

# **INDIRECT LAND USE CHANGE AND TRANSLOCAL DEVELOPMENT DRIVEN BY SUGARCANE EXPANSION IN GOIÁS, BRAZIL**

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*Relocation and expansion of soybean production by soybean producers from  
the municipality Jataí (Goiás, Brazil)*



**Master Thesis**  
By Lennard Yordy Abma



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## Abstract

The global demand for alternative fuels stimulated the expansion of sugarcane for the production of ethanol in Brazil. In 2007, this expansion occurred in the municipality Jataí, located in the state Goiás. This region mainly depends on grain cultivation and is located in the Cerrado biome, worlds' richest savanna ecosystem. Recent sugarcane expansion would not put pressure on vulnerable ecosystems as it would expand on degraded pasture land. However the sustainability of ethanol production is questioned as it could indirectly put pressure on natural vegetation by pushing soybean production and cattle ranching into the Amazon. By using the concepts of '*translocal development*' and '*telecoupling*' indirect land use change by sugarcane was analysed. Secondary data on land use and semi-structured interviews with soybean producers from Jataí are used to determine whether sugarcane expansion motivated them to relocate or expand production elsewhere and to identify their relocation and expansion regions. The main motives for soybean producers to relocate and expand production are related to the sugarcane expansion. These are the inflation of the 'lease price' of land and losing or the risk of losing a lease for land. The majority of soybean producers that lost land to sugarcane, relocated and expanded production elsewhere. There appears to be a preference to relocate and expand soybean production within the region. A multi-sited research approach reveals that soybean producers can be considered as agents for '*translocal development*' from the perspective of cattle ranchers, as they recover the fertility of degraded pasture land, inspire cattle ranchers to also start soybean production and import agricultural expertise and even might contribute to an increase of productivity of cattle ranching which would limit pressure on natural vegetation. For follow-up studies on indirect land use change, this research recommends to scale down from the national to the regional level, with specific attention to the Cerrado biome. It is also important to consider the distinct impact of sugarcane expansion on landowners and land tenants. In addition it is recommended to conduct further research on the alleged positive influence of soybean expansion on the productivity of cattle ranching.

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# 1. Introduction

The Millennium Development Report (2015) predicts further warming of planet earth by a continual rise in greenhouse gas emissions. This would have long term and irreversible effects on natural and human systems; for example altering of ecosystems, negative impacts on agriculture and more extreme weather conditions (United Nations [UN], 2015). These greenhouse gas emissions are partly due to use of fossil fuels. However these fuels will peak one day (International Energy Agency [IEA], 2010). To move towards a more sustainable energy system, renewable energy resources will play a vital role; often bioenergy is argued to be one of the solutions (Wicke et al., 2012). The European Union claims a 'triple win' for the use of biofuels, it would: protect the environment (by combating climate change), provide energy security (as an answer to peak oil) and create rural development (by combating poverty and hunger) (McKay et al., 2015).

In this research the focus will be on the biofuel, 'ethanol', made from the crop sugarcane. Sugarcane is mainly produced in the state São Paulo, Southeast of Brazil. The crop already played a major role in Brazil's colonial history. However, after the oil crisis of 1973 governmental support (Pró-Alcool program) stimulated the use of ethanol to become independent from fossil fuels (Goldemberg, 2007). This made sugarcane production expand and gave Brazil a prominent position in the biofuel sector (Schaffel et al., 2010). Currently, Brazil is the second largest producer of ethanol in the world (27% of world total, mainly distilled from sugarcane) after the USA (57% of the world total, mostly from corn) (McKay et al., 2015).

Increased investments in renewable energy are linked to large scale investments in land by foreign investors. In general this phenomenon is conceived as the outcome of global ecological, food and energy crises (Woodhouse, 2012). However Borrás et al. (2012) argues that the current large scale land investments are not just linked to food crisis but rather centered on 'flex crops'. These crops are for example soybean and sugarcane that have flexible markets, can fulfill various demands in the new food-feed-fuel complex and have various actors (native and foreign) linked to the production of the crop (Welch, 2013). In Brazil there is more a regionalization process happening since more Latin American corporations are involved in the large scale land acquisitions (Wilkinson et al., 2012). Unfortunately these investments often increase land concentration, while Brazil is already in second place with regards to highest land concentration of the globe. As a consequence, demand for agrarian reform is high (Hammond, 2009). According to De Schutter (2011), it is important to keep in mind that land has also a cultural and social value and not just a productive value.

The increasing demand for biofuels along with land saturation caused sugarcane production to expand from the state São Paulo towards the north (e.g. to the state Goiás). Subsequently the Federal Government of Brazil stimulates the search for new land for expansion (Canuto, 2009); zoning regulation triggers expansion to occur within the Cerrado biome of Brazil. The Cerrado is the second largest biome of Brazil after the Amazon and is highly valuable for its rich biodiversity and important hydrological system (McKay et al., 2015). In the period 2005 to 2013, Brazil had the largest expansion in hectares of sugarcane cultivation worldwide; in absolute and relative terms (an increase of 69%). These expansion areas have extensive environmental impacts far beyond the cane growing areas (McKay et al., 2015).

Besides environmental impacts there are also socio-economic impacts connected to sugarcane expansion. There is an inflationary pressure going on towards the (lease) price of land, which decreases access to land for farmers and for the government to restore indigenous land or settlements of landless peasants (McKay et al., 2015). Additionally, sugarcane expansion displaces existing livestock and agricultural production (of soybeans), this process is called '*direct land use change*' (dLUC), leading to the conversion of pasture land to arable land. This possibly causes the expansion of livestock and other agricultural production as farmers and ranchers are squeezed out of their former sites. According to Baines (2014), the ethanol boom has been a 'vector of redistribution'. This is called '*indirect land use change*' (iLUC) and can lead to deforestation in places beyond the cane growing areas. ILUC is a change of land use outside the biofuel production area, induced by a change in use or production quantity of that biofuel. This can occur when the agricultural land use before the biofuel crop is displaced to meet demand, or when a change in the price of agricultural products changes and triggers farmers elsewhere to use more or less of their land for production (Verstegen et al., 2015).

Indirect land use change as underlying driver of deforestation got more attention since the fast expansion of export oriented agricultural production (Gollnow & Lakes, 2014). According to Lapola et al. (2010), about 88% of the sugarcane expansion (145,700 km<sup>2</sup>) would take place in previous rangelands. Despite decreasing rangelands in the Cerrado, annual deforestation rates, which are the highest of Brazil, could indicate that iLUC possibly is happening here (Lapola et al., 2010). Oliveira (2013) argues that the deforestation of the Cerrado for the cultivation of crops and pasture has the potential to increase the surface water runoff by up to five times, which contributes to erosion and floods because water is no longer trapped by vegetation or riverbeds (Oliveira, 2013).

This research aims to understand the process of sugarcane expansion in the state Goiás of Brazil, with a special focus on the municipality Jataí. As the largest ethanol company of Brazil, named Raízen,

recently constructed a production unit for ethanol in this municipality. This region belongs to the Cerrado biome and experienced much agricultural development due to governmental incentive programs. First there was an expansion pattern of cattle activities. In general, cattle ranchers are the landowners of the region; when soybean activities started to take place, soybean producers *leased* plots of land from the cattle ranchers. Since 2007 the region experienced a second expansion pattern, that of the sugarcane crop. Much research has been done on the direct environmental and socio-economic effects of sugarcane expansion. This research is a follow up research on a project about the socio-economic impacts of sugarcane expansion in the municipality Jataí. Therefore, this research is focusing on the indirect effects of the sugarcane expansion beyond the sugarcane production area. The aim is to find out to what extent sugarcane production is displacing soybean producers or triggering them to relocate or expand their production of soybeans to other regions. From a translocal development and telecoupling perspective the influence of sugarcane expansion on the relocation or expansion of soybean production in other regions is analyzed. To this end, motives for relocation or expansion of soybean production, decision making processes for agricultural land use, social networks and the information flows between agents (medium sized soybean producers) were taken into account. The target group will be medium sized soybean farmers from Jataí because the previous research showed that they generally got affected by sugarcane production in the sense that they lose agricultural land to sugarcane production.

## **1.1 Summary**

This research aims to analyze the process of sugarcane expansion in the municipality Jataí, located in the micro-region Southwest Goiás, by looking at the type of land-use change that took place in the region and by identifying who is producing sugarcane and why.

It investigates how the sugarcane production is affecting the soybean producers by identifying to what extent the sugarcane production has motivated them to relocate or expand production in another region.

Additionally, the research analyzes the land use change in the region to where soybean producers from Jataí relocated or expanded their production and the contribution of these soybean producers to the local the development of the region.

Finally, it aims to contribute to the understanding of translocal relations that develop between regions where sugarcane production expanded and surrounding regions where it did not expand. The focus is

on the type of interaction and information exchange (regarding agricultural techniques or expansion opportunities) between the soybean producers and local agricultural producers or cattle ranchers of the new region.

## **1.2 Scientific and developmental relevance of the research**

### **1.2.1 Scientific relevance**

Most academic research on the expansion of biofuel production and institutions for land use and regulation focus on the environmental, social and economic outcomes for local communities. In general research observes cases where the investments for biofuels take place; it focusses on the direct effects on a locality and direct land use changes. Recently the effects of these investments beyond the investment locality are getting more attention. Searchinger et al. (2008), was the first to incorporate indirect effects of ethanol production in a research (Andrade de Sá et al., 2012). Although he argues that iLUC is controversial since it makes the biofuel industry responsible for the environmental consequences of decisions over which they have no control (Kim et al., 2009). However, the research of Searchinger et al. (2008) placed the indirect effects of sugarcane expansion for the production of ethanol on the research agenda. In general the actors involved in the production of biofuels, question the basis of iLUC models (Humalisto, 2015). Additionally, the limited amount of research that has been done on the indirect effects of sugarcane expansion is mainly focused on iLUC in the Amazon. Subsequently, it is argued that it is difficult to quantitatively measure and model these indirect impacts because not all indicators that matters are identified. Generally, outcomes of research on iLUC have a high uncertainty level since most land use decisions are the result of the behavior of land owners and land managers that respond to market prices and policy incentives (Verstegen et al., 2015). This leads to the need to understand how land rights and land governance influence land management decisions and the implementation of new land use systems (Verburg et al., 2013). Institutions that define access to natural resources are central to land use and land cover change theories because they structure the complex and dynamic interactions between society and the environment (Jepson et al., 2010).

This research is scientifically relevant because it aims to contribute to the debate on direct versus indirect land use change by focusing on the interconnections between regions that produce sugarcane and regions that do not. Differently that looking at geographic maps on a time scale to determine the land use change, this research took place in the field, analyzed the relocation or expansion patterns of soybean producers that are from the region where recently sugarcane expansion took place and tried to follow soybean producers that relocated or expanded production to the new location. By using the

‘translocal development’ concept the research investigates to what extent soybean producers are motivated by the sugarcane expansion to relocate or expand their production to surrounding regions. Besides this, the concept is used to understand how rural producers from these surrounding regions interact and exchange knowledge (about agricultural techniques and investment opportunities) with the soybean producers from the sugarcane region; interaction might influence rural producers of surrounding regions to also consider soybean production. In this way the concept of ‘translocal development’ could help in the understanding of how a region where sugarcane expansion took place gets more connected with a surrounding region where sugarcane expansion did not took place. Additionally, the research is relevant as it looks into the indirect effects of sugarcane expansion within the Cerrado biome instead of the Amazon biome. Subsequently, human and natural systems are mostly analyzed separately; it is argued that we live in the Anthropocene era, which is an era where the human system has become a significant part of nature (Steffen et al., 2011). This research is relevant for the scientific debate on sustainability since it links the environmental system with the human system by using the relatively new concept of ‘telecoupling’ to understand the connection between environmental conditions and agricultural practices.

### **1.2.2 Developmental relevance**

According to Lambin and Meyfroidt (2011), land systems can be seen as open systems with large flows of goods, people and capital that connect local land use with global factors. Land is a scarce resource on global scale (Lambin & Meyfroidt, 2011). This is why it is important to have a better understanding of these systems and outcomes of certain actions within it. Especially Brazil is fundamental for understanding global processes of land concentration and foreignization because it is becoming the main global axis in the production of major agricultural commodities (such as soybean, sugar and meat); it demonstrates the diversity of interests involved in the current wave of land acquisition; and because corporations that lead this process in Brazil are also investing a lot in the rest of Latin America and Africa (Wilkinson et al., 2012).

This research is relevant from a developmental perspective because it looks into how investments in agricultural land (development) in one area could influence the agricultural land use (development) in another area. The Brazilian and other governments, like the European Union (EU), argue that ethanol could be a great renewable energy resource. According to the EU, production of sugarcane for ethanol does not take place in areas with high carbon stocks (forests or wetlands) or in areas with high biodiversity (forests, wetlands, preserved areas and grasslands); this is one of the sustainability criteria of the EU for ethanol production (Unica & Apex Brasil, 2015). However their criteria do not include

indirect effects of the sugarcane expansion. This research could give insights in how to deal with indirect effects of sugarcane expansion on agricultural land use in a highly valuable biome where many investments take place: the Cerrado.

