then the use of no-tillage, particularly in soybean production in the lowlands of Santa Cruz, has continued to increase, from 240.000 hectares in 2000 to over 700 000 hectares in 2007 (Derpsch and Friedrich, 2009).

In 2005 the use of GM soybean were legalised in Bolivia. The varieties introduced were tolerant to the herbicide glyphosate, leading to an increase in its volumes of usage. By applying glyphosate a simplification of the production took place. A consequence of this was that the area of production dedicated to soybean took over for other crops, in addition to forest. With this legalisation a so called "technological package" has been introduced to the soybean farmers. The "package" consisted of GM seeds and fertilisers which go together in production. Originally, it was mean to be used in a rotation system, so that different crops would be grown in rotation. However, there is little rotation which has led to the need for more pesticide use in order to control weeds.

3.2.3 Consequence of soybean production

The expansion of soybean production has a series of social, economic and environmental consequences. One consequence worth mentioning is the land concentration. In Santa Cruz there are around 14.000 soybean producers, most of them are small and medium scale. In addition, there are some large scale farmers owning vast areas of land. Most of the soybean producers are people that emigrated from the highlands to the lowlands during the 1980s and 90s. Pacheco and Mertnes (2004) argue that the soybean expansion has not lead to much displacement of farmers; however the benefits have been unequal. The distribution of area of land cultivated land with soybean favours mostly large scale producers, and is an indicator of the land concentration, which is common in industrialised agricultural systems. It was calculated that in 2009/10, 2% of the soybean growers in Bolivia managed 52% of the land dedicated to this crop in plots equal to or larger than 500 hectares. In contrast, 74 % of the soybean producers had 28 % of the total land used for soybeans in plots less than 50 hectares (Catacora-Vargas et al., 2012).

Additionally, a feature of the soybean production is that large areas of lands are concentrated in the hands of transnationals. In the last two decades there has been a slow but steady process where the best agricultural land in Santa Cruz are increasingly being owned by foreigners, mainly Brazilians, Mennonites from different countries, Argentinians and more recently Colombians. This process was, amongst other reasons, stimulated by low prices on land in the 1990s (Urioste, 2011).

Further, soybeans are replacing other crops due to it being more profitable. Land used for soya production takes over land used for other types of stable corps, such as maize, rice and some places livestock (Catacora, 2007). It is argued that this results in less available local food, and to an erosion of the variety and quantity of the traditional food base. This can lead to less nutrient food and even malnutrition (Catacora-Vargas et al. 2012). This has also been argued by Cuesta et al. (2011), who point to that there has been a change in diets to more manufactured food from the more traditional, locally produced food.

Additionally, soybeans are contributing to land use change, especially by converting forest, and since the 1970s Santa Cruz has experienced large-scale deforestation (Steininger et al., 2001; Pacheco and Mertens, 2004; Suárez et al., 2010; Catacora-Vargas et al., 2012). This issue is further examined and discussed in chapter five.

4. Theoretical framework

This chapter provides an overview of the concept of food security, the development of the term and the ongoing debates around the topic. Further the chapter outlines the theoretical framework, i.e. the food system framework approach, which was used to approach the research questions and analysing the empirical findings of this thesis.

4.1 Food security

The theoretical concept of food security has its origin from 1970s when the World Food Conference was held in 1974 by FAO in Rome, following the food crisis in the African Sahel in 1972-74 (Maxwell and Slater, 2003). One aim of the conference was to agree on a measure that could ensure that: “within a decade nobody would suffer from food insecurity”. Originally the term food security was used at an international and national level to determine whether a country had enough food to meet dietary needs, with a focus on the available food supply (FAO, 2006; Ericksen, 2007; Pinstруп-Andersen, 2009).

Since 1974 the definition and meaning of the term food security has been a matter of controversy and debate, with at least 200 different definitions (Smith et al., 1992 in Lee, 2007:3). There is no universal agreement on how to define and measure food security, but the term has been impacted by political thinking and paradigms, and has further been evolved through discussion and views held by scientists, analysts and economists (Zurek, 2006).

4.1.1 From the national to the individual perspective

After the concept emerged in 1974, the focus had primarily been centred on the supply of food, at an international and national level (FAO, 2006; Pinstруп-Andersen, 2009). The problem of world food security was seen as connected to the problem of world food production, and increasing production in able to stabilise supply received enormous attention

(Shaw, 2007). Thus, the approach first taken gave an overwhelming focus on the international aspect of food security, and both trade and food aid was strategies within the food security debate. Actors such as the World Food Council, established by the UN General Assembly after 1974, and the ILO World Employment Conference in 1976 worked towards a broadening of the understanding of food security. However, the addition of the access to “entitlements” into the concept of food security is often credited the Nobel Prize winning economist Amartya Sen (Maxwell and Slater, 2003; Ericksen, 2007).

With Sen, a new discourse emerged, with focus on the importance of recognising starvation as a result of a person’s “inability to establish entitlements to enough food” (Sen, 1981:8). Sen argued that growth in food production could not eliminate starvation because the world had seen a production that expanded faster than the world population, and ending starvation needed to be a result of shifts in the entitlement system, such as entitlements in production, labour and trade resources (Sen, 1981). Further, Sen contributed with thoughts on the right to freedom from hunger, where he argued that the issue of food is central in social ethics. Food plays an important role in freedom because the fact that humans are dependent on sufficient food might lead vulnerable groups in the society to carry out actions they themselves resent, which limits their freedom (Sen, 1976). The concept of access and entitlements moved food security from an issue of agricultural production, into the sphere of poverty and development research, and this view is now commonly accepted in most literature. However, his ideas on freedom from hunger have been issues of more controversy.

During the 1990s the process of working towards food security was by many seen as a task for the UN (Shaw, 2007). Through this decade, a number of conferences were held, both specifically on food security and other development conferences where food security was included, due to the growing recognition of the multidimensional character of food security. One of the most known definitions of food security was the outcome of one of these conferences, the World Food Summit, held in Rome, Italy 1996. The definition states that; *food security exist when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life*” (World Food Summit, 1996). This definition is built on a multidimensional nature aiming to include a wider range of factors than when it was

introduced in the 1970s (FAO, 2006). The definition originally included three pillars; availability, access and utilisation. At the World Food Summit in 2009 the definition was reconfirmed, with broad agreement amongst the world leaders present, and the fourth pillar, stability, was added.

However, the efforts made by UN organisations on the issue of food security have been subject to criticism. Firstly, they have been accused of taking an excessive reach in terms of dealing with food security, yet not managed to go far enough in the effort of turning statements into measurable and concrete action. Organisations, such as the FAO, have also been condemned for wasting money on diplomacy. The critics claim that this actually have led to a delay in turning approach to food security into one of bottom-up multilateralism, and rather inflicted top-down global governance (Shaw, 2007).

One of the largest social movements, standing in opposition to the “westernised” view on agriculture, is *Via Campesina*, and the organisation has been a critical voice in the food security debate. *Via Campesina* is a farmers’ movement which started in South America, and later spread to all continents. The concept of food sovereignty is a key cause promoted by the movement, which shortly means that each country should be able to form own agricultural policies and the farmer themselves should have the freedom to produce safe and nutritious food. Key words have been right to land and access to resources. The ideas of food sovereignty can be seen as opposite to the top down approach imposed as an international agenda driven by some countries (Lee, 2007)

4.1.3.2 Food sovereignty

The concept of food sovereignty was arguably “born” in 1996 when it emerged as a political framework (Lee, 2007). The food sovereignty social movement can firstly be seen as a “protectionist countermovement” (McMichael, 2009:294) to the current agricultural system, and in particularly to the inclusion of agriculture into the international treaty of the WTO Agreement on Agriculture (AoA) (Lee, 2007). This inclusion is argued to be one of the reasons why the WTO negotiations have been unable to create a common agreement (Smedshaug, 2008). The food sovereignty movement has expressed concerns with

agricultural biotechnology and are highly sceptical towards the inclusion of large transnational firms in the work with developing agricultural technologies (Lee, 2007). These concerns are closely linked to the use of GMO.

The concept of food sovereignty has created a common framework, which has gathered various farmer unions, NGO's and social movement, and in 2002 the International Planning Committee for Food Sovereignty (IPC) was formed. The IPC has arguably emerged as a focal point for information and capacity building, yet not as a centralised structure presenting all members (Lee, 2007). IPC have 6 pillars, focusing on right to food, value of all food producers, localised food systems, local control, knowledge and skill building, and working with nature (IPC, 2013). IPC claim that all principles are interlinked and thus necessary to implement within a food sovereignty policy framework.

There are differences between the concept of food security and the concept of food sovereignty. Arguably, food security is a technical concept, made to measure and evaluate, whilst food security is a political one. Further, the two concepts are built on different discourses, where the first is built on economic rationalism and the latter on green rationalism. Simply explained, the economic rationalism favours the free market and depends on the efficiency of the market forces. In contrast, green rationalism sees the complexity of food production and the relationship between farmers and nature. These two discourses are not new, and echo the polarisation of the agricultural debate which sees agricultural production in an "ecological" versus "productivist" perspective (Lee, 2007). Arguably the "productivist" discourse describes the large productivity gains which have occurred in post war industrial agriculture, whilst the ecological discourse draws attention to the negative environmental impacts of agriculture intensification (Morgan et al., 2006 in Lee, 2007:12).

There has been a linkage of food security to trade and liberalisation of the agricultural trade. The food sovereignty movement is arguably concerned with this interpretation and express concerns over the fragmentation of the meaning (Lee, 2007). The views of Via Campesina, i.e., the concept of food security leaning on green rationalism, have been viewed as radical in comparison to the economic paradigm. The economic paradigm has been dominant amongst

western economist, especially since the 1980s, with international trade and trade liberalisation as a focal point of attention. Further there has been a focus on industrial intensification of the worlds' agriculture, later referred to as "sustainable intensification", followed by when sustainability entered the agricultural debate.

It has been argued that the discourse of food sovereignty is backwards. Critics claim the movement aim to "go back in time" in terms of production when indeed the world needs increasing food production. However, it is argued that the movement does not intend to "recover the peasant past" (McMichael, 2009: 295). A dominant focus on the "productivist" perspective of the issue puts an emphasis on production as the main issue for food security (Sen, 1981). Such a framing of the problem can be misleading, but such a purposive framing might be useful for biotechnology companies, which want to see increased production as the main way to secure food. With claims such as "in order to feed the world's growing population, farmers must produce more food in the next fifty years than they have in the past 10.000 years combined" (Monsanto, 2013), Monsanto justifies for example the use of GMO to increase production. However, enough calories to cover global needs are being produced at current day.

The link between humans and the environment is emphasised as a key feature in terms of securing enough food now and for the future. Within food sovereignty the aim is to see the food system and how it affects social and ecological relationships (McMichael, 2009: 300). These thoughts are more widely adapted amongst actors opposing to the current agricultural system, with organisations like the "slow food movement" (Slow Food, 2013). However, the view is also increasingly being recognised within international organisations, such as the UN; a new report from the United Nations Conference on Trade and Development (UNCTAD) largely agrees with many of the concerns expressed by the movement and urges a paradigm shift towards "ecological intensification" (UNCTAD, 2013: i).

4.2 Food systems and food security

For the last decades, the food system has transformed from “traditional” to “modern” (Maxwell and Slater, 2003; Ericksen, 2007), a transition with many features. A predominant change is the industrialisation and globalisation of the food system. The food is to a larger degree produced by commercial growers. The supply chain has gone from short and local, to long with many food miles. Further, the “new” food system is characterised by the move away from consuming staple crops towards more consumption of processed food. The way of producing food is more mechanised, dependent on fossil fuel machinery. The traditional farm size has gone from a small and moderate size to larger industrial units, producing fewer crops, with a more intensive production demanding high inputs (Maxwell and Slater 2003). Many of the world farmers have gone from subsistence to contract farming.