### **1.3 Research questions**

**To what extent is the sugarcane expansion in the municipality Jataí motivating soybean producers to relocate or expand their production in other regions and hereby causing land use changes?**

1. How did sugarcane production expand in Jataí?
2. Who is producing sugarcane in Jataí?
3. What opinion do soybean producers from Jataí have on the sugarcane expansion?
4. What motivates soybean producers to relocate or expand production outside Jataí?
5. Where do these soybean producers expand or relocate their production?
6. To what extent could these soybean producers be considered as agents of translocal development and land use change in the region of relocation and expansion?



## 1.4 Regional framework

### 1.4.1 The Cerrado biome of Brazil

The research took place in the state Goiás of Brazil. This is located in the Cerrado biome of Brazil (see figure 1.1). The Cerrado biome is second most extensive vegetation formation of South America and is the most biodiverse savanna on the planet (World Wildlife Foundation [WWF], 2012). It holds one third of Brazil's biodiversity and 5% of the world fauna (837 bird species, 161 mammal genders, 140 amphibious species and 120 species of reptiles); it is the world's fourth area regarding bird diversity (Barros et al., 2007). The estimated area is 2,047 million

Figure 1.1 Brazilian biomes



Source: WWF, 2012

km<sup>2</sup> and it is for 50% located between altitudes of 300m and 600m. In the period from October to March (the spring and summer period) is the rainy season with occasionally short dry periods which are harmful for agriculture. From May until September it is the dry period with little to no rainfall. The average annual temperature is around 23° Celsius; although temperatures are stable they can get above the 40° Celsius (Barros et al., 2007). The climatic conditions and types of vegetation make it look like a savanna; with grass, shrubs and relatively short trees with twisted branches and deep roots (see figure 1.2). This deep-rooted vegetation holds much water and gives the biome the nickname of 'the reverse Amazon forest'; it is one of Brazil's most important water sources. Of the Brazilian population 90% consumes electricity generated by waters from the Cerrado. In 2014 a water shortage in São Paulo underlined the importance to focus on the Cerrado as a large water source (Ross, 2015). Literally translated 'Cerrado' means 'closed', however migration, infrastructural projects and the legal deforestation of the biome has made the Cerrado less closed; 40% of the original vegetation has been destroyed for the production of crops and cattle (WWF, 2012). The state Goiás only has only an area of 47% left from the original vegetation (see table 1.1). Soils in the Cerrado biome have a high acidity with pH rates around 4. The 'latosoil' is for 50% present in the biome; the acid levels are between 4.0 and 5.5 which give low fertility. This makes the soil to poor for agricultural activities, unless correction with lime and fertilizer takes place (Barros et al., 2007). The changing landscape of the Cerrado from a 'wasteland' towards Brazil's agricultural heartland is mainly thought to be caused by state development policies and global soybean demand. There is a concern among scientists regarding the

Cerrado as biodiversity ‘*hot spot*’; an eco-region with a rich biodiversity that is under threat from land users (Jepson et al., 2010). In October 2006 only 10% of the biome was protected via indigenous land, national parks and Environmental Protection Areas (areas on public and private land, open to visitors and researchers) (Barros et al., 2007).

Table 1.1 Remnant area of the Cerrado biome per state in 2006

State	Original cover of biome (%)	Remnant area (%)
São Paulo	33	15
Paraná	2	31
Mato Grosso do Sul	61	32
Goiás	97	46
Federal District	100	51
Minas Gerais	57	53
Mato Grosso	40	66
Bahia	27	73
Tocantins	91	82
Maranhão	65	89
Piauí	37	92
<i>Total</i>		<i>61.1</i>

Source: Barros et al., 2007

Figure 1.2 Cerrado vegetation in National Park (Parque das Emas) located in the south-west of the state Goiás



Source: Author, 2016

### 1.4.2 Fieldwork locations Jataí, Caiapônia and Piranhas

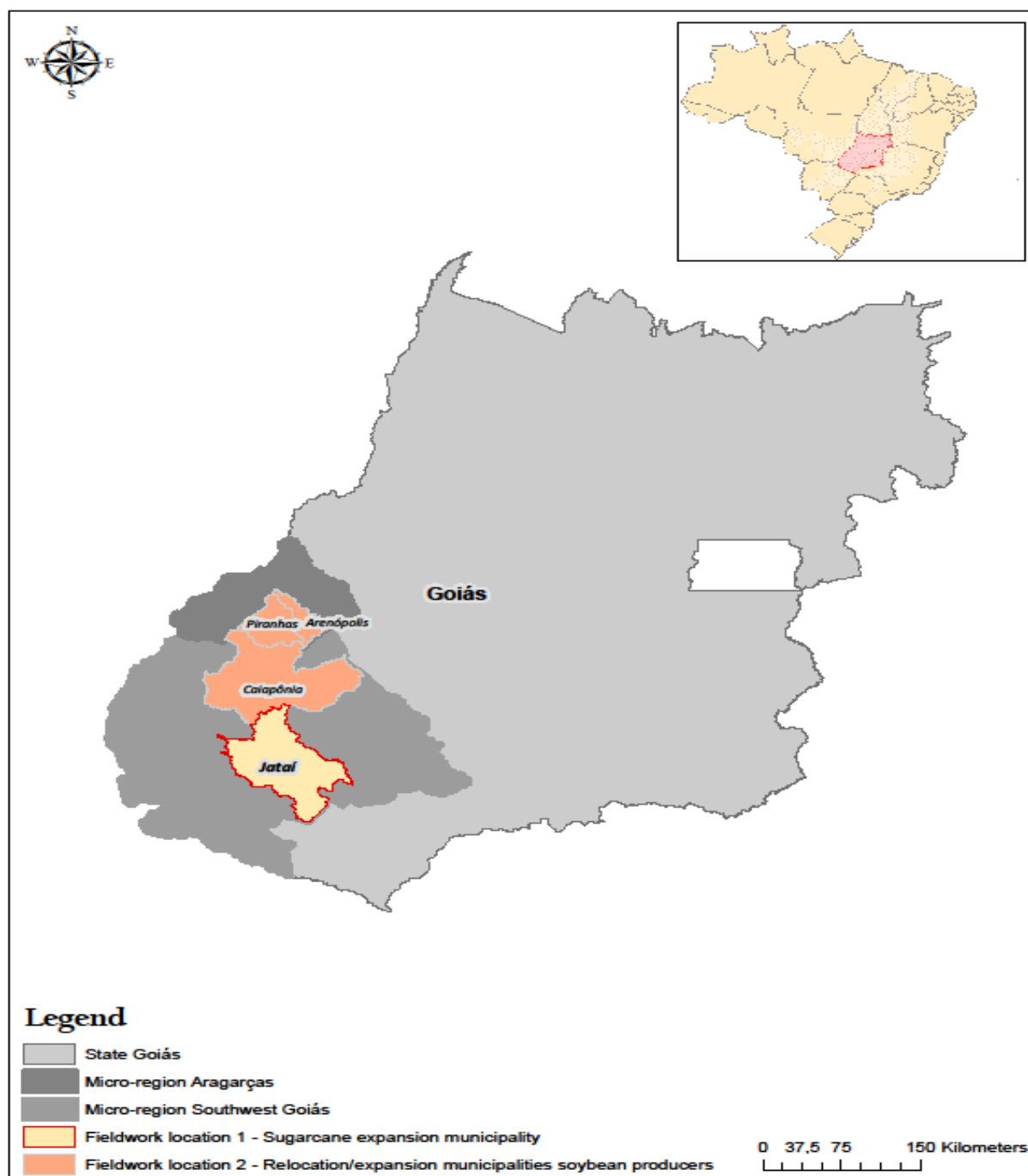
The municipality Jataí is named after a bee specie. It was founded in 1939 and covers an area of 7,174 km<sup>2</sup>. In 2010 the municipality was the home of 88,006 inhabitants (Instituto Brasileiro de Geografia e Estatística [IBGE], n.d.). The current population is estimated to be 95,998 inhabitants (IBGE, 2016). This is an increase of 9% in five years. Jataí is located in the micro-region Southwest Goiás. This region was economically dependent on the production of meat and food for the local population. However this changed when agricultural production modernized; the focus from food production for the local community shifted to the large scale production of grains (soybean and corn) and to agro-processing units for the grain and meat industry. The municipality Jataí is largely dependent on *'agropecuária'* (the meat and agricultural sector). In 2014 Jataí was the municipality with the highest soybean and corn production in the state Goiás (767,280 tons of soybean and 1,476,000 tons of corn); the total amount of grains produced was 2,283,890 tons (Instituto Mauro Borges [IMB], 2015). In 2015 they were the second biggest producer of corn of Brazil (City Hall Jataí, 2015).

From 2008 sugarcane expansion started to take place in the municipality; among the inhabitants there was discussion whether this would harm the local economy and soybean producers. In 2014 the outcome of the previous research on, *'the (direct) socio-economic impact of the sugarcane expansion on the rural population of Jataí'*, was that many soybean producers had to make place for the production of sugarcane (this research is not published as it was part of an internship at UNICAMP). In Jataí it is common that soybean producers (partly) lease the agricultural land from a landowner. These landowners came to Jataí before the soybean producers migrated from the southern part of the country to the municipality for agricultural opportunities. The landowners in Jataí are generally cattle ranchers or retired cattle ranchers that lease their land to other rural producers, mainly soybean producers. Soybean producers lease their land (partly) because in the region the purchase price of land is very high. The introduction of sugarcane production resulted in competition for land between sugarcane and soybean production. Some soybean producers lost their lease contracts of land.

This research is a continuation on the previous research; it investigates the impacts of sugarcane expansion in Jataí on soybean producers and on land use in other regions than Jataí. This research looks into the relocation or expansion regions to where soybean producers from Jataí went (whether or not after losing their land as a result of the sugarcane expansion). Therefore the research approach is multi-sited. Fieldwork was conducted in three municipalities. As figure 1.3 presents the fieldwork started in Jataí to understand perspectives of soybean producers on sugarcane expansion and to get an overview of the new regions for soybean production. As the report later will explain more in-depth, most respondents (soybean producers from Jataí) relocated or expanded production in neighboring

municipalities. Therefore the other two fieldwork municipalities are the municipality *Caiaopônia* and *Piranhas* (see figure 1.3). The main economic activity of these municipalities is cattle ranching; but soybean and corn production are increasing. The map also shows the municipality *Arenópolis*, because respondents explained that soybean producers consider Piranhas and Arenópolis as one municipality. Due to time constraint the municipality Arenópolis has not been visited.

Figure 1.3 Research location



## **2. Theoretical background**

### **2.1 Debate on land use change by biofuels**

Biofuel is popular as an alternative energy resource because it generates energy by the process of photosynthesis. In this process the biomass is created by transforming the energy from the sun. Usually this energy source is renewable as the CO<sub>2</sub> emission is recaptured by the growing crop that will be used for the next production of biofuel. The most promising biofuel is ethanol made from sugarcane because the growing sugarcane absorbs more CO<sub>2</sub> than it emits when burned as fuel (De Oliveira et al., 2005). However biofuel production has a different relation with its surrounding area than fossil fuels; it is based on agricultural products, where the main input is (farm) land (Rathmann et al., 2010). So when land investments are made for the biofuel industry the debate generally centers on the land use change coupled to the investment (Wicke et al., 2012). An important region in this debate is the central-west region of Brazil. This region offers favorable climatic and topographic conditions for sugarcane to expand. However in this region half of Brazil's soybean production takes place which means that land availability for sugarcane is limited. This possibly represents a threat for the environment if soybean production is replaced by sugarcane production because soybean producers could relocate or expand production to the north of the country, the Amazon. Therefore much discussion is still needed in all communities (scientific, political and civic) to determine the cleanness of the fuel (Martinelli & Filoso, 2008). The debate on land use change by biofuel production got more attention after the publication of Searchinger et al. in 2008. He published a research on the consequences for global land-use change of expanding corn-based bioethanol production in the United States (EU), that argued that the expansion of bioethanol would lead to the use of previously uncultivated land for crop production in the US, Brazil, China and India. The use of these lands would subsequently lead to the loss of pristine grasslands and forests; the use of good cropland for biofuel production possibly would exacerbate global warming (Searchinger et al. 2008). Therefore he highlights the value of biofuels produced on unproductive lands and biofuels produced from waste products because this can avoid land use change.

However the Gallagher Review (2008) questions Searchinger's arguments. It is not disputed that biofuel production will have indirect effects on land use change and subsequently on greenhouse gas emissions (GHG). Although they argue that there are many uncertainties in Searchinger's approach. The question is to what extent iLUC can be attributed to biofuels; deforestation might occur through meat production, timber extraction, accessibility, migration etc. (Sylvester-Bradley, 2008). Additionally, Martinelli and Filoso (2008) argue that iLUC from sugarcane expansion in the central-west region of

Brazil is unlikely to happen in the near future because soybean is produced on approximately 10 million hectares in the central-west region, which is 20 times larger than the sugarcane production area. Furthermore, Sylvester-Bradley (2008), believes that independent from biofuel production, the world will face an equal threat to GHG emissions and biodiversity loss because the world needs to increase food and feed production by 2050 to feed the growing world population. Other arguments that question iLUC by biofuel production are: the development of cellulosic ethanol which is produced from waste products and would not require additional land; agricultural improvements result in an increasing yield without increasing in land use; and agricultural developments allow for the use of marginal lands for biofuel crops, which would otherwise remain unproductive (Rathmann et al., 2010).