Further, there are concerns about the concentration of power within the food system, and the growing importance of supermarkets and the distance between consumers and producers are repeatedly being discussed in the debate regarding food security (Maxwell and Slater, 2003). The emergence of multinational companies has increased, leading to corporations controlling large parts of the food chain (Shaw, 2007). Worries and warnings about industrial agriculture and mono-cropping and its link to climate change (Shiva, 2008), agricultural technologies, including GMO and resource privatisation (Shiva, 2005).

The first researchers who picked up on these issues were outside mainstream science. Tudge (1977) early criticised big agribusinesses and were sceptical of the current food systems. He was followed by research examining trends and patterns of food production and biotechnology (Bernstein et al., 1990) and literature giving an overview of the dominant food system, its actors and the context in which the key players of the food system operated (Tansey and Worsley, 1995). In 1993, a series of articles which explained the “emerging” food system and examined parts of the forces which in the global food system such as trade, international trade policies, transnational food issues and new technologies was published (Gaul and Goldberg, 1993). Yet the issues discussed are in constant change as the world is becoming more complex, both politically and economically.

A significant development in the food system has been changing consumption patterns in large parts of the world. This was described as the “nutrition transition” by Popkin (1993), where he argued that dietary patterns moves from traditional, meaning high in cereal and fibre, towards a more “western diet” high in fat, sugars and animal products. Further it is argued that the industrialisation of the food system is destroying local and cultural food traditions, due to the emergence of fast food chains, and the marketing power to sell new, often unhealthy food products (Shaw, 2007). However, by recognising the trends it is possible to combat the development, through counteraction by policies, such as pricing policies or by controlling imports (Shaw, 2007). Including these issues in food security analysis might contribute to increased information on causes in a local context.

4.3 The food system framework

The refining, broadening and the development of issues incorporated into the food security debate testify that examining food security is demanding. It is clear that food security depend on the food system, which consists of societal and environmental factors that are now going through rapid changes (Ericksen, 2007). This thesis therefore argues for the need to engage in examination of these factors in order to see how they interlink, the context in which they exist and how food security is affected.

The food system framework from Ericksen (2007) is a step onwards from the concept of the food chain, or from “farm to fork”, too include a broader specter of components. As new concerns within the food system are more evident, it is argued that food security needs to be broader to include social, economic and environmental drivers (Ericksen, 2007:1). Further, there is a need to address food systems holistically, and not as separate components where issues of agriculture, nutrition, health and markets are looked at separately. *System* is a term often used to give an explanation about complex topics with “multi-causality resulting from interaction among interdependent components” (Ericksen, 2007:4). This means that a “system approach” can be helpful if one wishes to look at a system in a broader context or the impact that system has on the surrounding context. It is also possible to view the impact

of food systems on the surroundings, such as the provision of food security or food insecurity, attribution or mitigation of climate change and so no.

Figure 3.2 shows the food system framework and describe the components of a food system, illustrating the drivers and how the components interact. It also include how the food system activities such as producing, processing and packaging, distribution and retailing, and consuming, together with the food system outcome (food, social and environmental security) feeds back into the drivers. The food system approach first presented by Ericksen (2007) has later been adopted by FAO, ESF/COST and GECAFS in examining food security.

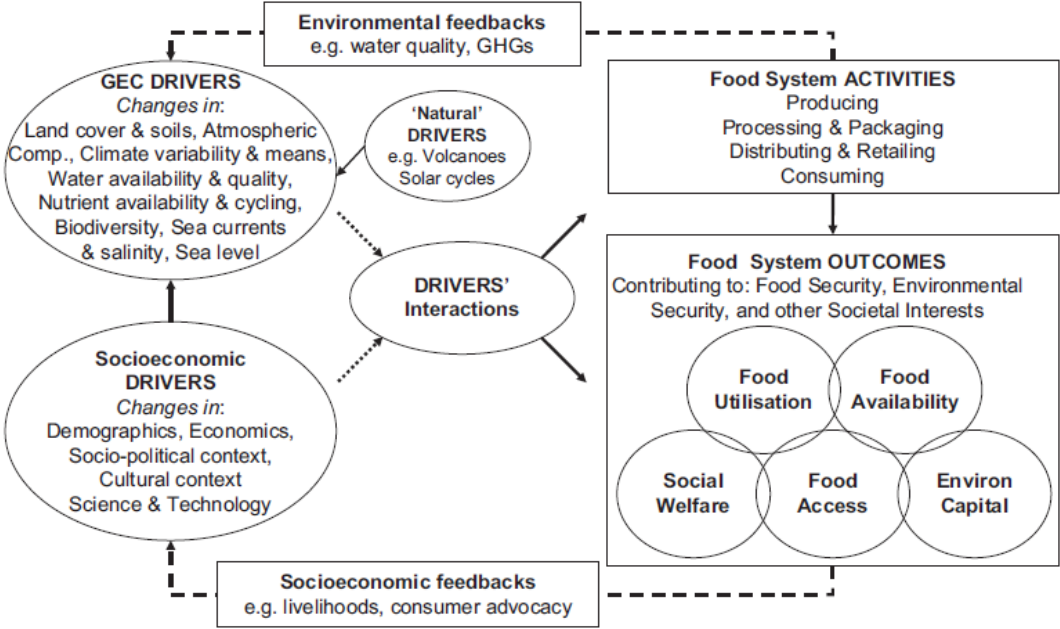


Figure 4.1: Framework describing the components of food systems (Ericksen, 2007:6)

According to the framework, the outcome of a food system contributes to food security, social welfare and environmental capital. The three main components of food security are access, utilisation and availability.

The term “availability” consists of elements such as production and trade, and are well known within the food security debate. Ericksen (2007) characterise production, distribution

and exchange as the three main elements of availability; the meaning of the elements has been modified somewhat to suit a more holistic presentation of the food system. *Production* refers to the amount and type of food available through local production, whilst *distribution* refers to how food is transported to be available to people, depending on determinants such as infrastructure, transport and storing facilities. Ericksen (2007) outline *exchange* as how food is obtained beyond local production, hence through trade and purchase, depending on social arrangements, markets income levels and so on.

“Access” consists, according to Ericksen (2007), of the three elements affordability, allocation and preference. *Affordability* refers to the purchasing power of a family, together with geographical and seasonal variations in food prices. *Allocation* means how the food can be accessed, where markets play a key role, whilst *preferences* is affected by cultures and values which affect the consumer demand.

“Utilisation” consists of the elements nutritional value, social value and food safety. *Nutritional value* is concerned with the daily food requirements to fulfil a nutrition purpose, such as the intake of calories, protein, vitamins and so on. *Social value* examines the social and cultural aspects of the food, where religion might affect what is acceptable to eat, or affect eating habits, e.g. during holidays. Food safety is concerned with the possible hazard related to food consumption, from production, to processing and packaging (Ericksen, 2007).

The framework can be used to examine the food system of a particular unit. It allows for a holistic understanding of the larger drivers and the local conditions, and can therefore be useful when investigating food security in an extensive manner.

5. Environmental and socio-economic drivers

This chapter addresses the first sub-question of this thesis:

- i) *What environmental and societal drivers affect small and medium scale soybean producers in Santa Cruz?*

As such the chapter will investigate what environmental and societal drivers affect the small and medium soybean farmers. In the first part of the chapter, the environmental drivers will be discussed, mainly rainfall variability, floods and drought, and visions of the future under climate change, since these were identified as the most relevant. The second part will attempt to outline the socio-economic drivers affecting the small and medium scale producers in the three communities, with the main focus on the context in which production exists. The importance of the technology context will also be outlined.

5.1 Environmental drivers affecting soybean production

The analysis of the environmental and socioeconomic drivers affecting the small and medium scale soybean producers in Santa Cruz are based on the insights provided by the informants in the three communities San José, San Pedro and San Julián. This information refers to different aspects of their situation as soybean farmers, together with a more institutional view from the organisations informants. The analysis presented also contains data from other studies carried out in the actual area regarding the social structure of soybean farmers in Santa Cruz.

5.1.1 Weather patterns and extreme weather

A large number of the respondent argued to have experienced more unstable rainfall patterns during the last 4-5 years. Some informants linked the unstable weather to the El Niño

Southern Oscillation (ENSO). Evidently, the southern South America is one of the regions most affected by El Niño and La Niña events, and several areas in the region have reported inter-annual precipitation variability associated with these events (Grimm, 2000). A number of farmers further explained how drought and floods have become more frequent as a possible consequence of the occurrence of El Niño and La Niña events. Figure 2.1 show the annual precipitation from weather stations located nearby the two research areas and it is possible to recognise the strong El Niño in 1997 and the La Niña in 2011. In 1997 the areas, and especially the Northern zone, experienced higher precipitation, whilst both areas had lower precipitations in 2011. There is some evidence indicating the southern South America will receive more frequent ENSO events, yet the predictions are associated with large uncertainties (IPCC, 2012).

The research for this thesis was carried out between July and October (2012), which are the drier months of the year, confirmed by most of the respondents who informed about dry weather conditions. However, drought can be defined in different ways. Agricultural drought refers to lack of moisture in the soil to support the growth and maturation of the crops, while drought can also be defined as lack of precipitation. For the purpose of this thesis, the latter description will be used as it is most relevant for examining farmers' impressions, and this state is what the informants commonly referred to as drought.

When the fieldwork was conducted, some of the farmers said they were experiencing a drought, or abnormally dry weather, even in the driest months of the year. This weather was opposite to the experienced in May (2012), argued to be exceptionally wet. When looking at the statistics (see Figure 2.1), the numbers corresponded well with the experiences and concerns expressed by many of the informants. The interviewees explained about more frequent erratic rain patterns which affects their crops, leading to problems with sowing, both in the conventional cash crops like soya, but it was also problematic for farmers that grew vegetables for self-consumption. This is consistent with literature, indicating that "increases in rainfall in [...] some parts of Bolivia have had impacts on land use and crop yields, and have increased flood frequency and intensity" (Magrin et al. 2007:583).

In addition to more erratic and unpredictable rainfalls, several of the informants stated concerns about experienced increase in temperatures. When looking at the Figure 5.1 it is

possible to see a trend towards warmer weather, and in the last 20 years the mean temperature has increased around 2°C in the Northern zone, with similar trends observed in the Eastern zone.

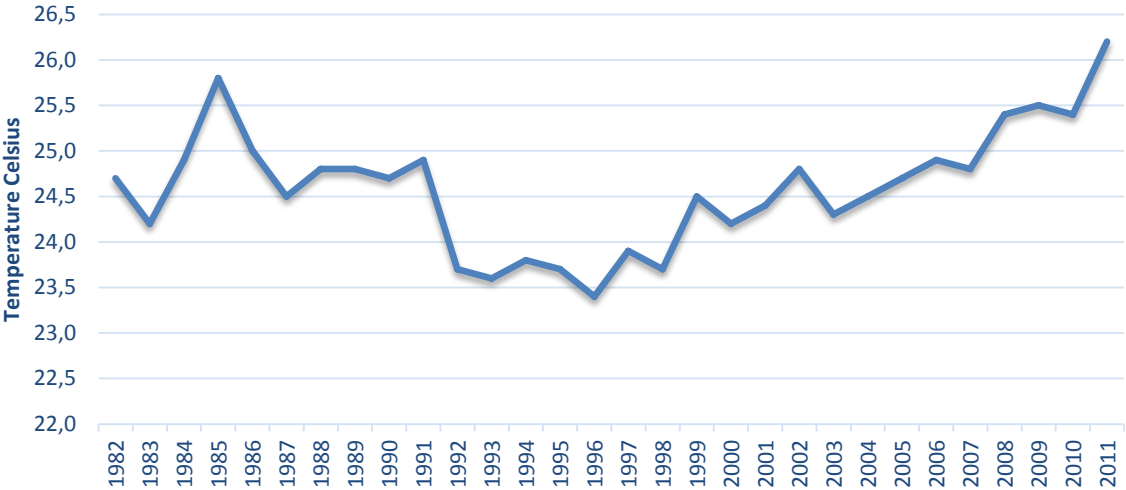


Figure 5.1: Mean temperature 1982-2011, Minero. (Authors work based on data from SENAMHI, 2013)

Several farmers talked about climate change or claimed to have observed more permanent changes in the climate. One informant complained “*the sun is strong and it’s heating the land, it is changing the climate*”, whilst another explained it shortly: “*is has become very hot*”. Many worried about the agricultural production in a possibly warmer weather and one male farmer describes; “*the weather is more humid and the last 3-4 years the temperature has increased. Before we did not get higher than 38 degrees, now we get 40. I think it affects the production as some crops cannot handle the heat*”.

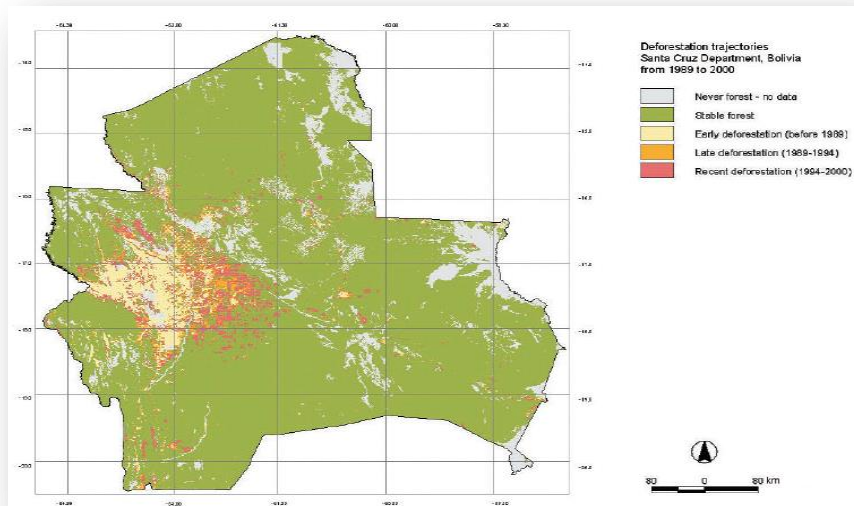
It is not possible at this point to claim whether the climatic variations experienced by the informants are caused by anthropogenic climate change or if it is attribute to natural climate fluxions. The intergovernmental Panel on Climate Change (IPCC), among others, demonstrate an increase in global mean temperature from 1880-2012, arguing an increase is likely to be induced by humans and that further increase in mean temperatures now are

inevitable (IPCC, 2012). At the same time, projections made by various actors within the field on climate change science have outlined some global and regional trends in Bolivia (World Bank, 2009), which are in line with the experience of the informants in Santa Cruz.

5.1.2 Land use change

Santa Cruz has experienced large-scale deforestation since the 1970s (Steininger et al., 2001; Pacheco and Mertens, 2004; Suárez et al., 2010; Catacora-Vargas et al., 2012). Traditionally the deforestation rate in Bolivia have been low in comparison to other countries in Latin America of the Amazon basin, however this changed in the 1970s and throughout the 1990s. During this period the deforestation rate reached 0.55 % per year in comparison to a 0.43 % averaged in other Amazonian countries (Pacheco and Mertens, 2004). The deforestation in Santa Cruz is linked to the agricultural expansion and is characterised by a profitable use of the land for agricultural production. Despite some degraded land, the agricultural frontier remains productive (Pacheco and Mertens, 2004).

Several farmers pointed to the experienced land use change, more specifically the large-scale deforestation in Santa Cruz during the last decades (Kaimowitz and Smith 2001; Pacheco and Mertens, 2004; Catacora-Vargas et al., 2012) and linked it to the expansion of soybean productions. One elderly informant vividly remembers how the rainforest used to surround the area, with a widespread animal and birdlife. As seen in map 5.1, the deforestation is mostly occurring in the areas where soybeans are being produced.



Map 5.1: Deforestation in Santa Cruz from 1989-2000. Red colour indicate areas prone to deforestation (Pacheco and Mertens, 2004:33)

A number of farmers linked the deforestation in the area to the experienced changes in the climate, meaning that the deforestation had affected the climate negatively. A male informant explains: *“with soybean production, something has changed [...]. So I have been thinking, now there are almost no hills or mountains left and that it is for this reason there is more floods and stronger winds”*

South America is a region that has experienced large scale deforestation, especially linked to the expansion of agricultural production. Soybean production has particularly intensified deforestation in the region and the IPCC (2007) argue that soybean production will be the largest contributor to land use change in Latin America in the next decade. Further, the IPCC (2007) argue that the “massive deforestation will have negative impacts on the biological diversity and ecosystem composition of South America as well as having important implications for regional and local climate conditions” (Magrin et al. 2007:594-595). The major consequences are described as enhanced desertification, land degradation, in addition to changes in water cycles and effects on regional climate. The predictions made by the IPCC in 2007 show how the planted area of soybean is expected to grow from 38 Mha in 2003/04 to 59 Mha in 2019/20 (Maarten Dros, 2004 in Magrin et al. 2007).

Several studies have been carried out in the Santa Cruz area about land use, highlighting the magnitude and localisation of deforestation in Santa Cruz (Pacheco and Martens. 2004), together with measurements and the drivers for deforestation (Steininger et al., 2001). A case study carried out by Bounoua et al. (2004), in the low land project areas of Santa Cruz, has examined the land use change and the correlation to the local climate.

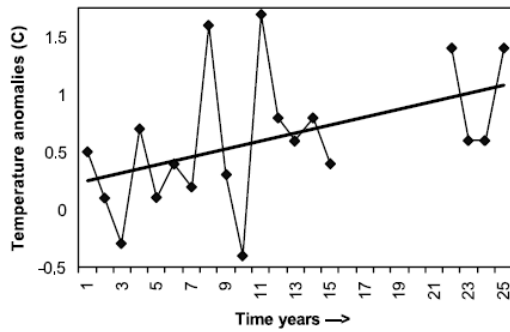


Figure 5.2: Temperatures anomalies 1975-1999, Santa Cruz (Source: Bounoua et al. 2004:83)

As shown in Figure 5.2, the temperature has increased and the study concludes that:

“the Tierras Bajas region of eastern Santa Cruz, Bolivia have undergone among the most rapid rates of concentrated deforestation during the 1980s and 1990s [...] Conversion from tropical forest to cropland implicates morphological changes in vegetation as the primary drivers for a daily maximum warming of about 2 °C and a slight night time cooling, suggesting that clearing of tropical forests for agricultural use may increase the diurnal temperature range, mainly by increasing the maximum temperature. On the other hand, the conversion of wooded grassland to cropland resulted in a similar daily warming and drying but exclusively due to vegetation physiological activity” (Bounoua et al. 2004:83).

5.1.3 Projections of future climatic changes

The climate prognostics that exist today are measured on a global or regional level. When examining these prognostics it is clear that projecting the future climate in the three

communities is a challenging, if not impossible task. It is therefore necessary to use these global and regional prognostics to assess possible effects on a local level in the three communities. The IPCC argue that “by the end of the 21st century, the projected mean warming for Latin America ranges from 1 to 4°C or from 2 to 6°C, [...] and the frequency of weather and climate extremes is very likely to increase. By the year 2020, 100 Mha of Brazil Amazonia forest will have disappeared if deforestation rates continue as in 2002/03” (Magrin et al. 2007:606). IPCC here points to some of the projections regarding temperatures, extreme weather and further deforestation rates in Latin America.

Temperatures: Projections in temperature vary. In the tropical South America, which include Santa Cruz, the temperature might increase between 0.4°C and 1,8°C by 2020 and between 1°C and 7,5°C by 2080 (Magrin et al. 2007). Prognostics more specific for Bolivia show an expected increase of between 0,8°C and 1,7°C by 2030 (World Bank, 2009). These estimates show great variation and it is difficult to project changes due to uncertainties, and because systems involved are large, inter-boundary and seasonal. It is therefore problematic to assess the specificities of future climate conditions in the three communities, even though it is reasonable to assume, based on the available research that temperatures will increase further.

Rainfall: Projected changes in precipitation are more difficult to estimate than mean temperature changes, especially on a local level. Nevertheless, it is predicted that Latin America will experience changes in precipitation patterns, which will affect water availability, both for agriculture but also for human consumption in general (IPCC, 2007). In Bolivia the predictions patterns show large variation, but Santa Cruz might expect to get between 4-22 % decreases in precipitation during the dry months, followed by an increase in precipitation during the humid months of the year (World Bank, 2009). However the precipitation projections are highly uncertain.

Extreme weather events: Anthropogenic climate change might lead to more extreme weather in parts of South America (IPCC, 2007). This is correlated with experiences made by many of the farmers interviewed for this research. Floods and droughts had an impact on farmers in both the northern and the eastern zone in terms of for example reducing the agricultural production. For many, this has led to economic losses, and several farmers have

debts from periods where weather events had impacted on their agricultural production negatively.

In recent years extreme weather such as floods and droughts have had both a human and economic impact in Bolivia. Between 1997-2006, damages for an average of 0, 15 % of GDP was due to extreme weather events (World Bank, 2009). Predictions made for the future show that the frequency in the occurrence of extreme events, such as heavy precipitation, high temperatures, windstorms, heat waves will increase in the future (Magrin et al. 2007). This might have further economic impacts on the farmers in the three communities.

5.2 Socio-economic drivers affecting soybean production

There are a number of key socio-economic drivers affecting soybean production in the three communities. The most prominent factors seem to be; access to land and credits, access and ownership of machinery, fluctuation of agricultural prices, infrastructure and the technological development. This section will further elaborate on these factors.

5.2.1 Access to capital

Access to financial resources: Producing soya demands large investments. Depending on the inputs used, calculations show that a farmer generally need investment between 360-530 US\$ per hectare (AEMP, 2012). The investments made depend on the area of production, inputs (mainly pesticides), types of seeds, access to machinery (own or rented), among other factors. A study from Santa Cruz shows that from the total investments made by small and medium scale farmers, around 45 % are used to control diseases and weeds. Further, almost 30 % goes to renting machinery, whilst 12 % goes to seeds, as few farmers keep seeds for the upcoming season (Suarez et al., 2010).

Lack of capital amongst small and medium scale farmers make them dependent on finding different sources of investment. This dependency might be up to 100 % (Suarez et al. 2010).

Hence, access to credit and loans is an important issue for the farmers in the three communities, and to be able to join the mechanised circle of soybean production and make the necessary investments, it is necessary for farmers to indebt themselves (Suarez et al., 2010). All small and medium scale farmers are dependent of credits to be able to buy inputs, in addition to buying or renting machinery. This is the reality in both the northern and the eastern zone.

There are seven banks which finance soybean producers; however the small and medium scale farmers do not have access to these banks. They depend largely on private financing entities, mostly oil processing companies and importers of agricultural inputs. Currently, around 60 % of the credits are provided by the oil companies (oil refineries) such as FINO, SAO and RICO, and other suppliers of inputs (Brenes, 2001; Catacora, 2007). In addition, there are 11 private financial funds providing credits and short terms loans, mostly having the harvest as the loan guarantee (Catacora 2007). These financial systems are strictly private and after the structural reforms following 1985, there is no national agricultural bank in Bolivia (Lømo and Eldby, 2003). When small and medium scale famers now are granted loans, rent annual interest commonly lies between 18-32 %, whilst for larger scale farmers the annual interest rate is between 14-18 %.