### **2.1.1 Direct land use change**

The type of activity on land is named 'land use'. The IPCC (2003) categorized six land categories for greenhouse gas (GHG) assessment: forest land, cropland, grassland, wetland, settlements and other land. 'Direct land use change' can be defined as a possible change in the carbon stock of a unit of land when the prior land use (for example forest or a crop) gets displaced by a feedstock for the production of biofuels (for example sugarcane for the production of ethanol) (Gnansounou et al., 2008). This type of land use change can be evaluated with remote sensing images. For example, it was observed that from the year 2000 to 2009 sugarcane expanded 69.7% on pasture land; 25.0% on annual crops; 0.6% on forest; while 3.4% was sugarcane land under crop rotation. As a result dLUC by sugarcane took place on 99% of pasture or agriculture land in Brazil (Adami et al., 2012). The replacement of pasture land for sugarcane production was compensated by increasing cattle productivity (Adami et al., 2012).

### **2.2.2 Indirect land use change**

Land use change happens indirectly when the relocated or displaced activity induces land use changes in other regions. Environmental effects by indirect land use change are called 'leakage' (Gnansounou et al., 2008). Turner et al. (2007) argues that the displacement of current land use for biofuel production possibly generates more intense land use in another location.

iLUC could be categorized by its geographical and temporal scope. Turner et al., 2007 made this categorization of iLUC:

1. *Spatial iLUC: Displacement of prior production to another location.*

This iLUC takes place when the production of crops for biofuels pushes the previous activity to another location. This relocation of the previous activity generates land use change in the new

location. For example, replacing pasture land for the production of a biofuel crop could be an incentive for deforestation elsewhere to replace the displaced pasture land.

2. *Temporal iLUC: Shifting land-use in the same location.*

This category occurs when the land is cleared for another activity but later it is used for the production of a biofuel crop. For example, deforested land is first used as pasture land but can later be used for the production of biofuel crops. According to Gnansounou et al., (2008), assigning the full impact of the deforestation to the first land use (pasture land) is not rational because the area is deforested to eventually produce biofuel crops.

3. *Use iLUC: Shifting biomass use in the same location.*

This is happening when the land use in a location remains the same but the production is used for another purpose and in this way pushing the production for the previous purpose to other land. For example if the production of sugarcane for ethanol replaces the production of sugarcane for sugar, then the previous sugarcane plantations for sugar production could move to another land and in this way causing iLUC.

4. *Displaced activity or use iLUC: Avoiding national land-use change by shifting previous activity to other country.*

This category is about dLUC in one country due to the relocating of a displaced activity from one country to another. The displaced activity could be imported from other countries. For example, Brazil imports more meat from Argentina because the Brazilian cattle production is reducing and this causes an increase in the demand for meat in Argentina which could change the land use here. In addition, when crop rotational land use is replaced by a monoculture than the same could happen. For example, the rotation of soybean and corn production changes to just soybean production, then the corn production could be relocated to another land in another country.

Current attempts to quantify the iLUC are focused on economic modeling on the demand for land by using an equilibrium approach. The modeling is focused on a global scale and the relocation of activities; decrease of supply in one country and an increase in production of the same commodity in another (Gnansounou et al., 2008). From these studies the only confirmed hypothesis is that iLUC takes place. These models focus mainly on the negative impacts like deforestation. However no model has been developed to down-scale indirect effects lower than the national level and neither to predict the spatial relocation or displacement activities. Land use is a dynamic process due to the rotation of crops (Gnansounou et al., 2008, p. 12). Current research focusses on the quantification of iLUC, GHG emissions from iLUC, accounting for these emissions in carbon reporting initiatives. Figure 2.1 shows that land use change studies already are done since the 1980s.

The US and European Union (EU) governments agree that more research should be done on indirect effects of biofuel production. According to Sylvester-Bradley (2008), biofuels are part of a wide policy space that involve governments on various scales and considers many land related issues: energy, diet, development, conservation and amenity. According to Gnansounou et al. (2008), further research on iLUC could be focused on:

- Down scaling global effects to the regional level
- Predict the relocation of displaced activities by using spatial interface
- Studying other iLUC sources (temporal or displaced activities)
- Developing emission factors based on soil type and management practices
- Adjusting economic model to account for iLUC in biofuel production

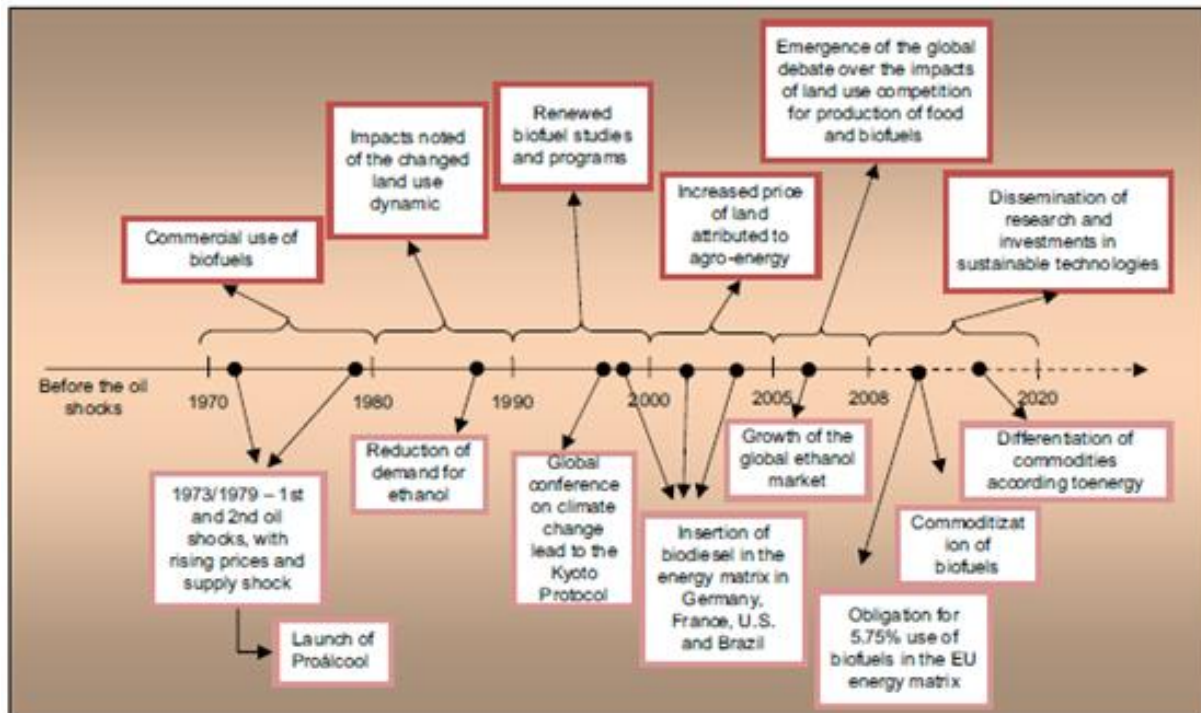
The Netherlands has developed criteria for the production of sustainable biomass (*the NTA8080*) but these criteria do not involve indirect effects on ‘*macro level*’ of the production of biofuels. Indirect effects of biofuel production are acknowledged by the Dutch government but they argue that an individual company cannot prevent or map all possible (negative) indirect effects from their production (Better Biomass, 2016). The Netherlands holds governments responsible for mapping indirect effects; therefore the Dutch government has made a reporting clause for other governments to estimate risks on indirect effects at the Dutch and EU level. The proposed methodology for estimating GHG emissions from iLUC (Gnansounou et al., 2008):

1. Determine the relevant markets/areas delivering biofuels to the country/EU.
2. Determine the expansion of each of these markets due to biofuels, food, feed (total).
3. Determine how the additional demand is being met.
4. Determine the GHG emissions of expansion of these markets.
5. Distribute the impacts of market expansion over biofuels and food/feed.
6. Divide these effects by the amount of biofuels per market.

If results from research on indirect effects of biofuel production can be converted into verifiable sustainability requirements then these requirements will be incorporated in future sustainability criteria.



Figure 2.1 Historical evolution and research on biofuels



Source: Rathmann et al., 2010

## 2.2 Translocal development

Global connections have become more complex and diverse than just local, national and international scales (Zoomers & van Westen, 2011). In this globalizing world places and people become more interconnected on different geographical scales with other places and people; this has its effect on development. Therefore Zoomers and van Westen (2011) argue that local development needs to be redefined. As a starting point they refer to the definition of 'development' from Sen (1999), who argues that *'development is a process of expanding the real freedoms that people enjoy and greater freedom enhanced the ability of people to help themselves and also influence the world'* (Zoomers & van Westen, 2011). According to Zoomers and van Westen (2011), local development is highly valued in development studies, development policies and poverty alleviation strategies. To analyze local development much attention goes to access and distribution of resources. Although an increasing attention is given to the position of people and places in networks, assessment of local development (the extent to which people have improved their situations) is often space-bound. The mobility perspective could be more integrated in development studies; development could be viewed as a sequence of interrelated changes. Through mobility, exchange and information flows, places are interconnected in different ways and this affects their meaning and potential for humans and development (Zoomers and Westen).

These interlinkages and local change are described via the '*development corridors*' concept (Zoomers and Westen). This refers to development facilitated through certain routes as the consequence of repeated mobility of people, goods, capital or information. These corridors can have a physical existence (transportation infrastructure) or can be information flows through the internet or flows of goods and finance between factories and offices integrated in value changes. The characteristic of '*development corridors*' is that they may start as migration corridors but new interaction can materialize these corridors. The type of interactions can broaden or lead to path-dependency when migrants decide to buy a plot of land in the destination location or when migration related industries and services will be established in the destination location. Besides this the migrants or local investors in the destination area could start investing in the origin area of the migrant. Zoomers and van Westen (2011), highlight the importance of local factors in the outcome of a development corridor. A corridor does not necessarily have to bring development (innovations or new opportunities to improve the situation of actors) to everyone. This depends on the perspective; a positive outcome for one locality or group of people might have a negative outcome for other localities or people.

However there has been little attention to this '*travelling of development effects*'; that change in one locality or sector will affect other localities or sectors (Zoomers and Westen). This phenomenon is connected by the concept '*translocal development*'. According to Grillo and Riccio (2004), translocal development is a process of channeling decentralized aid between institutions 'below the level of the state' that are jointly engaged in 'co-development' (Bontenbal & Lindert, 2011). Clarkes (2010) argued that translocal development will create topological proximity between topographically distant locations (Bontenbal & Lindert, 2011). It differs from transnationalism and local development because it highlights the importance of spatial connectedness (Zoomers & van Westen, 2011).

There are several ways for exchange and interaction between places. Important is the peer-to-peer exchange, when participants liaise with counterparts on a colleague-to-colleague basis and exchange information on the subject of interest (Bontenbal & Van Lindert, 2011). This peer-to-peer or colleague-to-colleague interaction is considered to be a vehicle for knowledge and skills transfer because they speak the same technical 'language'. It generally takes place face to face when for example government staff visits other, or can take place at long-distance via email, telephone or social media networks. An important point is that the transfer of knowledge and skills is multidirectional. Besides this individual people can have different degrees of mobility from permanent migration to immobility, depending on gender, household composition and opportunities locally and elsewhere. The moving of people involves strategic decisions (Zoomers & van Westen, 2011). According to Griet Seel, Nanneke Winters and Carlos Sosa (2011), translocal mobility of rural people is in some cases necessary; these

rural people have multi-sited livelihoods as a way to make fully use of their livelihood in different localities (Zoomers & van Westen, 2011); So access to local and non-local networks through mobility is important to give people more opportunities and create local development.

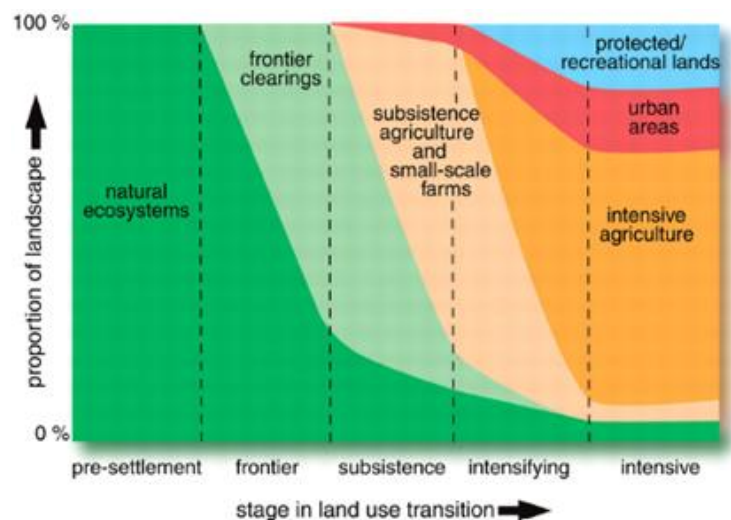
The translocal development concept has been commonly used in research on migration or translocal ethnographies (Bontebal & Van Lindert, 2011); research on how engagement in two or more countries affects identities, political and religious affiliations (Zoomers & van Westen, 2011). However it is barely applied to questions about indirect land use change. Therefore the use of this concept will broaden the research base on translocal processes by providing new insights in translocal actors; the research will argue whether soybean producers and cattle ranchers can be considered as actors for translocal development. In addition, since the concept '*translocal development*' highlights the spatial connectedness of localities it is a relevant concept to apply in exploring to what extent sugarcane expansion in one area indirectly leads to changing agricultural land use in another area by the movement of rural population (soybean producer and cattle ranchers); in other words it is a useful concept when studying the interconnectivity between regions through the movement of their rural population. It fits this research because decisions to relocate or expand rural production and decisions on agricultural land use are not fixed in the sense that farmers can get knowledge about investment opportunities or new agricultural practices via social media or their social network. This social network does not necessarily limit to one specific locality because farmers possibly have colleagues, friends or family that live(s) in another region than they do.

## **2.3 Telecoupling**

The increased global interactions often lead to profound impacts on socioeconomic and environmental sustainability; a poignant example of this is related to biofuels (Liu et al., 2013). Processes at one place may enhance or compromise sustainability in others (Liu et al, 2015.). Changes in consumption patterns or land related policies in one country may trigger changes in land use (LUC) and management elsewhere (Bruckner et al., 2015).

Land-systems are dynamically coupled human and environmental systems (Liu et al., 2007). Two main theoretical conceptual notions of land change are: the transition of land use from pre-settlement *extensive* use to highly industrial *intensive* use of land (see figure 2.2); and the idea of *proximate causes* (direct influences) and *underlying driving forces* (large distant processes at longer time-scale) (Friis & Nielsen, 2014). Arguments against the

Figure 2.2 Land use transition model

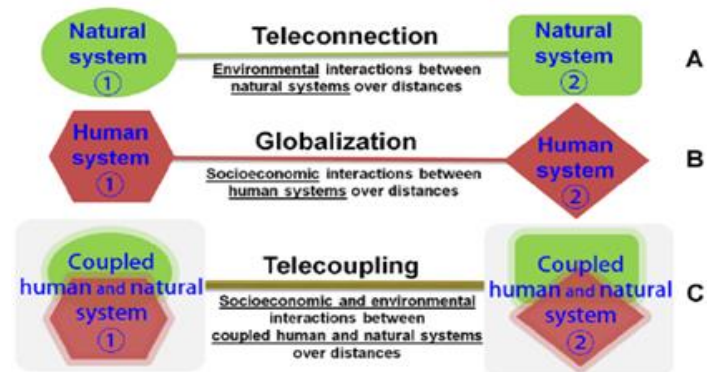


Source: Foley et al., 2005

transition notion are: no notion of cultural or historical differences, a modernist vision and LUC treated as a linear process without feedbacks, loops and thresholds (Friis & Nielsen, 2014). There is effort to integrate more place-based approaches with more process-based understanding of key drivers of LUC including feedbacks, multidirectional and circular flows of influence of distance (Friis & Nielsen, 2014).

Increased awareness of the growing complexity of the drivers for land change has led to the 'telecoupling' concept. It builds upon previous concepts like teleconnection (interaction between natural systems) and globalization (interaction between human systems) (see figure 2.3) (Liu et al., 2013). A telecoupling arises when a cause produces flows between two or more place-based coupled

Figure 2.3 Definitions of teleconnection, globalization and telecoupling



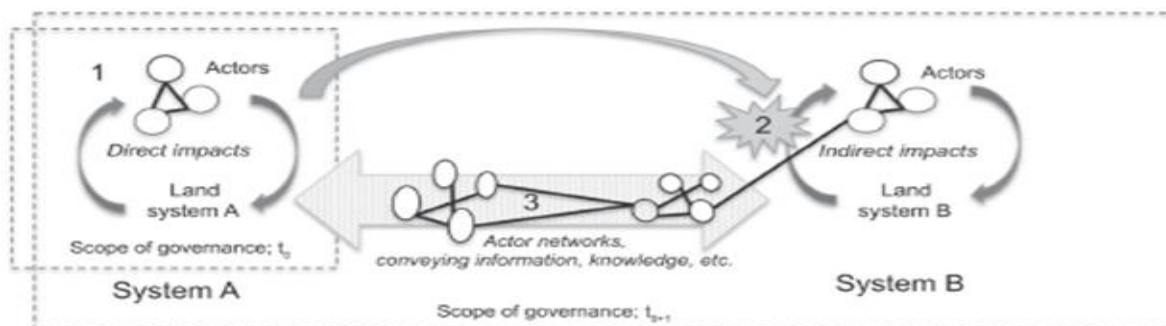
Source: Liu et al., 2013

rather than unidirectional influences (Friis & Nielsen, 2014).

According to Eakin et al. (2014), the outcomes of telecoupled interactions and feedbacks are often indirect because governance of the different land use systems is principally independent of each other. The emphasis of this framework is on *networks, actors and processes of interaction* in the system and

the way they produce linkages and changes in spatially separated localities (Friis & Nielsen, 2014). This framework can also be useful at regional scale (see figure 2.4). Biofuels are a prime topic for systems integration research because production, consumption and their impacts vary across time, space, and organizational level (Liu et al., 2015). Good integrated approaches are agent-based models of LUC; human decision-making is combined with other tools like GIS to capture socio-economic and biophysical processes across a landscape (Liu et al., 2007). The telecoupling perspective is a valuable addition for this research as it takes the complexity of interactions into account that could indirectly lead to land cover change. In addition, the model could help understand the decision making process for choosing a specific region for relocating or expanding soybean production because possibly these decisions are besides social networks related to environmental conditions (like climate and fertility of the land).

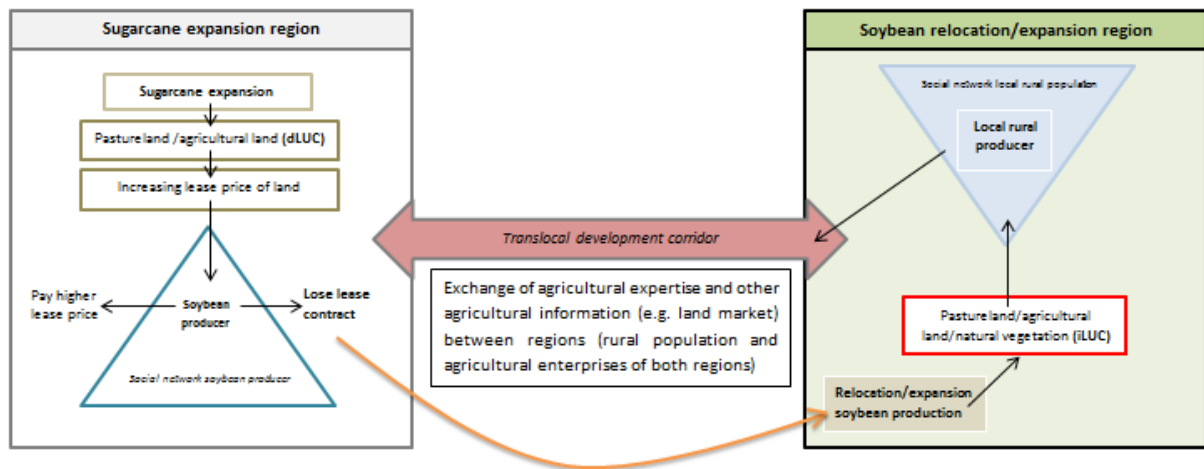
Figure 2.4 The telecoupling framework



Source: Friis and Nielson, 2014

## 2.4 Conceptual model

Figure 2.5 Conceptual model



This Conceptual model is inspired by the *'telecoupling framework'* and *concept of 'translocal development corridor'*. It shows two hypotheses: the first, hypothesis is that when rent or land prices get too high due to sugarcane expansion, soybean producers are triggered to move to a neighboring region with cheaper land. This relocation could lead to land use change in the region of relocation; the second hypothesis is that soybean producers that relocate production stay connected to the region where they lost land through social contacts or because they still have a plot of land in that region. This could lead to a *translocal development corridor* as these soybean producers can bring agricultural expertise to the relocation region and might also in return bring new agricultural expertise which they obtained via interaction with the local rural population from the relocation region. Key concepts are:

### 1. Land use (change)

'Land use' refers to the type of crop that has been planted or other agricultural activity that takes place on a unit of land. In the paragraph on 'the debate of land use change' various types of direct and indirect land use changes are discussed. Although direct land use change by sugarcane expansion is taken into account, the focus of the research is on the indirect land use change. Specifically on the 'spatial indirect land use change'; this is the displacement of a crop to another region. In this research the focus is on the displacement of soybeans to other regions.

### 2. Relocate or expand production

The focus of the research is on soybean producers. The motivation for this is that the economic and agricultural sector of the research region is mainly focused on the grain industry (soybeans and corn). Additionally, sugarcane is produced on land that previously was used for the

production of grains and cattle. Therefore it is feasible that soybean production is replaced by sugarcane production. In the research the terms 'relocation' and 'expansion' are both used, because on the one hand soybean producers could have lost (some) agricultural land to sugarcane production and relocated their soybean production for an equal amount of land elsewhere. On the other hand, soybean producers might expand soybean production for other motives.

3. *Development of the region*

This refers to the benefits that soybean production might bring to local rural producers (cattle ranchers and small-scale farmers) in the relocation region of soybean producers. Development is related to the perspectives of local rural producers from the new destinations on the soybean expansion in their region; is soybean production accepted by or is it beneficial to the local rural population?

4. *Translocal relations*

This refers to the interaction of soybean producers that relocate or expand their production with the local rural population in the new destination. It is about the interaction and information exchange via communication, observation and imitation. These knowledge flows are not unidirectional. For example, soybean producers might learn from the local rural population how to manage the land for soybean production or the local rural population that did not produce soybeans might be inspired to start producing soybeans themselves and learn from the new soybean producers. Translocal relations focus on the information exchange regarding agricultural techniques or expansion opportunities between rural producers from different regions. In this research, soybean producers are considered as agents for translocal development if they stimulate the creation of translocal relations between regions.

### 3. Methodology

Primary and secondary data are complementary used. The primary data, consisting of interviews with rural producers (primarily soybean producers) and governmental officials, is used to explain decisions regarding land use, relocation and expansion of soybean production. Secondary data on land cover is used to indicate patterns of land use and possible changes in land use.

#### 3.1 Primary data collection

In this research two approaches were used:

1. The first approach is a '*multi-sited*' research approach. This means that multiple localities were visited. This approach offers the possibility to explore the driving forces of translocal development and gives a better appreciation of the context of translocal processes (Zoomers & van Westen, 2011). It is argued that this approach holds methodological advantages because it allows the researcher to investigate the processes of translocal development more in-depth. For this research the '*multi-sited*' research approach also offered the opportunity to investigate the process of indirect land use change. Visiting municipalities where soybean producers from Jataí relocate and expand gave the opportunity to gather data on the impact of soybean expansion on the local rural community and how interaction and information exchange takes place between the soybean producers from Jataí and local rural producers from Caiapônia and Piranhas.
2. The second approach is a '*life history*' approach. This involves in-depth interviews about the life of the respondents. This approach was used to get a better understanding on the motives for relocating or expanding production. In addition, it was used to get clarification on the motives for the choice to relocate or expand to the specific location. According to McGowan (1998), an individual is not strictly a rational being but his actions in the present are formed by his past and in this way individuals are oriented towards a future.

To acquire primary data, *qualitative methods* are used. These methods give the opportunity to explain the relationships more extensively (how they developed or changed) than quantitative methods (e.g. survey). Since a life history approach was used, qualitative methods gave the respondents freedom to talk in-depth about their life and important events in their life which determine their present actions and situation. *Semi-structured* interviews were held with rural producers (primarily soybean producers) and governmental officials. The interviews with soybean producers were focused on opinions towards sugarcane expansion and motivations to relocate or expand production elsewhere. In addition, questions were also about the type of interaction they have with rural producers from the



regions of relocation or expansion. To get information about the past of a soybean producer, research questions are also related to past migration patterns (where the respondent and his family originally came from), interests in agriculture (how the respondent got interested in the agricultural sector), and learning of agricultural practices (how did the respondent built his expertise on agriculture). For the complete topic lists see the appendix. These semi-structured interviews are combined with a *short survey* on the characteristics of the soybean producer (age, type of land use, size of the land, relocation or expansion region etc.). This survey was conducted after the interview and used as a tool to check data and already structure some of the data. Notes were made on every interview. Unfortunately it was not possible to record all the interviews because the respondent did not always give permission or the location of the interview was too noisy to make a good recording. In total 16 interviews could be recorded. Furthermore, by using the program Geographical Information Systems (GIS) the data on relocation and expansion regions was transformed into a geographical map; the research location map is also made with GIS.

### 3.1.1 Contacting respondents

To find and contact respondents a *snowball method* was used. Since a previous research has been done in the municipality Jataí, respondents from the previous project were contacted first. Many of them were not willing to cooperate a second time in a research. Nevertheless, two soybean producers and two teachers from the federal university of Goiás UFG in Jataí were willing to participate for a second time. In addition, several agricultural consultancy offices for technical advice were visited to find soybean producers. In general rural producers visit their consultant or agronomic engineer in the morning before going to the farm. Therefore these consultancy offices were visited in the morning to increase the chance of finding soybean producers willing to schedule an interview. Several consultancy offices were visited to get a less biased set of respondents. In addition agricultural stores, the rural union of Jataí, the cooperative for soybean producers (Comigo) and the secretary of agriculture were visited to meet rural producers or get phone numbers of rural producers. Many rural producers were contacted by telephone. Furthermore, a local capoeira (a Brazilian martial art) group and gym were regularly visited to create a social network that might help me to identify potential respondents. The non-response in this research is 62% (see table 3.1). For an overview of the respondents (74 respondents), the type of interviews, location of the interviews and duration of the interviews see the appendix.