For the majority of the farmers it was possible to access credit, with a number of companies both in San Pedro and in San Julián. The farmers could themselves choose from whom they obtained credit and/or inputs, and had the possibility of choosing the company with the best conditions. One informant clarified “*I use AgroBolivia, but I sell to whoever pays more*”, while another informs explained “*people can choose where the prices are best*”. However, despite the possibility of choosing a company, once under a credit agreement it is difficult for small and medium scale famers to break out, due to the loaning conditions. The common practice is that farmers had to pay back the credit within a season (*una campaña*), which normally lasts 4 months. This type of repayment might leave the farmers in a vulnerable situation due to the possibility of failing harvest. Even in seasons with normal harvest, many farmers still end up owing money to the company. This was a serious concern for many of the informants. Some were still indebted from previously failed harvest, caused by extreme weather. One informant explained “*in 2006-2007 the weather affected us a lot here due to*

floods. [...] The people that lost in this flood are still working on paying their debts. I still have debts of 15 000 US\$ from this time. Every year I pay a little.” Others tell about constant worrying about whether the soya will grow well, and a woman explained about her male relative that were sent to the hospital due to stress from failing harvest.

Even though there are a number of companies providing agricultural inputs, i.e. there is competition amongst the companies, several informants claim that the price of inputs keep increasing for small and medium scale farmers. The majority of inputs sold in Bolivia are foreign, mainly from Argentina, Paraguay, China, Brazil and Europe (Catacora-Vargas et al., 2012). Hence, the inputs are more expensive than in other Latin American countries and the price of inputs in Bolivia is for example 60% higher than in Brazil (Brenes, 2001). Several informants express concern over expensive inputs and one informant tells: *“there are a lot of companies, but the inputs are expensive and that is why the price of food has gone up”*.

The agricultural industry has taken much of the “responsibility” of providing both credit and technical help to small and medium scale farmers. Many of the companies that are suppliers of credits and inputs additionally give technical assistance, complementary to the other services. Some companies also fund local research projects on nearby land aimed to develop new varieties and agrochemicals (Brenes, 2001). Many of the informants had received help during the start-up phase of their soybean production, or in relation the introduction of new seed varieties or fertilisers. One informant explains; *“I have been to courses with engineers, they gave us chats. The companies selling seeds and agrochemicals teach us how to use it, when to apply etc.”* This had been helpful to many of the farmers, however it is also a mean for the companies to insure the demand of their own products, which is followed by the conditions for the small farmers as described above.

Access to land: The access to land, and the possibility it gives to generate income, is key for farmers. Never-the-less, access to land in the three communities is uneven; varying between 14 - 200 hectares. Four of the farmers interviewed did not own their own land, and one informant from San Pedro expressed the following about the land distribution; *“the division of land is very uneven, many people don’t have land. Some people have a lot. It is unevenness, also here in San Pedro and this is the system that exists in this country and this*

village too. Some people have the possibility of having more, but the people that don't have anything, don't have the possibility of getting land. There is no help, if people die, they die. Especially here, we are immigrants, from Potosi and Sucre, Auroro".

Many of the farmers in the three communities came from the highlands of Bolivia during the 1970, 80 and 90's. Some received a parcel, whilst others did not and therefore had to rent land, or work as contractual labour in the fields. According to the two key informants, the possibility of renting land now is increasingly difficult. High prices for agricultural output, such as soya, makes renting land desirable, which has given the outcome of high rental prices on land. This made soybean production difficult for some farmers, and it was argued that production on land under 15 hectares was unviable, due to high to production costs. During an interview, one informant explained; "*when you grow small amounts you don't see the gain*". This corresponds with a study carried out in Santa Cruz by Suarez et al. (2010), concluding that a minimum of 15 hectares is necessary to grow soybeans. He points to high production costs in relation to input prices, but also to the fact that soybean production is fully mechanised, requiring the use of machinery for all parts of production.

Access to machinery: As soybean production is 100 % mechanised, owning agricultural machinery is almost as important as owning land for small and medium scale, when it comes to capitalisation. With the possession of machinery, it is possible for the farmers without land to rent land and still be able to produce. However, this presupposes that there is land available for renting. Further, to own machinery also gives the possibility for the farmers to rent their equipment to others that do not own machinery. Research show that the first savings made by farmers, both the northern and eastern zone, commonly are used to buy machinery, such as tractor, seeder and fumigator. Expanding agricultural production is to a larger extent possible by investing in machinery, rather than buying land (Suarez et al., 2010).

5.2.2 Infrastructure

The development of infrastructure is pointed to by many informants as important. The early state policies are seen as the most important in favouring the agricultural development in

Santa Cruz from the period 1952-64 (Suárez et al., 2010), especially through construction of infrastructure such as railways and roads. The building of roads has been key for the development of agricultural frontier. In San Pedro and San José, the construction of the main road has led to more frequent and reliable supply of food. It has also made it easier to transport agricultural goods. Several informant explains how it earlier could be difficult to enter into the communities, especially during heavy rain as the main road turned into mud, making transportation challenging.



Photo 5.1: Main road in San Pedro, Santa Cruz, Bolivia. Source: Astrid Thuen (2012)

5.2.3 The technological context

In addition to environmental and socio-economic factors, the technology context in which soybean are produced affects the food system in the three communities. The soybean was introduced around 15-25 years ago in the northern zone and 5-10 years ago in the eastern zone. Soya is seen as a “safe crop” and “easy” crop, due to its high export value and the

growing international demand. It is projected a continued growth, in linkage with increased animal consumption, vegetable oil demand and the increasing use of biodiesel. The soybean production is a mechanised production and was introduced into a mechanisation climate.

In 2005 genetically modified seed became legal in Bolivia. This led to a rapid increase in farmers using GM soya; from a small number in 2003 to 62% in 2007 and 92% in 2010 (Catacora-Vargas et al., 2012). All the informants participating in the research produce GM soybeans, except one that this season only produced conventional, and one that produced both GM soybeans and conventional soybeans in separate fields. The majority of the soybean farmers had gone from conventional to GM soybean production, in the period 2002-2011.

The main reason for choosing GM soya, according to the informants, is that it becomes easier to keep the soya “clean”. This meant that by applying glyphosate and/or other agrochemicals the weeds and grass died, and only the soya was left in the field. Most informants claim that keeping the field clean of weeds was the main problem with conventional soya and several informants explain the advantage of weed control. One informant explained; *“the most important factor is to control weeds, with GM soybean we just put on glyphosate and it kills everything, except the soya. With conventional soya we had to apply two times, once for weeds with wide leaf and once with narrow leaf”*. Another farmer have similar experiences; *“We changed due to the weed problems. We could not control the weeds. Now we use glyphosate and all the weed dies”*.

Another reason for choosing soy production is that it is seen as economically better, especially in relation to fumigation, which is both less and cheaper with GM soybeans. An additional advantage mentioned by the farmers is that GM soya leads to decreased need for manual labour, leaving the farmers with a smaller burden of work. Earlier, the agricultural production in Santa Cruz led to a large demand of contract workers, which often came from the other side of the country. A male informant summarises; *“it is more profitable, its less manual labour and you send less money”*.

However, the changes to GM soybean seem to have had both social and environmental consequences. Some feel pressured to growing GM soybeans because “*everyone is doing it*”. Others feel disadvantaged because the chemicals applied on soybeans reached their field, making the production of conventional soya difficult. One informant tells; “*most people have vegetable gardens, and a few gardens are more commercialised. But these gardens are affected by glyphosate; the farmer growing vegetables next to soya feels the problem more and more due to the wind. It is difficult to grow other things next to soya. You practically have to grow soya due to the application of glyphosate, or the land doesn’t give anything*”. Others are worried that the use of the chemicals, mainly glyphosate, will have more long term consequences for the environment. Some informants also worry about chemicals entering the drinking water in the community. Another man is concerned for the future; “*When we produce it here it is cheaper and we have plots of land to produce, but it is not natural, it is with chemicals. Before I could produce tomatoes easily without fumigating and the rice had no plagues, but now there is a lot of plague and poison. I don’t know how the people will hold out*”.

Together with the growth in soya production, there has been a growth in the use of pesticides. This has been the trend in all the Latin American countries including Bolivia (Figure 5.3). There seems to be a correlation between the introduction of GM soya and increased use of pesticides (Catacora-Vargas et al., 2012). As previously stated, almost half of the investment cost amongst small and medium scale farmers goes to control weeds. The largest increase has been within the use of herbicide, where glyphosate accounts for the majority. In addition, the price of pesticides has gone up, which was confirmed by several of the informants. Some of the informants see the increasing use of chemicals as related to lower production and “tired land”, while others see glyphosate as an easier way to keep their fields clean.

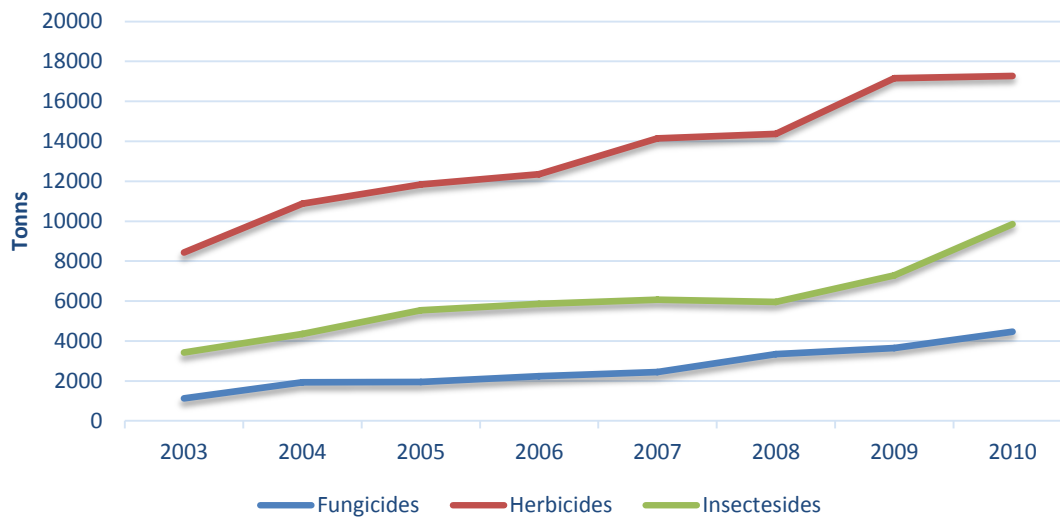


Figure 5.3: Growth of pesticide use in tonnes, Bolivia 2003-2010 (own elaboration based on FAOSTAT, 2013).

Few of the interviewees had seen an increase in yield, as “promised” by the seed companies, and informants from all places claim to have the same or smaller yield with GM soya. In the department of Santa Cruz few official research results are published on the difference between conventional and GM soy when it comes to yield performance. Most farmers agreed that the productivity was not improved with GM soybeans; however the cost was decreased, especially in relation to inputs such as fertiliser. Not all varieties of GM seeds are meant for increased production. RR soybean is one of the varieties that do not lead to higher yield, but reduces cost for the farmers, which correlates with the finding made in this research. Yet, some farmers expressed that the cost of inputs was increasing to the level that they were not sure about the gains made with GM soy anymore. This, however, stands in contrast to what some of the seed providing companies claim.

6. Food security and small and medium scale farmers

This chapter addresses the second sub-question of the thesis-

- i) *How do the farmers experience own situation in terms availability, access and utilisation of food?*

As such the chapter aim to examine and discusses the empirical data collected on farmers' experience regarding their own food security. Elements from Ericksen (2007) framework of food security are applied as indicators of the three pillars; availability, access and utilisation.