Tabel 3.1 Non-response

	Number	Percentage
Respondents	35	38
Non-response	57	62
<i>Total</i>	92	100

### **3.2 Secondary data collection**

For data on land use, statistical data on crop production and harvests, and information on agricultural techniques (e.g. soil correction) various websites from institutions were consulted: the geographical institute of Brazil (IBGE), the annual monitoring of sugarcane production (Cansat), the national supply company (Conab), the Brazilian Institute of Environment and Renewable Natural Resources (Ibama) and the Brazilian Agricultural Research Corporation (Embrapa). Additionally, lectures were followed on UFG (Federal University of Goiás) in the municipality Jataí and the biggest market for agricultural innovation of the region southwest Goiás (TécnoShow) was visited in the municipality Rio Verde (a neighboring municipality of Jataí).

### **3.3 Research schedule**

This research is done in cooperation with the federal university of São Paulo, Unicamp. Therefore the first month was spent in the city Campinas in São Paulo to register at the university. In this first month potential respondents were contacted via email, the first version of topic lists were made and scientific articles were studied related to sugarcane and land use change. The following six months were spent doing fieldwork and analyzing data in the state Goiás. First the municipality Jataí was visited to meet the host family and already contact some respondents from the previous research. Two weeks later, a period of two weeks was spent in the capital city Goiânia to conduct interviews with professors of UFG, social movements and governmental officials on the state the level of Goiás. Hereafter the researcher returned to the municipality of Jataí to find soybean producers that relocated or expanded production in other regions than Jataí. There were difficulties convincing soybean producers to participate in the research because the research took place in the harvest and planting season; many times soybean producers did not have time for an interview. As a consequence most of the research took place in the municipality Jataí. The municipalities Caiapônia and Piranhas were visited after finding out that most of the soybean producers that participated in the research relocated and expanded production in these municipalities. Fieldwork in these municipalities was conducted during one month. After this month approximately eight weeks were spent on further analysis of the data and writing the thesis. See figure 3.1 for the research schedule.

### **3.4 Ethical considerations**

Firstly, respondents were asked if they want to stay anonymous. In general, respondents wanted to stay anonymous. Therefore pseudonyms are used for all respondents. Secondly, respondents were always able to decide where the interview should take place and at what moment. In case respondents

could only be contacted during working hours, they were always given the option to abort the interview at any time. For example, small-scale farmers and salesmen on the market need to be able to address a customer at any moment to sell their products. Additionally, the researcher frequently bought products from these respondents to show gratitude for their cooperation. Thirdly, to be transparent on the objectives and what would be done with the information, respondents were asked if they had any questions about the research.

### **3.5 Limitations of the research**

The research was conducted at the end of the year and during the harvest and planting season of rural producers. This was an inconvenient period to do research in the region because many rural producers were on vacation at the end of the year (the period of Christmas and New Year's Eve) or very busy with harvesting and planting crops. Additionally, agricultural consultancies were reluctant to provide contact information about their clients because these clients were very busy in this period of the year. Therefore it was difficult and time consuming to find sufficient rural producers that were willing to participate in the research. As a result the research took longer than anticipated and needed an extension of eight weeks. Other difficulties and limitations of the research are:

- The initial focus of the research needed to be changed. It was the plan to follow the soybean producers that lost all their land in Jataí to sugarcane production and therefore had to migrate to other regions to produce soybeans. Almost all respondents confirmed that many soybean producers had to migrate out of Jataí because of sugarcane. However it was very difficult to identify these soybean producers because they barely kept contact with soybean producers in Jataí. In some cases they kept contact with a soybean producer from Jataí; but this soybean producer from Jataí did not want to give the contact information of the soybean producer that had to migrate out of Jataí because he was afraid that it would harm their friendship. The researcher was able to get six phone numbers of soybean producers that migrated out of Jataí due to sugarcane but unfortunately it was not possible to contact or meet them. The reason for this is that these producers live on their farm in a remote location where there is no telephone signal or they were travelling. In some cases, they were willing to plan a meeting but did not return calls after this confirmation. It is arguable that it is shameful for these respondents to talk about losing all their land to sugarcane because in general they worked the land for approximately 30 years. As a result the research had to shift focus to the soybean producers that lost land in Jataí to sugarcane but kept living in Jataí while relocating or expanding production of soybeans elsewhere.

- The researcher does not have a driver license or a car (with four wheel drive). The guest family also did not have a car available (with four wheel drive). Therefore it was only possible to visit the rural properties when a farmer invited the researcher. This made it difficult to visit farms and rural producers who live only on their farm and not in the city. This might make the research somewhat biased, since only rural producers that live in the city were interviewed.
- The quantification of the indirect land use change by sugarcane expansion is very complex and difficult. This research does not cover a quantification of indirect land use change.
- Investments in agricultural land and land use are sensitive topics because the land concentration is very high in Brazil and agriculture is often related to the destruction of the natural environment. In some cases soybean producers were suspicious and reluctant to reveal personal information land use to a foreign researcher. This was noticeable when respondents: gave very short answers; expressed that he would not talk about land prices or agricultural practices; asked if the researcher wanted to buy agricultural land; did not have time to answer all the questions; or when the respondent asked the researcher if he was an environmentalist.
- Provided phone numbers of respondents did not always exist or the respondent hung up. It was difficult to win trust and convince respondents to participate in the research.
- Although the researcher had prior experience in conducting research in Brazil and speaks Portuguese on an intermediate level there still was a language barrier. Brazil is a large country with many dialects of Portuguese. The researcher did not understand all technical words. Furthermore, the researcher has a different accent than native Brazilians. Possibly respondents were less willing to participate in the research due to the accent. It might have caused some of the non-responses.

Figure 3.1 Research schedule

Month	Research phase	Activity
<i>AUGUST</i>	Research proposal	Work on the research proposal; wait for approval of the research; read articles; work on topic lists
<i>SEPTEMBER</i>		
<i>OCTOBER</i>	Arrival in Brazil and registrate at Unicamp and the Federal Police	Arrive in Brazil; register at Unicamp and at the Federal Police; present the previous research and the research proposal at Unicamp; contact professors from the Federal University of Goiás (UFG); contact respondents from the previous research; work on topic lists
<i>NOVEMBER</i>	Fieldwork in the municipality Jataí located the state Goiás	Start land use analyzis of Goiás and the municipality Jataí by using secondary data; travel to the field work location Jataí; contact respondents from the previous research; find new respondents via a snowball method; conduct semi-structured interviews with respondents from Jataí (sugarcane producers, soybean producers, agricultural consultancies and governmental officials); semi-structured interviews with respondents from Goiânia (professors UFG, governmental officals and representatives of social movements); transcribe interviews; analyze data by coding; analyze the notes made during the interviews; difficulties in getting interviews with soybean producers due to Christmass, New Years Eve and the harvest and plant season of crops
<i>DECEMBER</i>		
<i>JANUARY</i>		
<i>FEBRUARY</i>		
<i>MARCH</i>	Fieldwork in the municipalities Caiapônia and Piranhas located in the state Goiás	Start land use analyzis of the municipalities Caiapônia and Piranhas by using secondary data; travel to the fieldwork location Caiapônia and Piranhas; conduct semi-structured interviews with respondents (soybean producers, cattle ranchers, agricultural consultancies, governmental officials, representatives of social movements, small-scale rural producers and rural workers on occupation camps); analyze the notes made during the interviews
<i>APRIL</i>	Return to the Netherlands and write thesis	Analyze the data from the research; write thesis; hand in thesis the 5 <sup>th</sup> of June 2016
<i>MAY</i>		
<i>JUNE</i>		

## 4. Sugarcane expansion in Brazil

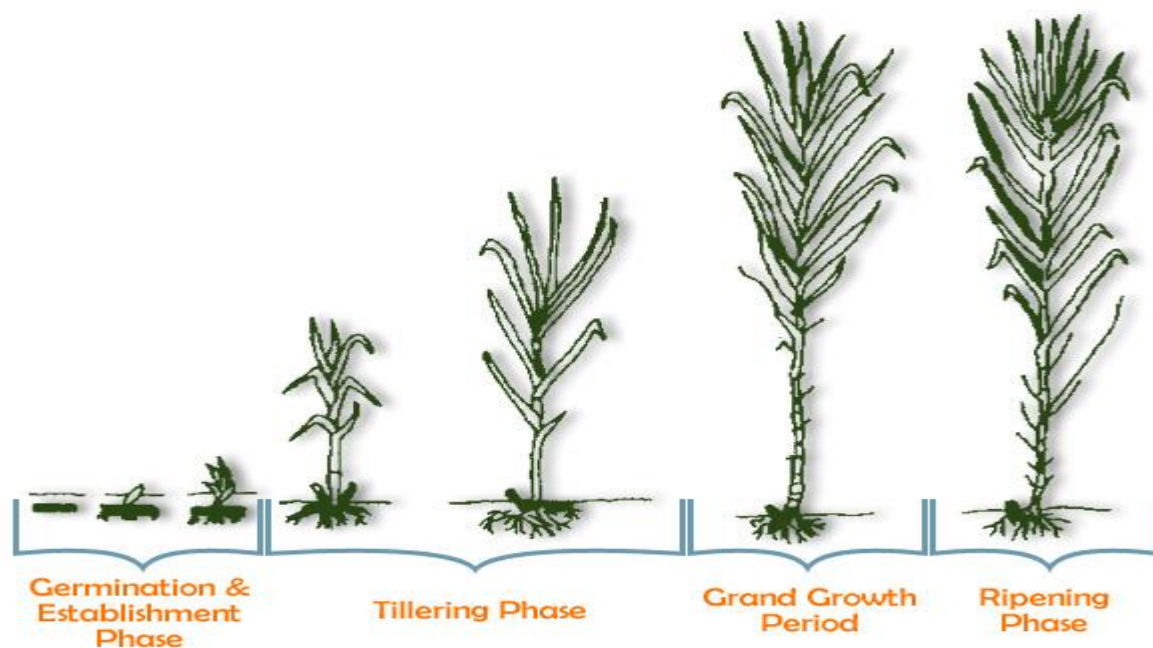
### 4.1 National context of sugarcane production in Brazil

#### 4.1.1 Sugarcane and ethanol

Sugarcane is a grass species that can grow over 2 meters high and get a diameter up to 5 centimeters. The crop grows in tropical semi-perennial conditions. It needs about 1,500 mm of water annually and the perfect temperature is between 22 and 30 degrees. Temperature is the most important factor for the sugarcane production; up to a temperature of 35 degrees the crop can develop well but above 38 degrees the development of the crop will be seriously affected (Franco, 2014).

The lifecycle of sugarcane is quite variable. In Hawaii it varies from nine months to two years, but in Brazil, Cuba, South Africa and Australia the cycle is generally between 15 and 16 months. When sugarcane is planted one time it can provide two to four cutting seasons (equal to two to four years) and in some cases it can provide for eight cuts (equal to 8 years). This is depending on the availability of water, the temperatures and flowering of the crop (Franco, 2014). According to Netafim, (2015), a cycle of sugarcane has four stages: the first stage, germination and establishment phase (lasts 30 to 35 days); the second stage, tillering phase (starts 40 days after planting and can last until day 120); the third stage, the grand growth phase (starts from day 120 and lasts up to day 270); the fourth stage, maturation and ripening phase (starts from day 270 and can last up to day 360) (figure 4.1).