6.1 Availability of food

6.1.1 Production

All the farmers interviewed in this study were soybean farmers who also produced other crops as a secondary or rotational cultivation. This is linked to the climatic conditions which make it possible to have two seasons a year and that the farmers need a constant income flow. As seen in Figure 6.1 maize, rice, and to some extent wheat, are the most important secondary crops. It is important to emphasis that the figure shows what the farmers planted the year the fieldwork was carried out and that this depend on weather conditions. One farmer explained; *“the wheat is grown in the winter, but now we don't have [it], due to the rain”*, whilst another told *“we produce some vegetables like tomatoes, but this year due to a little drought, it was difficult to sow”*.

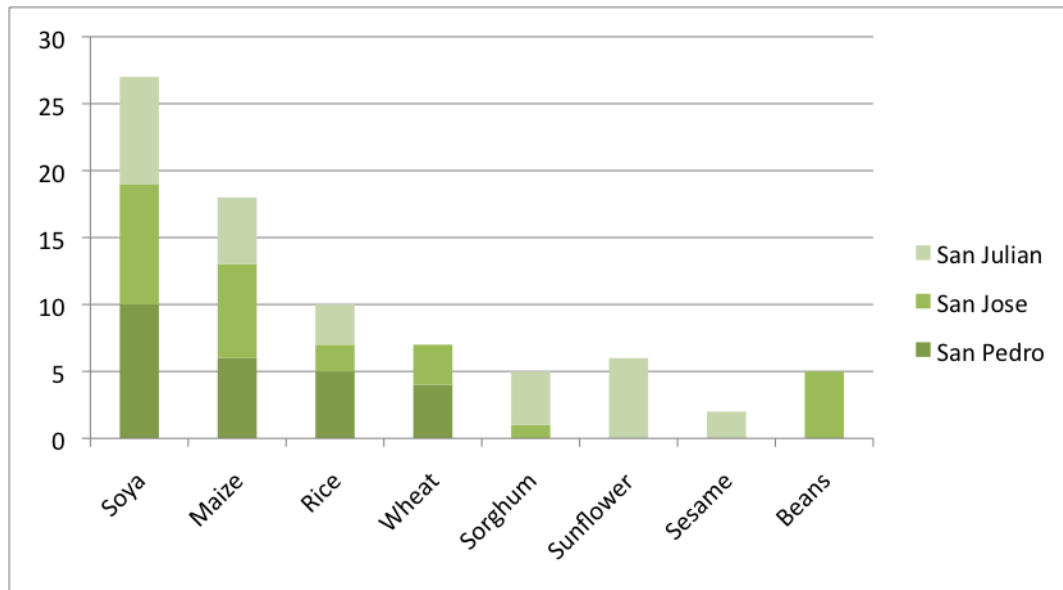


Figure 6.1: Overview of the agricultural crops produced by the informants in the three communities (Authors own elaboration based on the interviews in the period July-October 2012).

Consumption of own production

Most of the informants explain that they do not consume much of the food they produce; hence most of what is being produced for the markets i.e. are cash crops. Nevertheless, most informants explain that they eat some of own rice production. In addition, a number of the farmers have small plots for vegetables (e.g. tomatoes, lettuce and others) for self-consumption. A various number of vegetable gardens were also observed, even though the consumption from own garden varied between the farmers. Figure 6.2 shows that most foodstuffs consumed are not from own production and is purchased through the market.

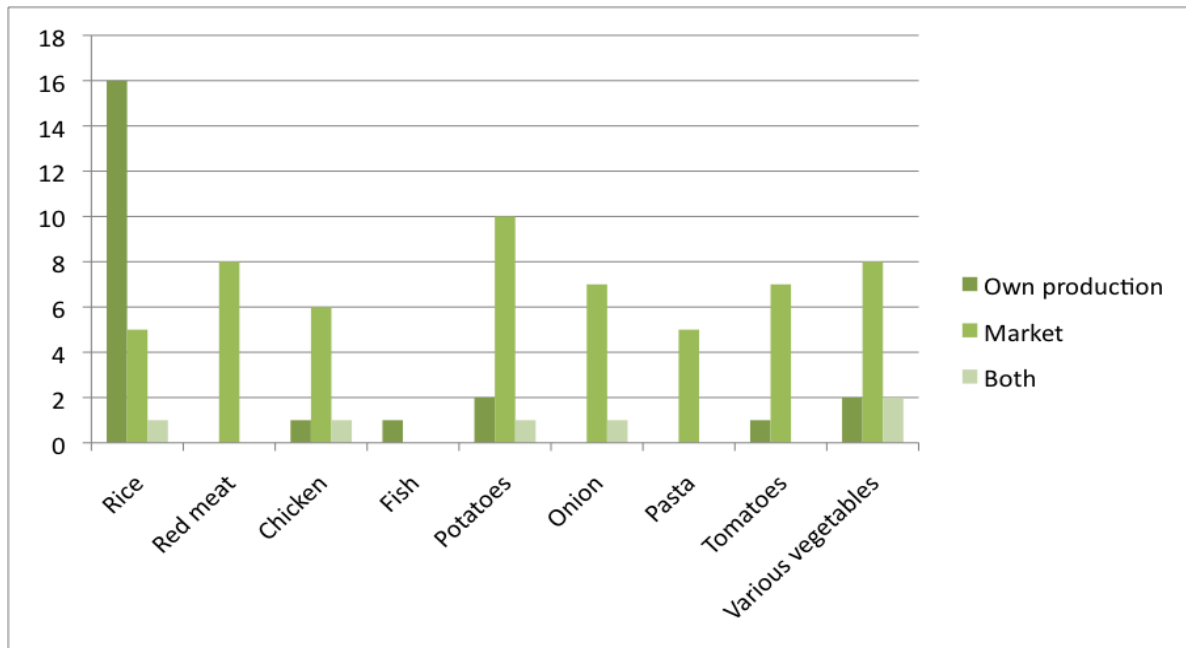


Figure 6.2: Most typical food consumed by the informants in the three communities, and the source of access. (Authors own elaboration based on the “food consumption form”, in the period July-October 2012).

Even though the main crop produced is soya, few of the interviewees claim to include this in their diet. This is despite soybeans being promoted by the government and other institutions dedicated to soybean promotion e.g. ANAPO. Distribution of packets with soya and quinoa has been carried out, yet some of the informants claimed that it is not used.

There is an artisanal processing sector of soybeans in Bolivia delivering to the local market, which produce soymilk, meat substitute, ice cream, etc. However, it is also noted by Brenes (2001) that the market for these products is not well developed and the demand is low.

One reason for not including soybean is because it is not a costume to use this crop in the Bolivian diet. Soybean originates from China. The use is more included into the Asian diet, with for example soya sauce or as replacement for meat though tofu, whilst it was not introduced in Bolivia at a larger scale before the 1980s. Hence, there is little knowledge on how to prepare soybeans and several informants reported preparation as an important reason for not including soybean in the diet In addition, many informs that the preparation of

soybeans is time consuming and one woman explains; *“it is a lot of work; wash it, then dry it. Here we work a lot, so we make what is fast. It takes a lot of time to start with raw seeds”*.

On the other hand, a number of the informants eat soya, yet mostly occasionally or in small quantities. An important reason for choosing to consume soya was related to health benefits, due to high protein content, such as one male informant which explains; *“yes of course we eat it, about two times a week. It is important for the high protein; I think it is around 40 %. We make soya milk from own production, and we also make bread.”* Another informants, however, have a different reason for including soybean into the diet *“Yes, we eat it, what else can we do? We have to use it”*. This might reflect the different economic situations experienced between the informants.

Yet, it was interesting to observe that the change to GM soya had changed a number of informants' view on consumption, and several seemed to show scepticism regarding health risks linked with GM soybeans. A couple explained their concern, and to the question referring to whether they consumed any of the soybeans they answered; *“no, not now, because it is GM soy and we don't know the consequence of that. Before we made milk and we used to eat soya once a week and sometimes we had chicha (soymilk) every day”*. Another couple agrees and explain *“We don't eat anything now, only before when it as conventional. We did milk, cheese, but now it is only GM and we don't eat that”*.

In the literature regarding GMO there are claims about the health hazards connected to the consumption of GMO food. On the other hand, there are also strong opposing claims of GMO food consumption being safe. This debate is rapidly evolving, with literature on both sides. It is now 15 years since the first GMO was introduced on the market, and the literature around the health effect has been continuous. Yet, there seem to be a lack of scientific studies to support the claim that GM foods are safe. Additionally, there is a lack of openness around the studies on health effects carried out by the biotechnology industry (Domingo, 2000; Domingo 2007; Dona and Arvanitoyannis, 2008; Spiroux de Vendômois et al., 2010). Over 10 years ago it was noted by Domingo (2000) that few experimental studies related to the potential health risk of GM foods were available. Still the debate on food safety related to GMO was dominated by the proponents of the safety of transgenic food, who contributed with comments, briefs and opinions with little experimental data. The lack of data, and the

reluctance by biotechnology industry to publish studies in known journals for scientific judgment, has led to questions such as “where is the scientific evidence showing that GM plants/food are toxically safe?” (Domingo, 2007:271). Further, a call for a more transparent and open studies, including lifetime studies of laboratory animals was made (Spiroux de Vendômois et al., 2010), in contrast to today’s practises and regulations.

6.1.2 Local trade

As less of the consumed foodstuffs are locally produced, the availability of food is dependent on food from trade, and further on transportation and infrastructure. Food brought to the area is available at the local market.

The informants held various views regarding the availability in the local market. Some are satisfied with both the selection of food and the stability, as expressed by one farmer; *“you can get everything, all you need for cooking. It is stable all year around. 10 years ago it was not like this and you needed to travel to Santa Cruz”*. Another farmer reasoned; *“you can find everything because of the mobility”*. Others were more reluctant regarding both the availability and the stability, and one male informant explains *“for cooking you can find a lot, but the availability is not stable. In the summer the vegetables are not so available and more expensive”*. Several interviewees mentioned the season as an important factor for the availability, and that the price of the food fluctuated with the seasons. A producer in San Pedro told that *“you can find everything, but not always, it depends on the season. In the dry season you cannot find everything [...] some families suffer and go hungry”*.

As little of the production is consumed by the producers, the growing of cash crops might affect the availability of food. Answers to the question regarding what the informants produced before starting with soybean production is presented in Figure 6.3. Even though the number of informants might not be representative, due to sample size, it is possible to see that the variety of crops were somewhat larger before starting with soybean. This might underpin that the soybean production affects the availability, and further the variety of food.

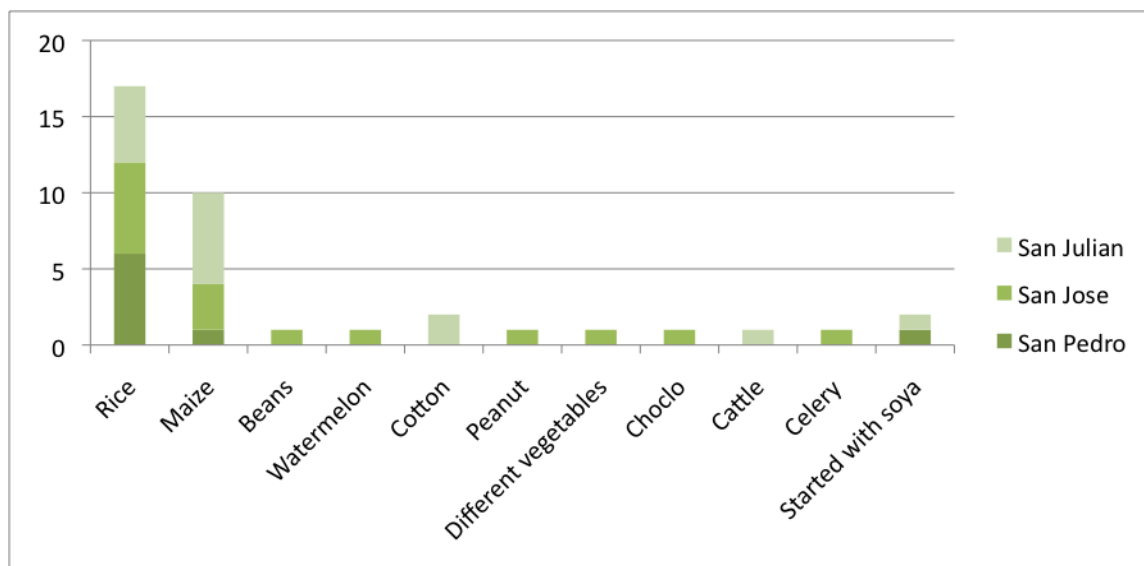


Figure 6.3 The crops produced by the informants in the three communities before starting with soybean production (Authors work based on interviews, in the period July-October 2012).

6.2 Access to food

6.2.1 Affordability

All the three communities have seen an economic growth due to high prices of soybeans. To the question concerning how the economy has changed after switching to soybean production, the majority of the respondent confirmed that the economy has changed in a positive direction with an increase in income. One respondent from San Pedro explains; *“the economy has improved a lot, which is why, here in San Pedro, most people have real houses. Before the houses were made of woods and leaf”*. Many of the farmers in the three communities had relatively high-income levels, with good standard houses and own machinery. However, there are several issues that might affect the affordability, such as an observed decrease in soybean earnings, an increase in food prices, and uncertainty regarding the international market (price of soya and oil).

Even though close to all the informants have experienced economic growth due to soybean production, a number of the farmers expressed concerns about the economic situation. In the

later years a number of the farmers have experienced a decrease of income, despite initially large economic gains. The reasons for this situation are complex. One reason might be increased use of inputs. As described in the latter chapter and shown in Figure 5.3, the amount of pesticide use has increased substantially in Bolivia, and as argued by Suarez et al. (2010), 45 % of the investments made by small and medium scale farmers are used to control diseases and weeds. Further growth of pesticide use, in a time with increasing prices on fertiliser (Figure 6.4), might therefore pressure the economy of the small and medium scale farmers.



Figure 6.4: Development of fertiliser price in real US\$ dollars, annual indices, 2000-2012. 2005=100 (FAO 2013a)

Further, some farmers explained how increasing inputs might affect the land and how the removal of bush and trees are leading the land more exposed to floods, which again is affecting the harvest and the income generated from the production. It is clear that many of the farmers are cautious about the possible effect of soybean production, and like one informant explained; *“the truth is that soya is a monoculture, yet with the best profitability, with the best money. It is always best profit, and therefore the people have started to cut down trees and plant soya”*.

An issue mentioned by all the informants where they experienced an increase in food prices during the last 10 years. The world's food prices saw a peak in 2008 and again in 2011, both globally and in Bolivia. This is confirmed by most of the soybean farmers, which point to a large increase in food prices. One informant from San Pedro explains "*the oil was the first thing to go up, and then the sugar and meat. Everything has gone up, it's not like before*", whilst another female respondent from San José describes her family's situation; "*the price has increased and sometimes we don't have enough to buy food, or sufficient food. We can only get the minimum of food because it is very expensive*". Further, some informants point to the instability of the prices and one informant explains "*today is one price and tomorrow it is different*".

Also affecting access to food for the small and medium scale farmers are the prices on foods they purchase. When looking at the development in price of some crops (Figure 6.5) it is evident that the prices have had large variations for the last 6-10 years on some of the important staple crops and there was a clear peak around 2008. This was confirmed by all the farmers in the research, and they experienced economic stress related to these price increases. In the period January 2006 to October 2013 the price of potatoes and wheat flour have increased 172, 1 % and 59, 5 % respectively. From January 2003 to October 2006 the rice has a more modest increase of 16 %, whilst the price of maize has decreased with 29 % (FAO, 2013a).

As maize is the second most grown crop amongst the informants, a decrease in selling prices of maize might affect their economy negatively. This trend is evident worldwide in 2013, especially due to the good maize harvest in the US. This might lead to, as noted by the chief economist of the International Grain Council (IGC) secretary Helen Helton, soybean production replacing maize due to the large difference in price (IGC, 2013).

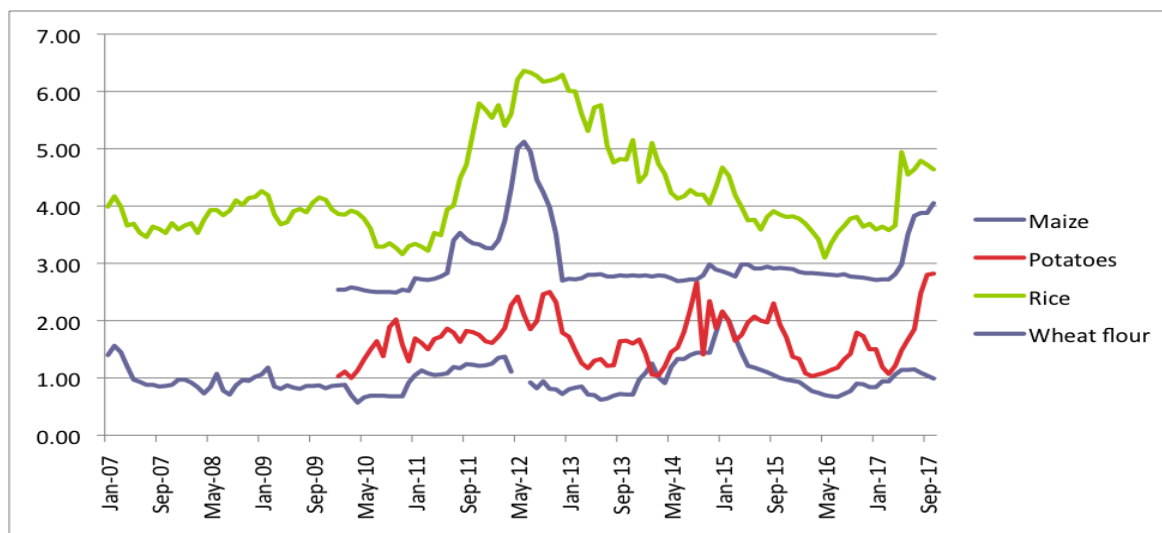


Figure 6.5: Food prices in Santa Cruz, Bolivia. In real Bolivianos (Bolivian currency), January 2002 to October 2013 (FAO, 2013a)

6.3 Utilisation of food

6.3.1 Nutritional value of food

The farmers included in this study all produce soybeans in corporation with other crops. Maize, rice and to some extent wheat are the other most important crops, in addition to soybean. Further, several of the informants have vegetable gardens, with tomatoes, potatoes, lettuce etc.

Close to all of the agricultural production is for sale outside the local market. When examining the use of own production it is clear that close to all of the soybean and maize is for the market, but that the majority of the farmers in the study report that the rice consumed stems from own production. Additionally, several informants have vegetable gardens for producing some vegetables, depending on the season and weather conditions. Still, the impression was given by one of the farmers union leaders that it becomes less common amongst the farmers to keep own garden plots productive. Some interviewees confirm that they consume from own soybean production. This is however, slightly misleading, as most

of these claim it is seldom or occasionally included in the diet. Only three of the famers claimed to include it weekly or more often.

To get a better overview of the food consumed, a “24 hour food consumption form” was filled out by the informants (appendix 3). The findings are presented in Table 6.1, and demonstrate a count of what the famers eat one in one specific day. The result showed that rice is the most consumed foodstuff, and was included in all the meals during the day. Further, the findings show that the consumption of meat is high, in particular chicken and red meat.

Top three most common foodstuff	%	Common source
Breakfast		
Bread	46 %	Market
Egg	31 %	Market /self-production
Rice/tomatoes	19 %	Market / self-production
Lunch		
Red meat	58 %	Market
Rice/carrot	42 %	Market / self-production
Onion	35 %	Market / self-production
Dinner		
Rice	58 %	Market/self-production
Chicken/tomatoes	35 %	Market
Red meat	31 %	Market/self-production

*Table 6.1: Most common foodstuff consumed for the informants, and source of access. (Authors work based on food consumption form, in the period July-October 2012). * not included coffee/tea for breakfast*

The informants were in addition asked to list the food most commonly used and the result is presented in Figure 6.5. Rice is the food most interviewees reported to frequently consume, together with potatoes, chicken and read meat. Lettuce and tomatoes, in addition to some other vegetables are reported to be one of the more used types of food. The nutritious value of tomatoes and green salad is however rather limited, as they mostly consist of water.

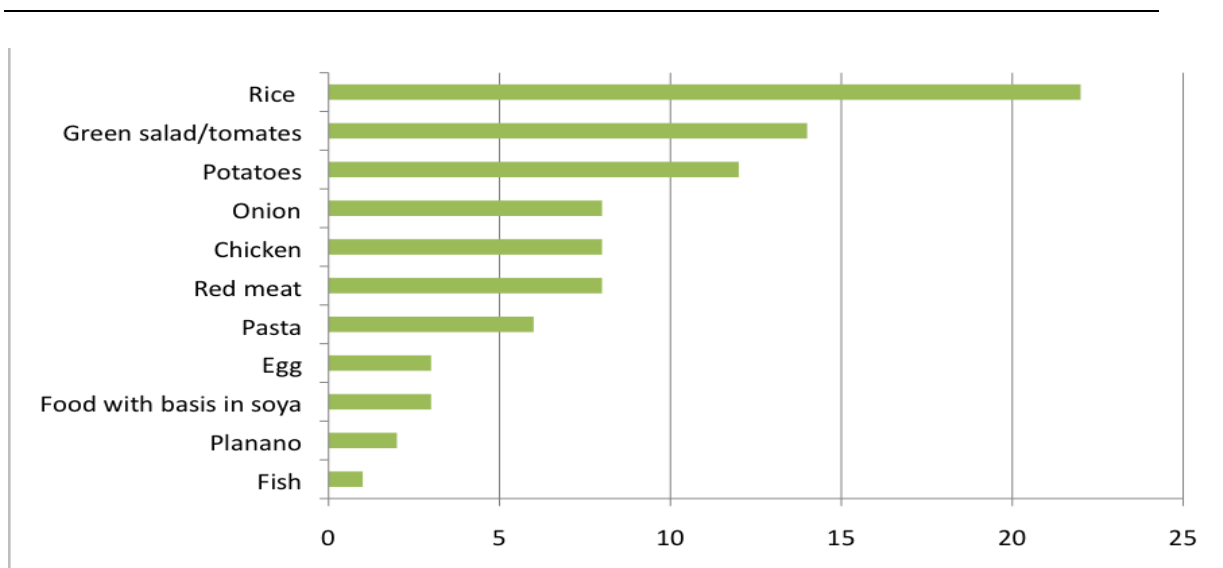


Figure 6.6: The foodstuffs most frequently consumed by the informants. (Authors work based on food consumption form, in the period July-October 2012).

The preparation of the food is important for the nutritional value of the food (Kearney and Geissler, 2011). It was observed that food consumed in both the farmers houses and in restaurants is fried. The potatoes were commonly served fried, as was the chicken and red meat.