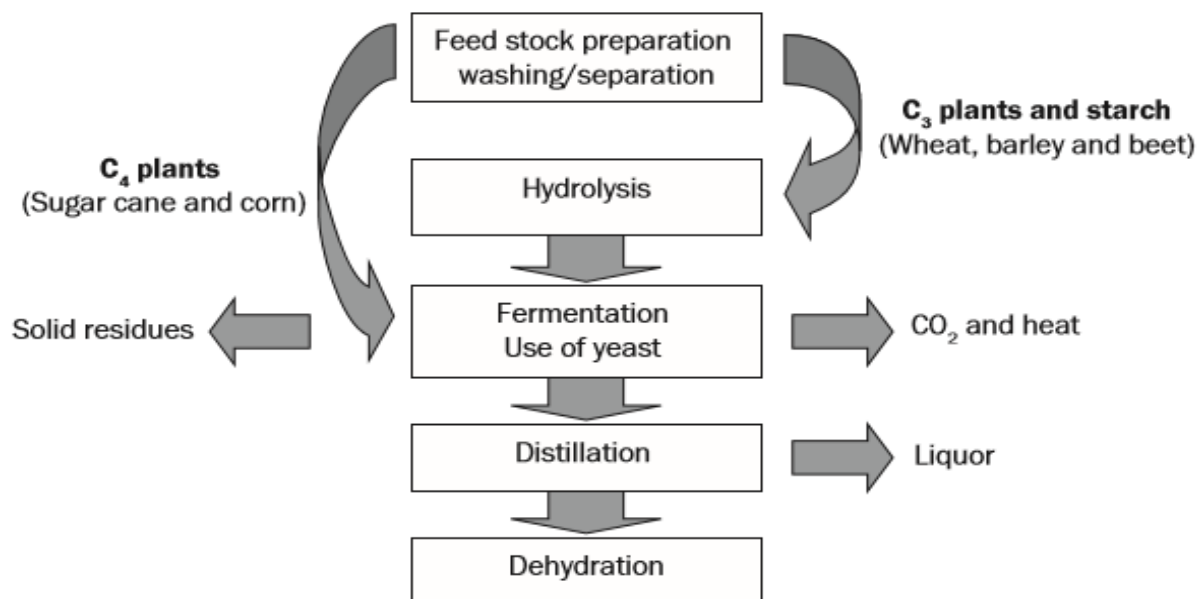
Figure 4.1 Growth phases of sugarcane



Source: Netafim, 2015

The global search for fossil fuel alternatives, led to an increasing support for the production of biofuels. These fuel types are made from raw biomass, named *feedstock*. One of these biofuels is *ethanol*, which can be made from sugar and starch-based crops (sugarcane, maize, wheat, sugar beet, sorghum and cassava) or from wastes, residues and cellulosic material (Zuurbier & van de Vooren, 2008). There are three stages in the production of ethanol: conversion of the feedstock to fermentable sugars, fermentation of sugars to ethanol, and separation and purification of the ethanol (figure 4.2). After the first fermentation process the ethanol still contains much water. Via distillation the ethanol is separated from the water, resulting in 96% pure ethanol. This ethanol type is called hydrous ethanol. To make the ethanol suitable for blending with gasoline the remaining water is removed; this final product is called anhydrous ethanol. Depending on the engine in the car ethanol can be used entirely or mixed with gasoline; the mix can range from 100% ethanol to 5% or lower (Zuurbier & van de Vooren, 2008).

Figure 4.2 The production process of ethanol



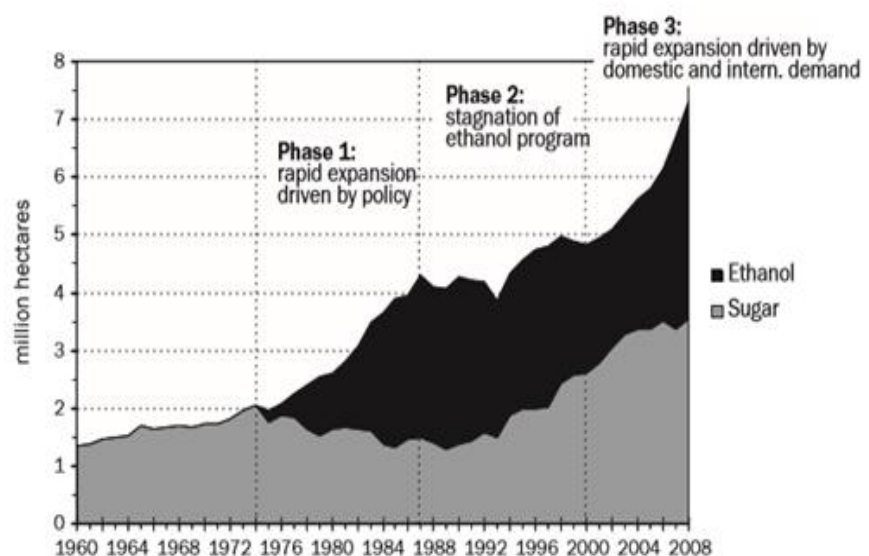
Source: Zuurbier & van de Vooren, 2008

#### 4.1.2 History of sugarcane in Brazil

Sugarcane originates from tropical South- and Southeast Asia. European colonial powers took an interest in the crop and started to produce sugarcane in the Caribbean, South America and the Pacific. Sugarcane production played a major role in the history of Brazil. In 1532, sugarcane was introduced by the Portuguese Matim Afonso de Sousa to provide sugar for the European market (Franco, 2014). However in the past 30 years, Brazilian sugarcane production is mainly driven by domestic policies to support the bioethanol production to increase the energy self-sufficiency of the country and reduce reliance on fossil fuels (Zuurbier & van de Vooren, 2008). In 1975 a national program named Proalcohol (Law no 76.593 of 14-11-1975) was started to foster the production of sugarcane and bioethanol. This program made Brazil the largest sugarcane producer in the world. The expansion of sugarcane in Brazil can be described in three phases (see figure 4.3). The first phase is after the launching of Proalcohol. This phase lasted from 1975 to 1986 and the area used for sugarcane production increased significantly in Brazil. The second phase lasts from 1986 to 2000. This phase had a growth of sugar production but ethanol production stayed equal due to the low price of petroleum. The third phase starts after the year 2000. This phase shows the most rapid expansion of sugarcane especially in the period 2005 to 2008. In this period the international demand for ethanol to substitute fossil fuels and the introduction of the flex fuel vehicles in Brazil (vehicles that can partly run on gasoline and partly on ethanol) were responsible for the Brazilian sugarcane expansion. After the introduction of the flex fuel vehicles in 2003, the expansion mainly took place in the states São Paulo, Minas Gerais and Goiás. From 2003 to 2008, São Paulo had an increase of 1.8 million hectares, minas Gerais had an increase of 479,327 hectares, and Goiás had an increase of 314,874 hectares (Cansat, 2015).

These numbers show that the state São Paulo showed the most expansion of sugarcane in absolute terms. Figure 4.4 illustrates that the Cerrado region is the main region for sugarcane expansion as the Amazon forest is protected by law.

Figure 4.3 Land use for ethanol and sugarcane production

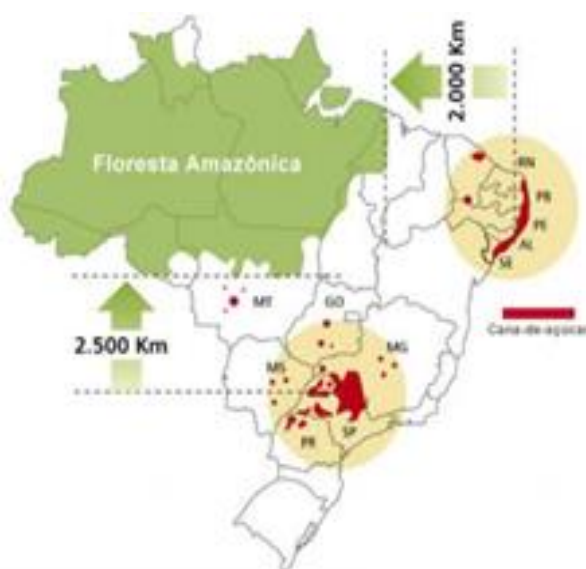


Source: Zuurbier & van de Vooren, 2008



Szmrecsányi et al. (2008), observed that the sugarcane production in Brazil grows horizontally. This means that the increasing production is not due to major improvements in productivity but because more land is used. In the period 2000 to 2008, the area used for sugarcane increased from 4.8 million hectares to 8.1 million hectares in Brazil. This means that 196% more land is used for sugarcane production. In 2015, Brazil has an area of 10.8 million hectares planted with sugarcane (Unica, 2016). Compared to the year 2008 this is an increase of 33%.

Figure 4.4 Area for sugarcane expansion in Brazil



Source: Franco, 2014

### 4.1.3 The Cosan group, Raízen and Radar Propriedades Agrícolas

#### 4.1.3.1 The Cosan Group brief history

The Cosan Group is currently one of the largest economic groups of Brazil with national capital. This group has grown a lot in a relatively short period. Nowadays it is the largest sugar and ethanol group in the world (Bruna, 2014). The trajectory of the group started in 1936 and was founded by an Italian Family, named Ometto. This family immigrated to Brazil in the beginning of the 1900s. Their first sugarcane production unit was named 'Usina Costa Pinto', located in the city Piracicaba in the state São Paulo. According to Guedes (2000), the growth of the Cosan Group is related to the growth of the family. The expansion of territory took place in parallel to the growth of the Family; the purpose was to accumulate capital and preserve Family ties (Bruna, 2014). This capital accumulation made it possible for the family to buy farm land from farmers that went bankrupt due to a frost in 1918. The frost of 1918 in the southern states of Brazil destroyed many crops (like sugarcane and coffee). Although frost damage has a different impact per region due to variables such as altitude, wind velocity and prior rainfall, the consequences for farmers can be great (Margolis, 1979). The frost of 1918 forced a lot of farmers to sell their farm land. An example of a farm that was bought by the Ometto family is farm Aparecida with 114 hectares, located in Iracemápolis about 30km from Piracicaba in the state São Paulo (Bruna, 2014).

Figure 4.5. Organizational structure of the Cosan Group



Source: Easy Brasil, 2014

With the Proálcool program, the strategy focused mainly on the production and export of sugar and on the industrial processes of the agricultural production in 1990. This vision changed in the following years. As one of the Cosan directors says:

*“The vision of the Group is no longer exclusively focused on the agricultural sector; its strength became the industry and marketing”* (Guedes, 2000).

Today many agricultural activities have been outsourced. The Group has several contracts with suppliers of sugarcane to reduce production costs and raise liquidity. In the fiscal year of 2012-2013 50% of the sugarcane used by the Cosan Group came from third parties (Bruna, 2014). This expansion of the Cosan Group is also characterized by the diversification and vertical integration of investments in logistics and infrastructure. From the 1980s the strategy was focused on the acquisition of various plants. Today it has control over 24 production units, most units are located in the state of São Paulo but there is also one unit in Mata Grosso do Sul and one in Goiás. The unit in Goiás established in 2007, is special due to the fact that it is Cosan’s first *green field* production unit (Bruna, 2014). Production units newly built by Cosan are referred to as *green fields*, while existing production units that are acquired are referred to as *brown fields*. The expansion strategy of incorporating new production units led to a higher production of sugar and ethanol; to modernize the production, investments were made in new equipment and technology (Bruna, 2014). All acquisitions were strategic moves; the geographical location of production units, the location relative to customers and logistic opportunities were considered.

In the year 2000, the Group Cosan S.A. was officially established. The name used since then is Cosan S.A. Indústria e Comércio. This name refers to the merger of two plants of the Group, Costa Pinto and

Santa Barbara (Bruna, 2014). By buying the oil and natural gas company Esso Brasileira de Petróleo SA in 2008 and by diversifying its profile, Cosan became the first company in the industry completely vertically incorporated. Then the Cosan Group worked with the distribution and manufacturing of fuels, lubricants and distribution of aviation fuels from Esso in Brazil, including the license to use the Esso and Mobil brands. However, with the incorporation of Shell, the gas stations of Esso were replaced by the Shell brand (Bruna, 2014). By the incorporation of different companies and production units Cosan could create several subsidiaries and form a group. Current members are: Radar Propriedades Agrícolas, Raízen, Rumo Logística, Cosan Lubricants and Specialties and Comgás (Bruna, 2014). See figure 4.5 for the organizational structure.

#### **4.1.3.2 Raízen**

According to Xavier et al. (2013), financial capital is linked to the territorial expansion of agribusiness and causes disputes over the land of indigenous and peasant farmers. The expansion patterns of the sugarcane industry changed due to the financial crisis of 2008. Sugarcane production declined because investments for maintenance of high production stopped (renewal of sugarcane plantations, crop handling and fertilization). Nevertheless, territorial expansion of sugarcane mono-cropping continued (Xavier et al., 2013). This declining production triggered the Brazilian government (the president in this period is Dilma) to stimulate the industry by increasing the mix of ethanol in gasoline from 20% to 25%. This was an attempt to give the domestic demand for ethanol a boost. Governmental support like this is justified by the idea that the biofuel from sugarcane is clean and renewable (Xavier et al., 2013).

To guarantee expansion of sugarcane production, enterprises seek funds from international investors. Enterprises do this by merging with other companies. A good example of this is the merging between the sugarcane ethanol company 'Cosan' and the fossil fuel company 'Shell' in June 2011. Together they made a joint venture (JV) focused on the production of ethanol from sugarcane, named *Raízen*. Both companies had extensive experience in Brazil and were motivated to start this joint venture (Raízen employee Institutional Relations [Raízen IR], interview, 2014). The Royal Dutch Shell is an energy group with their headquarters in the Netherlands and is presence in many other countries, including Brazil. The company was already investing in Brazil since the early nineteenth century and besides their activities of distributing and marketing fuels in the country, they started participating in companies focused on the technology development and research of biofuels (Raízen IR, interview, 2014). For Shell the joint venture would offer them more distribution locations because Cosan would contribute its 24 production units of sugar and ethanol and its fuel distribution locations that used to be under the Esso brand (Raízen IR, interview, 2014). Raízen employee Jataí production unit (2014):

*“Unfortunately for Shell, Cosan bought Esso first. By getting a partnership with Cosan the Esso stations would turn into Shell stations, so Shell would have more distribution points, which leads to more money”* (Raízen employee, interview, 2014. Translated from Portuguese by author).

Additionally, Shell would get easier access to ethanol. Cosan also acquired the company Rumo, which is specialized in railway transportation; this makes Shell’s distribution of oil and gas easier and cheaper. Cosan also aims to turn its ethanol into an international commodity; creating this joint venture increases opportunities to achieve this goal (Raízen IR, interview, 2014).