According to the informant from CEDLA the consumption patterns in Bolivia in general are changing, especially in urban, but also in rural areas. Arguably, the diet moves away from traditional food consisting of sheep, animal oils and traditional potato varieties, to more consumption of red meat (cow), vegetable oil and refined carbohydrates, such as white bread, rice, pasta and foreign potatoes. This was also noted by the informant from PROBIOMA, who pointed to a reduced variety of food produced, leading to a less variety in the diet. This phenomenon is well documented in studies worldwide and one of the first to explain this transition in food consumption was Popkin (1993) with the theory of “nutrition transition”. In Bolivia, 30-39 % of the total energy supply was derived from animal products, sugar and sweeteners in 2003 (Millstone and Lang, 2013), a share which is believed to have grown.

7 Soybean production and food security

Chapter 5 describes at the environmental and social drivers that affect the food system in which the small and medium scale soybean farmers interviewed in the three communities are part of. Complementary, Chapter 6 reviews farmers own experiences on food security in relation to specific relevant aspects. This chapter will build on the findings from these previous chapters aiming to answer the main question of the thesis on how soybean production, as a food system, contribute to or constrain food security for small and medium scale soybean farmers in terms of availability, access and utilisation. To address this question, the findings will be discussed in light of the food system framework provided by Ericksen (2007), which includes analysis on how the environmental and socio-economic drivers affect food security, both directly and through interactions with food system activities.

As mentioned, the discussion restricts to the results presented in chapter five and six; hence do not cover all the possible drivers, interactions and activities pointed out in the reference framework.

The drivers considered in this analysis are from the environmental, socio-economic, and technological context. Environmental drivers are described through global and local climate change, in addition to land use change. Socio-economic drivers are described through access to financial resources, land and machinery, infrastructure, and the technological package applied. The activities discussed are production and consumption, and to some extent distribution and retail.

7.1 Availability

Production: According to the framework, local production is an element impacting the type and amount of crops being available. First, soybean production had replaced production of other crops amongst farmers. Answers from the respondents showed that previous to the introduction of soybean, the variety of crops produced was slightly higher, thus, indicating

that the change to soybean production, in different extents, decreased the variety of local food production. However, many of the respondents still keep small vegetable gardens or grew other crops partly for self-consumption (e.g. rice), which contribute to the variety of food crops production.

The socio-economic context together to the technological changes in the soybean production has resulted in the shift towards GM soybean production, currently planted by the majority of soybean growers. Some farmers interviewed expressed they had anticipated an increase in yield using GM soybeans compared to conventional soybeans. However, only few of the interviewees had recorded an increase in yield, and informants from the different communities claim to have the same or smaller yield with GM soybeans. In the department of Santa Cruz few research results are published on the difference between conventional and GM soybeans when it comes to yield performance (interview PROBIOMA, 2012).

One important reason for changing to GM soybeans was the simplified weed control. However, this simplification has, in time, related to an increase in the use of pesticides. The farmers' appreciation of this change varies; some informants found the increased use of pesticides good and unproblematic, while others pointed to the damaging effect on other crops grown next to GM soybeans, and concerns for soil degradation now and in the future.

Another factors affecting production are environmental drivers. Based on the regional trends, changes in climate, such as increased temperatures, unreliable rainfall and extreme weather are the likely factors that will affect the agricultural production in the near future in the three communities visited. This was expressed by the local farmers and some interviewees claim to already see effects on their yields due to weather factors. Some were for example concerned with higher temperatures and their effect on the soil moisture. This is consistent with the literature (ICPP, 2007) that suggests that small scale famers in Latin America are likely to experience a large decrease in yield in the next decades, e.g. 10 % decrease in maize yields. The yield of soybean might increase due to the rise in atmospheric CO₂ levels (Margin et al., 2007), however there are large uncertainties related with such predictions.

Other local factors may further influence weather conditions, such as deforestation (Bounoua et al., 2004), which is common in the areas of study

Distribution: Distribution is the second element of food availability according to Ericksen's framework. The major factors influencing distribution are infrastructure, transport and storing facilities. These factors have not been comprehensively assessed in this study; however, the information provided by farmers and the literature, suggest building of roads have improved transportation possibilities to Santa Cruz and surrounding areas for food distribution. Thus, it seems one of the socio-economic drivers, i.e. improved infrastructure may have contributed to availability of food in the local markets.

Exchange: The last element related to availability is exchange, encompassing how food is obtained through trade and purchases. In the three communities appraised, the local market was the place to acquire foods in addition to that of own production. The data gathered regarding foods consumption shows that a large proportion of foods were purchased at the market, thus becoming an important source of food for the farmers.

The results further indicate that the variety of foods consumed was quite limited; however, it was not clear whether this was due to low variety at the market or due to choice of purchase. The respondents held opposing views on the availability and variety of foods in the local market; some describing them as satisfactory, while others as limited and highly variable according to the seasons. If the variety of food from own production is indeed decreased, it is important to question whether the variety is substantially replaced by the selection available at the markets. In rural areas where food is not produced for self-consumption, the local market has a stronger importance (Kearney and Geissler, 2011).

7.2 Access

Affordability: Soybean production affected the access to food. Price and volume of yields, input costs, and other socioeconomic factors (e.g. access to capital, land and machinery) affect the economic situation and purchase power of farmers, thus their access to food. As

noted in Chapter 5, the three communities have seen economic growth as a result of the high prices of soybean and increasing demand. Since 1988 the prices on soybeans have increased continuously, especially during the last years, and FAO (2013) predicts further growth.

At the same time, several informants expressed concerns about the economic situation, as gains were starting to decrease, while prices and use of some inputs were rising as well. The system of soybean production described in Chapter 5 has facilitated the establishment of the soybean cluster (Suarez et al., 2010). A *cluster* refers to a group of actors, such as companies and institutions in a certain area, that complement each other for a commercial activity. The companies and institutions are central providers to the cluster, in terms of materials, machinery, credits, financial services etc. (Brenes et al., 2001). The participation of small and medium scale producers in this cluster takes place usually by acquiring loans for covering the necessary investments for soybean production, such as access to machinery for the mechanised production, fertiliser that according to interviewed people has increase the application volumes with GM soybean production. The most common source of loans is the oil processing and agrochemical provider companies.

As described in Chapter 5, the small and medium scale farmers were dependent upon loans from private actors since the interests on loans are lower than on loans granted by banks. Further, repayment of loans was dependent upon harvest and selling price. Many of the farmers interviewed were indebted to the companies, and struggled to relieve themselves from the debt.

The dependency of farmers upon companies seemed to be reinforced by two means; the provision of credits, and technical assistance in the soybean production. Although this was helpful to many of the farmers it is also a mean for the companies an strategy to ensure the demand of their own products.

In the context generated by these socio-economic drivers, the small and medium scale soybean producers seemed to be especially vulnerable to the environmental changes, especially local climate changes, effecting yields, but also through global climate changes,

affecting global agricultural production and, accordingly, markets and price. A more unstable climate globally may lead to more uncertain production and more fluctuating prices.

7.3 Utilisation

Nutritional value: The variety of food consumed by the informants seems to be rather limited, with four to five types of food accounting for the majority of the food intake to many of the informants. It is not clear from the results whether this low variability stems from few options available at the market or the respondents choosing to buy a limited selection of foodstuffs. From observations, people with more affluence eat more meat. Low variety in diet may lead to a sub-optimal nutrient intake, as a range of different foods is needed to cover all nutritional needs. This is why most national dietary guidelines and food selection guides emphasise and promote variety in diet (Lawrence and Robertson, 2007).

Even though soybean is the main crop in production, it is noticeable that its consumption is limited. Most of the informants do not consume soybeans in their regular diet. Hence, in terms of consumption, soybean plays a limited role in local food security. Based on the responses on frequently consumed foods, the main source of carbohydrate is rice, followed by pasta and potatoes. Since white rice and pastas are mostly refined carbohydrates, their contribution for micronutrients and fibre is reduced (Pedersen, Hjartåker og Anderssen, 2010). Potatoes could be a good source of micronutrients, e.g. vitamin C (Pedersen, Hjartåker og Anderssen, 2010), however they were mostly consumed fried, which degrades nutrient content, especially vitamin C, and fat is absorbed (Gordon, 2011).

Sources of protein were chicken, red meat and eggs. Rice and bread are also contributing to protein intake. As the rate of respondents eating red meat or chicken for both lunch and dinner frequently was quite high, it seems protein intake is not a problem for the soybean farmers. Sources of fat were red meat, chicken and fried foods. Few sources of unsaturated fatty acids, including omega-3-fatty acids, were reported to be frequently consumed. From this, it seems the frequently consumed foods do not provide an optimal composition of dietary fat (Gordon, 2011; Yaqoob, Minihane and Williams, 2011; Pedersen, Hjartåker og Anderssen, 2010).

Few vegetables and fruits are included in the common soybean farmer; tomatoes, green salads and onions, mostly. A more diverse consumption of vegetables and fruits would be needed to provide the several essential micronutrients and fibre required for a healthy diet (Pedersen, Hjartåker og Anderssen, 2010).

Similar diets to the described among the farmers interviewed are typical in countries undergoing or having undergone the nutrition transition (Popkin 1993), as diet moved towards more consumption of meat and especially red meat and chicken, together with more refined carbohydrates, such as sugar, and oil. This trend is followed by a range of developing countries (Johns and Eyzaguirre, 2006).

Social value: It is also interesting to look at the social value of food. Strong feelings about traditional food were frequently observed amongst the farmers. It is clear that traditional foods, which include a variety of ingredients, play an important role in the life of many of the interviewed in the three communities. However the issue of social value is complex issue.

To get a better picture of the situation a more in depth study is needed to include the food intake over a longer period examining the nutrient content of the food. If the income generated by soybean production is a factor contributing to less consumption of traditional foods, this can be seen as constraining the social value of foods for the farmers.

7.3.1 Limitations of research

This study has certain limitations. Even though the food system framework approach was useful in examining the empirical finding and allowed for the inclusion of a wide set of drivers, it was not possible to assess all the components included in the framework. When looking at the food system outcomes, food security was examined, while little emphasis was put on the social welfare aspect and environmental capital. This is due to limited time availability for this thesis.

Further, not all the drivers that affect a food system were examined and limited attention was given for analysing the feedback mechanisms. For addressing these issues, a longer timeframe would also had been required. Furthermore, although this research aim for an interdisciplinary approach, the inclusion of all drivers would require competence within the different fields of studies; politics, biology, economic, nutrition etc. Instead the findings are meant to complement previous and future research to get a more holistic understanding of the food security situation amongst small and medium scale farmers in the three communities.

More specifically, a number of variables could have been measured quantitatively, for example in relation to the famer's economic situation. Income and distribution of expenses in food was not systematically collected.

8 Conclusion

The aim of this research has been to investigate how soybean production, as a food system, in three villages, San Pedro, San José and San Julián, in Santa Cruz, Bolivia affects the food security situation of small and medium scale soybean farmers. The main research question has therefore been; *how does soybean production, as a food system, contribute to or constrain food security for small and medium scale soybean producers in Santa Cruz, Bolivia.* This topic has been investigated during a fieldwork in the three communities between July and October 2012. The research has taken a qualitative approach and used a theoretical framework based on the food system approach as a guide to analysing the empirical findings.

By using the food system approach the thesis aimed to give a broad view of soybean production as a food system, and how this system impacts food security. This has been done by examining the different environmental, social, and economic components that affect the food system and their interaction (Ericksen, 2007). The first of two analysing parts in this research has therefore examined the following sub-question; *what environmental and societal drivers affect small and medium scale soybean producers in Santa Cruz?* The societal drivers have been divided in two sections: environmental and socio-economic, the latter encompassing the technological context. The climatic and societal drivers were found to be interlinked in a wide variety of ways, affecting in a large extend the local food system.