#### **4.1.3.3 Radar Propriedades Agrícolas**

Raízen aims to increase the production of ethanol. One option in achieving this is to expand its control over agricultural land. The sugarcane ethanol industry expands territorially by making use of the advantages of joint ventures (extra credit and expertise), by constructing and modernizing the processing units, or by obtaining control over land. The latter can be done by purchasing the land or by signing partnerships or leasing contracts (Xavier et al., 2013). The economic crisis of 2008 was characterized by defaults on the real estate loans, which limited the ability of companies to invest and gain credit (Xavier et al., 2013). Many sugarcane plantations went bankrupt due to this global economic crisis. A way to compensate the reduction in investments was through territorial expansion. Gaining control over land by purchasing, leasing or setting up partnerships, became increasingly fundamental for corporations to increase the value of their assets. It is a way for companies to speculate with the perspectives whether or not the value of the land will increase (Xavier et al., 2013). From this perspective, it is no coincidence that in the year of the global economic crisis in 2008, Cosan S.A. created another subsidiary together with TIAA-CREF (a pension fund from the U.S.A.); the name of the subsidiary is Radar Propriedades Agrícolas (Radar). This subsidiary completely focuses on the acquisition of agricultural land. Radar was created to make property deals with land owners and to increase the value of assets of Cosan S.A. However, according to Pitta and Mendonça (2015), the company was created to speculate with agricultural land. Moreover they argue that the company Radar even bought land in the state Maranhão from the biggest land grabber. In this case Radar would be indirectly involved in land grabbing (Pitta & Mendonça, 2015).

#### 4.1.4 Agrarian reform and social movements

Large enterprises like the Cosan Group S.A. and especially their subsidiary Radar are searching for options to control more land to expand their production. Brazil remains a country with one of the world's highest concentration of land (Movimento dos Trabalhadores Rurais [MST], 2015a). Roughly 46% of the land is owned by less than 1% of the population (Friends of the MST, 2014). According to the Pastoral Land Commission (CPT) in Brazil, this concentration of land has been increasing between 2011 and 2014 (MST, 2015b). In the past decade 20 million rural workers moved to the city in search for a better life. There are still 12 million rural workers without land to work on because the land prices are high (Friends of the MST, 2014).

The land problem in Brazil dates back to 1530, when the Portuguese Crown (colonizer of Brazil) distributed large tracts over people that were willing to cultivate the land and give the Crown a sixth of the harvest in return (the grant system). When Brazil became independent in 1822, the situation became worse because the acquisition of land by landowners occurred with great violence (Incra, 2014a). After establishment of the Republic, the political power remained in the hands of the landowners; these were the feared colonels from the slavery period. In the late 50s and early 60s during the industrialization of Brazil, the land issue began to be debated by the society. On November 4<sup>th</sup>, 1966, the first National Plan for Agrarian Reform was established (Incra, 2014a). However, this plan was never finished. Nevertheless, on July 9<sup>th</sup>, 1970, the National Institute for Colonization and Agrarian Reform (Incra) was created. This institute would be responsible for the regularization of agricultural land and check the productivity and work conditions of a property.

The current land reform program achieved that 956,543 families settled on land in 9,128 settlements covering 88,101,001 hectares of land (Incra, 2014b). Unfortunately, the actions of Incra are slow and the expropriation of land takes a long time (Buainain et al., 2008). Incra is aware of this but argues that they do not have sufficient employees and financial capital. Most employees at the headquarters of Incra in the state Goiás are old; this suggests that little new employees are hired (Respondent Incra Goiás, interview, 2015). According to respondents from Incra Goiás (2015), the Brazilian government does not give much value to agrarian reform. They state that many Brazilian politicians are large landowners and they defend the right of the large scale farmers. For example Blairo Maggi (a senator of the state Mato Grosso since 2011) is the biggest soy producer of the world with the Amaggi Group.

Incra acquires rural properties for agrarian reform in two ways: expropriating rural property and by buying the land. According to the Brazilian constitution, a rural property should be used productively and have a social function for the society. Incra can expropriate the rural property if it is not

productively used according to legislation. When Incra acquires a rural property, it is divided into plots and distributed among members of the social movements (the rural workers). These plots form a settlement (*assentamento*) where the rural workers live and produce food for the local community. In this way the rural property gets a social function and ensures a better future for the poor rural workers (MST, 2015a).

There are many social movements in Brazil that strive for social equality. One of the larger social movements that fight against the concentration of land and injustice in rural areas is called the '*Movimento Dos Trabalhadores Sem Terra*' (Movement of Rural Workers Without Land (MST)). The main objectives are: fighting for land, fight for land reform and strive for a more just and fraternal society (Friends of the MST, 2014). By uniting rural workers (poor people) and occupying large rural properties, these social movements try to force the government (Incra) to agrarian reform. The occupation of large scale properties often takes place on a rural property that is (according to the social movement) not productively used. The occupation of rural properties can be compared with the squatting of houses. These rural workers are often very poor and seek means to escape poverty via the occupation of land. These occupation camps (*acampamentos*) are often lacking basic needs like running drinking water or food. Many times the rural workers produce their own food on the occupation camp (see figure 4.6). In the state of Goiás 13,252 rural families are settled in 300 settlements. These settlements cover 706,477 hectares. From these settlements 170 with 8,042 families exist for more than 10 years and 130 settlements with 5,210 families exist for less than 10 years (Incra, 2014c).

Figure 4.6 Occupation camp in the municipality Caiapônia (Goiás)



Source: Author, 2016



## 4.2 Regional context of sugarcane production in the state Goiás

### 4.2.1 Development of the central-west and the state Goiás (Cerrado biome)

To understand the occupation and economic activities of the central-west region of Brazil (the Cerrado biome) it is important to know the historical development of Brazil in the 20<sup>th</sup> century. Brazil wanted to urbanize the central-west by stimulating agrarian activities in this region. In order to achieve this, programs were developed to support the agri-industrial sector. In the 1930s, the former dictator and later president of Brazil, Getúlio Vargas initiated the colonization of the western region of Brazil with several expeditions referred to as '*Marcha para o Oeste*' (March to the West). These expeditions aimed to stimulate the formation of the so called agricultural colonies. The central-west region of Brazil was seen as an 'empty space' that had to be occupied. This would lead to a better distribution of the Brazilian population; it would absorb people from the northeastern and southern regions. In the 1950s migration was stimulated with credit and fiscal incentives for migrants and the agricultural sector. After the transfer of the federal capital from Rio de Janeiro to Brasília in the state Goiás, many infrastructural projects were executed in the Cerrado biome and especially in the state Goiás because the federal capital Brasília is located in this state (Barros et al., 2007). Credits and fiscal incentives together with the infrastructural projects attracted many farmers from the Northeast, South and Southeast; from 1960 to 1970 the population in central-west Brazil grew with 46% while Brazil's total population grew with 26%. This number of migrants was higher than expected and made funds insufficient to construct proper settlements. As settlements grew, conflicts over land property increased. The land occupation and tenure were uncontrolled which led to the invasion of indigenous lands, forest reserves and the competition for land between different groups of migrants; it was a violent and unfair process (Barros et al., 2007).

The state Goiás provides a good example of the conflicts that appeared over land rights between different groups of migrants. In 1950, the construction Belém-Brasília highway attracted migrants from the northeast (the states Piauí and Maranhão) and from the southern state Paraná to Goiás. The northeast migrants were poor itinerant farmers, '*posseiros*' (informal landholders or tenants). They came from rural communities that were characterized by the collective use of land; every three years they changed to another plot of land to recover the fertility of the land; the concept of land as an individual property did not apply to them. In contradiction, migrants from the southern part of Brazil were '*grileiros*' (land grabbers) or large land buyers. They often purchased land without a legal title. This land could have been bought from a *grileiro*. These migrant flows resulted in bloody conflicts between '*grileiros*', '*large landowners*', and '*posseiros*' over land properties (Barros et al., 2007).

#### 4.2.1.1 Cattle production in Goiás

In the 1970s the relatively cheap land in the south of the state Goiás attracted the activity of cattle ranching; private colonization projects of southeastern slaughterhouses took place (Barros et al., 2007). Cattle production was one of the first activities in Goiás and the Cerrado biome. In the 1980s, when the availability of land to expand diminished, cattle ranchers started to consider pasture lands not only as natural vegetation but as a crop that could be cultivated to feed their cattle. This cultivation of pasture consists mainly out of growing African grass types; introduced with slave ships in the 19<sup>th</sup> century. Pasture expanded as the result of developing a new grass type, '*brachiaria*'; this type of grass grows better in acid and less fertile lands than other available grass types. Today pasture lands in Brazil are for 80% to 90% cultivated with *brachiaria*. This was an important development because the feeding of cattle depends a lot on pasture in the Cerrado (Barros et al., 2007). The Social Environmental Institute (ISA) argues that 87.4% of deforestation in Goiás authorized by the state environment agency was for cattle ranching in 2001. In general 'cattle ranching' is viewed as a technique to open up new areas before agricultural activities are deployed. A sustainable strategy of increasing cattle production without occupying additional Cerrado land could be diversification and rotation of crop activities with cattle production; this would limit fertility loss of the soil and consequently increase productivity (cattle) (Barros et al., 2007). Cattle ranching is still an important activity in the state Goiás. In the year 2014 there were 21,538,072 cattle heads in the state. According to Ipeadata (2010), there are 1.5 cattle heads per hectare in the Cerrado biome. This means that 14,358,714 hectares are used for cattle in the state. As the territory of Goiás consists of 34,011,138 hectare (340,111.4 km<sup>2</sup>), 42.2% of its territory is used for cattle.

#### 4.2.1.2 Soybean production in Goiás

Various governmental programs were implemented to support the agricultural sector in the Cerrado biome; for example POLOCENTRO (Cerrado Development Program) or PRODECER (Japanese-Brazilian Program for Agricultural Development of the Cerrado Region). The latter is an agreement between Brazil and Japan International Cooperation Agency (JICA) on soybean production and export. After the embargo of the United States on the export of soybeans to Japan, Japan became interested in importing soybeans from Brazil as animal feed (Barros et al., 2007). The PRODECER program had a major impact on the soybean expansion to in the Cerrado biome of Brazil. Before the program in 1980, soybean and corn production represented 15% respectively 28% of the national production. After the program started, soybean and corn production in the Cerrado represented 52% respectively 31% of the national production. The soybean expansion in the Cerrado can be explained by a mixture of factors: infrastructural improvements, fiscal incentives to prepare land for agriculture, relative low



land prices, credit for machinery, the flat topography of the region makes mechanical planting and harvesting possible and development of new technologies to plant soybeans in the low latitude of the region. Although the Cerrado land has low fertility this was compensated by the fore-mentioned factors together with the managerial and technical capacity of rural producers that migrated from the southern region of Brazil; these migrants are called Gaúchos. The soybean production was first introduced in the southern states of Brazil. Contrary to the large farms in the Cerrado, farms in the south are small to medium in size. Besides being small, the production is diverse and the work is done by families that live on the rural property (Barros et al., 2007). These Gaúchos migrated to Goiás (the Cerrado region) and bought a small plot of land; like the farms from the south. In many cases these migrants were young and did not have sufficient financial capital to buy a large plot of land. Their expansion strategy was to lease the other plots of land from landowners with sufficient land. These landowners are cattle ranchers that were born in Goiás or migrated earlier to the state Goiás. The land was paid in bags of soybean (*sacas de soja*); this is an old system but it is still used to determine the lease price. Nowadays the lease is paid in the monetary value of bags of soybean (Respondents Jataí, interview, 2016).

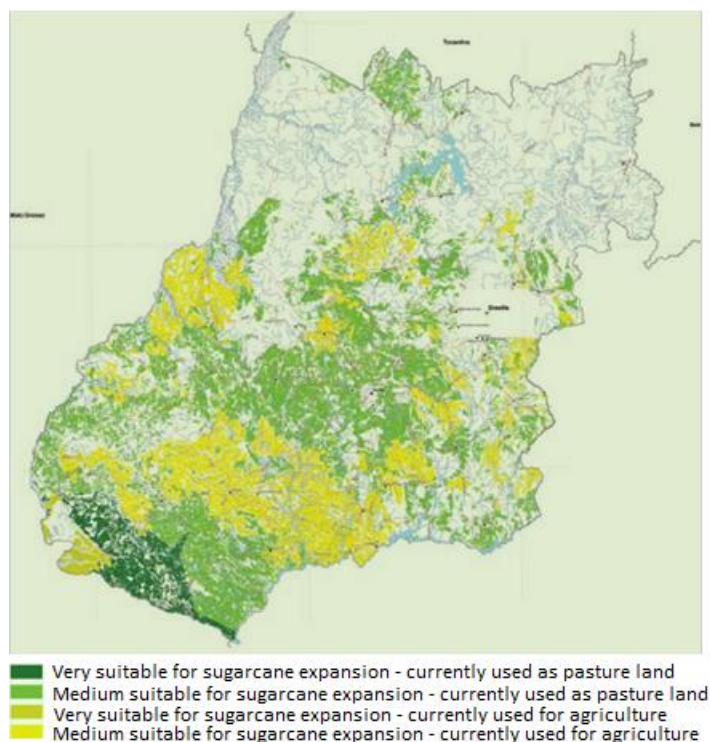
To support the development of Brazil's agricultural sector the institution Embrapa (Empresa Brasileira de Pesquisa Agropecuária) was created to coordinate agricultural research in early 1970. Embrapa did much research on how to improve the agricultural potential of the Cerrado biome. Much research was done on soybean types (cultivars) that could be planted in the acid soils of the Cerrado. Technological improvements are made in the development of new soybean seeds like the 'precocious' soybean type. This type became available in 2003 and is used for early planting in order to be followed by the planting of another crop like corn (Barros et al., 2007). In the municipality Jataí (and more regions in the state Goiás) a strategy is used to plant soybean and corn in the same year (Respondents Jataí, interview, 2016). After harvesting the soybeans around the period of December and January corn is planted as second crop. The planting of corn as a second crop is called 'safrinha' (little harvest). The second harvest is intensifying the land use, which could lead to erosion and make the soil more compact (Barros et al., 2007).