The thesis found that the main environmental drivers are extreme weather such as reoccurring floods and droughts, more frequent erratic and unpredictable rainfall, and a trend of increasing temperatures. The findings suggested that the weather is affected by the El Niño and La Niña events, worrying a number of the famers in the three communities studied. The research area has experienced large scale land use change through the expansion of soybean production. This further affects already ongoing climatic variations, such as more floods. The climatic drivers have damaged harvest in the soybean communities, leading to

income losses that have made farmers unable to pay back their loans. A number of farmers experienced to struggle with debt due to climatic events which happened several years back.

Socio-economic drivers and technological drivers have been identified as the most prominent societal factors affecting the soybean production. A so called “cluster of soybean” has been created. Within this context there are interconnected link of companies and institutions which are providers of important products, such as financial services, machinery, materials etc. The findings showed that soybean production required large investments, and lack of own capital made farmers indebted in order to enter the mechanised soybean production. The small and medium scale farmers did not have access to banks, but depended on credits from private financing entities, such as vegetable oil processing companies and importers of agricultural inputs. The conditions and terms for these loans are leaving the farmers in a vulnerable position, where the outcome often was being further indebted.

The technological context of soybean production is characterised by full mechanisation, which made farmers dependent on self-owned or rented machinery. The introduction of GM soybean had expanded the “cluster”, where companies offered technological packages containing GM seeds tolerant to glyphosate, the herbicide glyphosate and fertilisers. All the farmers grew GM soybean, which was legalised in 2004/05. The findings shows that farmers had chosen to convert from conventional to GM soybean were mainly for simplified weed control. However, the study also showed that a number of farmers felt a pressure to enter into producing GM soybean because “*everyone was doing it*” or due to the fact that it was difficult to find non GM seeds and fertilisers. Further, a common environmental concern in relation to GM soybean production was present amongst some farmers interviewed in the three communities: the use of agro-chemicals and its effect on both the soil and on the human health.

The findings show that land is unevenly distributed between the farmers. Many of the informants rent land; however the possibility of renting land was described as difficult due to high prices.

To fully understand the societal and environmental consequences of GM soybean production the findings from this work should be complemented by further research. In order to see the effect of the GM soybean an interdisciplinary in-depth study could reveal the farmers opinions together with field-based analysis on soil and water qualities, as well yield performances and changes on volumes and types of pesticides applied.

The second part of the of the thesis's analysis outlined in Chapter 6 examines and discusses the empirical data collected on farmers experience regarding aspects of own food security. The chapter addresses the second sub-question on; *how do the farmers experience their own situation in terms of availability, access and utilisation of food.*

The findings of this chapter showed that soybean production has to various degrees influenced food security. In terms of availability, through the interviews it was found that all the farmers produced soybean in rotation with other crops, but that a small proportion of their production was consumed locally. Soybean had further replaced other crops amongst the farmers, which might have influenced the availability of locally produced foodstuffs. Soybean, as the main crop, was to a small extent integrated in the diet of the farmers and did therefore has very limited, if any contribution to food security, in terms of availability. The study points out that a number of famers were reluctant to consume soybean because it is genetically modified and, accordingly in their view, pose a risks to health. Most of the foods consumed were acquired at the local market, and the study showed that some of the farmers did not find satisfactory food availability.

Access was assessed through looking at affordability of food. As most of their foodstuffs were purchased, their economic situation affected access. Soybean production has improved the economic situation for farmers. However, due to the previously described situation of indebtedness, some famers had concerns related to their own financial situation, which makes them vulnerable particularly in light of increased need for synthetic agricultural inputs (e.g. fertiliser and pesticides) and climatic events, such as floods.

The findings show that utilisation of food was characterised by low variability in the foodstuffs consumed. A high proportion of the diet consisted of sources of carbohydrates,

such as white rice, pasta and potatoes. The intake of animal products was also high, especially red meat and chicken. Vegetables and fruits frequently included in diet were few.. Frying was a commonly used method of food preparation, and with negative effect on nutrient contents of foods according to the literature. Utilisation is a complex matter to examine and only few aspects of it were analysed in this thesis. Accordingly, a more in-depth study is needed over a longer period, followed by an examination of the nutrient content of the food.

The discussion used the food system framework approach to look at how the identified drivers and experiences of the farmers interacted and affected food security. The three pillars of food security proposed by FAO (1996); availability, access and utilisation, were assessed. Availability was found to be influenced by reduced variety of crops and low consumption of own soybean production. Technological drivers were related to this situation as they have been an important factor in the conversion to mono-cropping and to growing GM soybean varieties. GM soybean production had not proved to increase yields according to the farmers. In addition, higher use of pesticides worried some farmers as they saw negative effects on soil and other crops. Environmental drivers also affected availability as climatic events may affect agricultural production. Some of the environmental drivers may be affected by negative feedback from soybean production, such as deforestation. Availability was also affected by improved infrastructure, i.e. better roads, to the area, and trade at the local market. With less variety in own crops and low consumption of these, availability at the market was found to be an important factor for food security.

Access to food may have been improved by soybean production, through increased gains and improved economic situation for the small and medium scale farmers. However, the economic situation is uncertain, and the conditions and outcomes for the farmers in the “cluster of soya” may be a contributing reason. The farmers are often indebted and has a dependency relationship to the companies involved in soybean production. The farmers are further vulnerable to the environmental drivers affecting crops and prices, and thus ability to pay debts. Increasing and fluctuating food prices makes food more expensive for the farmer, thus constraining access to food.

Utilisation was characterised by nutritional value being somehow limited due to low variability in diet, high intake of refined carbohydrates, significant amount of fried foods and little fresh fruits and vegetables. These characteristics are in line with those described as the nutrition transition. The farmers expressed strong feelings for traditional foods, which may be less available as the income generated by soybeans is an important driver for replacement of traditional crops and foods.

Some of the findings made in the thesis correlated with findings made in other research carried out on soybean production and small and medium scale soybean farmers. Hence, the findings of the thesis contribute to a better understanding of the relationship between soybean production, farmers and food security, which can be summarised as follows:

- Soybean has limited contribution to food security through direct consumption
- Amongst the small and medium scale farmers there was little variety of foodstuffs consumed. The expansion of soybean production and the decrease of other cultivated crops is one of the factors of influence.
- Farmers are skeptical on the consumption of GM soybeans; among the reasons for this is their fear for health risks.

Despite soybean production being promoted as a mean for food security, both by the Bolivian government and actors involved in the soybean cluster, such as ANAPO, it was difficult to clearly state that this was the case.

The thesis illustrates the importance of examining soybean production as a system, which gives the possibility of addressing it in its broader context including the different components and their interactions (Ericksen 2007) considering the local and global context. Further the thesis shows the importance of interdisciplinary studies in order to appraise the environmental and societal components of agricultural food systems.

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Appendices

Appendix 1: Semi structured interview with farmers in Santa Cruz

Questions to village leader/ leader for farmers

1. What is the number of habitants in this village?
2. What is the main livelihood in this village?
3. How is the division of land in this village? What are the reasons of this? Would people prefer larger plots of land?
4. What credit possibilities exist for small scale farmers in this area?
5. Do you feel that people in this village are concerned with the issue of food security?
6. How is the political attention around the issue of food security in Bolivia?

Questions to soybean producers

1. What type of food is available at the local market? (VISIT TO THE MARKED)
2. Do you find in the local market all the selection of food that you need and want?
 - 2.1 If yes, is the availability stable? If not, why do you think it is not stable?
 - 2.2 If not, if there a possibility to get it somewhere else? If yes, Where?
3. Did the crisis en 2008 affect you and the farmers here? If yes, in which way?
4. Did the economic crisis lead to less available locally produced food?
5. Do you experience that the climatic event (drought and flood) affect the availability of food? How has the resent climatic events affected the region in general?
6. The ongoing climatic events (drought in US), do you think this will affect you? If yes, in which way?
7. Do you own the land you cultivate? If no, who owns it?
8. How has your economy changed after switching to soya production?
9. How much of your income is used for food? %

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10. Have there been any changes in food prices the last 10 years? If yes, in what products?
 11. How is the access to inputs (seeds, fertiliser)?
 12. What company provides the inputs you need for cultivation (seeds, fertiliser)?
 13. To whom do you sell the soya you produce?
 14. Do you produce any other crops?
 - 14.1 If yes, which? Is this for own consumption or sales?
 - 14.2 If not, why?
 15. Do you see an alternative to producing soya?
 16. Does informal trade of local food exist in the community?

 17. How long have you (and your family) produced soya?
 18. Which crop(s) did you produce before producing soya?
 19. Why did you choose soya production?
 20. How many hectares are currently being produced with soya?
 21. Do you produce GM soybean?
 - 21.1 If yes, since when?
 - 21.2 Did you produce conventional soybean before?
 - 21.3 If yes, why did you switch to GM soya?
 - 21.4 If yes, what were the challenges and benefits by changing to GM soya?
 23. How do you feel about GM food? Positive or negative? Why?
 24. When and how did you learn about soybean cultivation?
 25. Have you received help from the government or private institutions?
 26. Do you think soya is a crop for human consumption? Why/ why not?
 27. Do you and your family consume any of the soy that you produce?
 - 27.1 If no, why not?
 - 27.2 If yes, how much is for export and how much is for own consumption?
 - 27.3 If yes, why does your family include soybean in your diet?
 - 27.4 If yes, how you consume/prepare it?

Appendix 2: Semi structured interview with CEDLA/PROBIOMA

1. Can you please tell me about CEDLA/PROBIOMA? When was it started?
2. What are the main areas of work of CEDLA/PROBIOMA?
3. Can you tell me about the growth soybean production in Bolivia?
4. How has the soybean production affected food security in Santa Cruz?
5. What is the role of soybean production in food security?
6. Has soybean production been promoted to improve food security? If so, How?
7. Do you believe the consumption (promotion of consumption) of soybean can help to improve food security?
8. Do you believe that soybean production have an effect on available locally produced food?
9. In 2005 – and the legislation of GM soybean. How has the legalization of GM soya affected food security in Santa Cruz?
10. How is the political attention on the issue of food security?
11. Can you explain a little about the trade agreements CAN/Mercosur? What role do these agreements play in soybean production?
12. How is the export economy of agricultural production affecting local food security?
13. What is the typical diet in Santa Cruz? Do you think this diet has changed the last years? If so, how and why?
14. Do you think the soybean production has led to changes in the diet among small scale soybean producers?
15. Do you believe soybean has been included in the diet of the producers?
16. Do you believe there is a difference between the consumption of soybean among small and large scale soybean producers?
17. Do you believe soya is replacing other crops? If so, which? If so, what effect do you believe this has on food security in Santa Cruz?
18. Santa Cruz and industrial agriculture is now producing a lot of the food consumed in Bolivia? How is this affecting the diet of the people? How is this affecting Santa Cruz?

Appendix 3: 24 hour consumption form

Tiempo de comida	Cereales y derivados Medida casera	Tubérculos Medida casera	Productos animales Medida casera	Leguminosas Medida casera	Frutas Medida casera	Azúcares y miel Medida casera	Verduras											
							Verdes Medida casera	Amarillas Medida casera										
Desayuno -hrs.																		
Merienda mañana -hrs.																		
Almuerzo -hrs.																		
Merienda tarde -hrs.																		
Cena -hrs.																		
Otros -hrs.																		

2.2 Con base a lo que acaba de recordar, ¿Cuáles son los alimentos más comunes que consume? ¿De dónde los consigue? ¿Cómo los consume? – Usar cuadro de abajo para responder.

Alimento	Fuente del alimento <i>Marcar con una "x"</i>			Forma de consumo <i>Marcar con una "x"</i>			
	Producción propia	Intercambio	Mercado / Tienda	Fresco	Cocido	Procesado	
						Casero	Industrial