In 2014 soybean is produced on 3,176,995 hectares in the state Goiás; representing 9.3% of the state's total territory. Additionally, corn is produced on 1,404,928 hectares in the state; representing 4.1% of Goiás's territory. This shows that the production of soybean and corn besides cattle ranching play an important role for the economy of Goiás (together these activities use 51.6% of Goiás's territory).

#### 4.2.2 Sugarcane expansion in the state Goiás

The federal government of Brazil has given a lot of support for the expansion of the sugarcane-ethanol industry. However the growing debate on the sustainability of the sugarcane-ethanol industry encouraged the federal government to create zoning legislation for the production of sugarcane in 2009. The zoning legislation (*Sugarcane Agroecological Zoning*) had as slogan ‘to expand production, preserve life and ensure a future’ (Leopold, 2010). The *Sugarcane Agroecological Zoning* aims to protect the natural vegetation from the Amazon, Pantanal and the Upper Paraguay Basin. In addition, it should

Figure 4.7 Land suitable for sugarcane expansion in the state Goiás



Source: Embrapa, 2009

guide sugarcane expansion into degraded pasture lands in order not to compete with other agricultural crops and thus secure food production. Especially areas currently used for cattle would be suitable (Leopold, 2010). According to the zoning legislation, 12,600,530 hectares would be suitable for sugarcane expansion in the state Goiás; this is equal to 37% of the state (see figure 4.7). The Brazilian government targets the Cerrado biome as a priority area for sugarcane expansion. According to Silva (2011), there will be a lot of pressure on the Cerrado biome (see table 4.1).

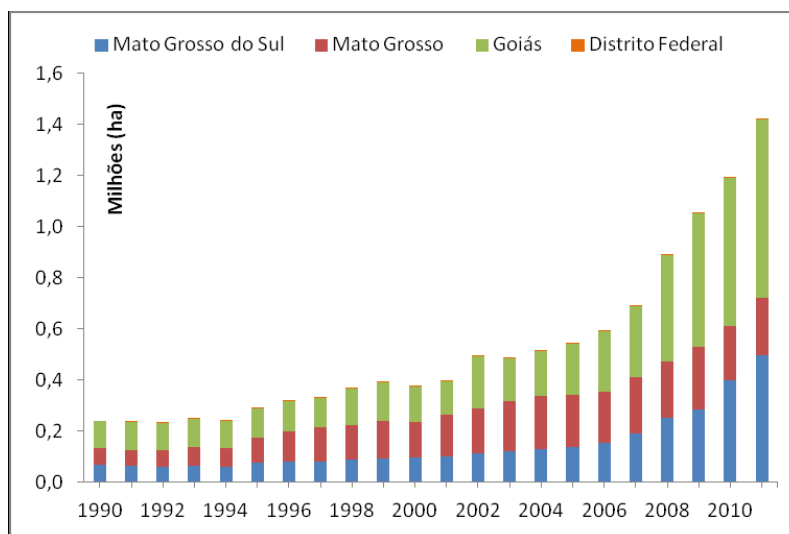
Table 4.1 Sugarcane expansion in the Cerrado region (2007-2035)

Land use (2002)	Land use for sugarcane in 2007 (km <sup>2</sup> )	Land use for sugarcane in 2035 (km <sup>2</sup> )	Sugarcane expansion (%)
Agriculture	22,863	74,077	224
Cerrado	1,044	7,145	584
Pasture	7,223	63,049	773
Reforestation	194	1,304	572
Total	31,324	145,575	365

Source: Silva, 2011

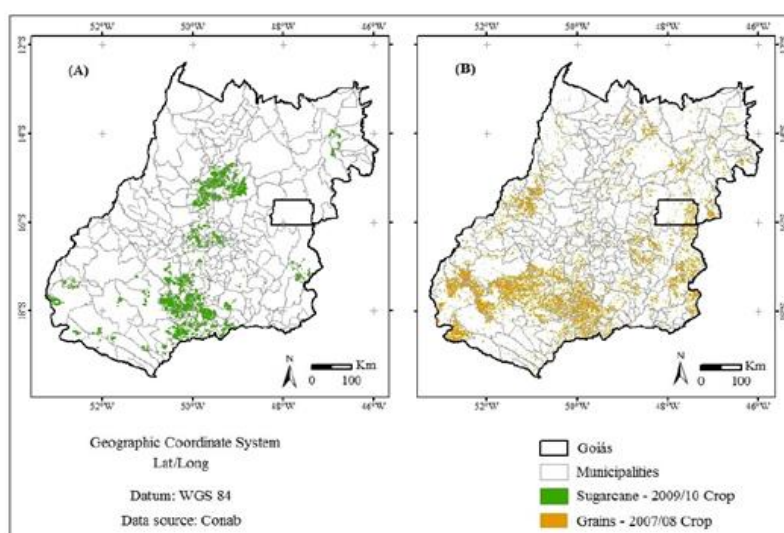
Goiás is one of the states with the highest increase in sugarcane production (see figure 4.8). The total surface area of 340,103 square kilometer makes it the seventh largest state of Brazil. Goiás has the 9<sup>th</sup> largest economy of Brazil, mainly depending on a diverse agricultural production (soybean, cotton, sorghum, corn, beans, tomatoes and recently sugarcane (Petrini & Rocha, 2014). It consists of 246 municipalities of which 122 municipalities became a location for sugarcane expansion from the year 2005 to 2010 (see figure 4.9). From 2007 until 2011, there is a rapid growth in Goiás (419,541 hectares). In Goiás, 70.4% of the total yield of sugarcane was used for ethanol production in 2012 to 2013. The ethanol

Figure 4.8 Increase in sugarcane production per Brazilian state



Source: Moreira, 2013

Figure 4.9 Areas of sugarcane and grain mapped in Goiás by Conab. (A) Sugarcane (2009-2010) – (B) grain (2007-2008)



Source: Petrini & Rocha, 2014

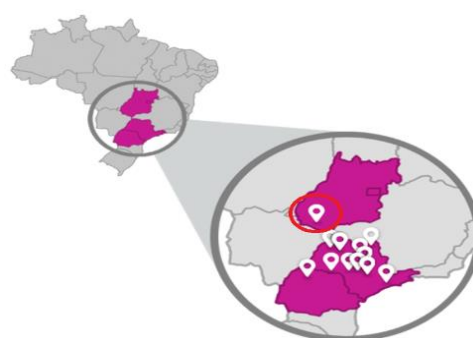
production in Goiás is the second largest in Brazil with 10.6% (Moreira, 2013); within the state 53,136 thousand tons of sugarcane were produced of which 38,646 thousand tons were dedicated to fuel production in the year 2012 to 2013 (Petrini & Rocha, 2014). The state Goiás represents one of the frontiers of sugarcane expansion with an expansion area of 726,000 hectares in 2012 to 2013. This is an increase of 7% relatively to the previous harvest. In total, Goiás harbors 8.5% of the entire area devoted to sugarcane production in Brazil (Petrini & Rocha, 2014). As the economy of Goiás is focused on the production of grains and meat there is the concern that sugarcane production will cause a change in the land use pattern and push the production of grains and cattle to other regions. According to Franco (2014), a higher percentage of the expansion of sugarcane in Goiás occurred on land formerly used for the production of grains in 2008. In 2008, 76% of the sugarcane expansion was on land

formerly used for grain production and 24% occurred on pasture land (Franco, 2014). In total 130,800 hectares were substituted by sugarcane production in 2008. However during the period 2009 to 2010 this substitution pattern slightly changed. The area for sugarcane expansion in Goiás was for 61% in areas previously occupied by pasture, for 36% in areas previously used for soybean cultivation and for 3% in areas formerly used for corn cultivation (Petrini & Rocha, 2014). This led to the competition for land between grain crops and sugarcane and between sugarcane and pasture in Goiás.

#### 4.2.3 Sugarcane expansion in the municipality Jataí

Some historians argue that Jataí begins its history with the formation of a livestock farm Ariranha on December 26, 1857 (IBGE, n.d.). Today Jataí's economy is based on agriculture (grain crops) and cattle. In March 2007, the municipality Jataí was chosen as the location for the new production unit of Cosan S.A. for the production of ethanol. This production unit in Jataí became known as the sugarcane-ethanol unit of Raízen (referred to as *Raízen Unit*) (see figure 4.10). Below is a brief outline of the motivation to construct the sugarcane-ethanol unit in the municipality Jataí of Goiás:

Figure 4.10 Raízen production units (Red circle indicates Jataí)



Source: Raízen, 2014

- From the available land in Brazil, 92.5% was considered to be unfit for sugarcane cultivation. The remaining 7.5% that was considered fit for sugarcane production was for a large part located in the mid-west of Brazil. Within this region 18.9% was fit enough of which 7.8% was located in Goiás. The municipalities with the fittest lands were Rio Verde (601,961ha of suitable areas), Jataí (470,980ha), Mineiros (367,965ha), Serranópolis (330,709ha) and Caiapônia (290,894ha) (Moreira, 2013). Raízen first wanted to build their mill in Rio Verde but the City Hall did not allow Raízen to settle in the municipality because a large poultry enterprise (named Perdigao S.A.) was already located in the municipality. Perdigao S.A. used the grain of Rio Verde as chicken feed. The settlement of Raízen would substitute grain land and cause grain prices to go up (Landowner Pedro, interview, 2014). There were no large enterprises in Jataí so Raízen would have less competition for land.
- The state Goiás has a favorable climate and soil for the production of crops. The average productivity of sugarcane is 71 tons per hectare; this is higher than the average of other states

in the center-south of Brazil, which is *69 tons per hectare*. It shows the competitive conditions from the state Goiás (Franco, 2014).

- The transportation network of the new site was highly valued by Raízen. An infrastructure of roads is important to meet the demands for transporting the sugarcane and employees. The intention of Raízen was to expend its production and still be able to easily transport the ethanol to the consumer market in São Paulo and international markets. The logistic system of the region Jataí was favorable for transport of the ethanol to São Paulo (Moreira, 2013). The railway network of central Brazil would reduce logistic costs. In addition, there are expectations that the Petrobrás ethanol pipeline project will reach the state of Goiás in the near future, which may also reduce the transportation cost for ethanol (Cosan, n.d.).
- Since the 1990s, several Brazilian states provide incentives for industrial companies that invest in the state territories. The expectation is that this will contribute to employment and economic development (Masterclass Brazil, 2014). Raízen received tax incentives from the government of Goiás and from the Federal government (Moreira, 2013). The government of Goiás offered a program to support the industrial development of Goiás, named the FOSTER program (Fun for Participation and Promotion of the Industrialization of Goiás). The program lasted from 1986 to 2000. This program was replaced by the program PRODUZIR (in English it is called PRODUCE). This program encourages the implementation, expansion and revitalization of industries; it also encourages investments, technological renewal and aims to improve the competitiveness of the state Goiás with the emphasis on employment and generation of income and reducing social and regional inequalities (Governo de Goiás, 2015a). To achieve these goals tax exemptions and flexibility in tax payment were provided.

The tax payment is called ICMS (Tax on the Circulation of Products and Services) and is the main state tax. It was introduced for operations involving circulation of goods (including manufacturing, marketing and import) and on interstate and inter-municipal transport and communications services (Masterclass Brazil, 2014). In general the interstate rates vary from 7% to 25%. On average the rate is 18% in the states of Rio de Janeiro, São Paulo, Mato Grosso and Rio Grande do Sul. Whereas for the Distrito Federal and other states (Goiás as well) the rate is 17% (Masterclass Brazil, 2014). The program PRODUZIR ran from the 2000 to November 2007 and supported the establishment of 89 enterprises in Goiás (Governo de Goiás, 2015b).

In 2012 the governor of Goiás and the president of SIFAEG (Union of the Ethanol Manufacturing industry of the State of Goiás) had tried to make Goiás attractive for Raízen to come to the state (Governo de Goiás, 2015b). The contract stated that Raízen would get 1.38 billion in exemptions, which

was about 73% of ICMS. This contract would have a term of 15 years (Moreira, 2013). Together with this tax incentive from the state government, the Federal government provided R\$ 635,719,506 in tax incentives for the construction of the plant (Moreira, 2013). Additionally, the City Hall of Jataí welcomed Raízen to the municipality. They expected the sugarcane industry to generate directly 5,600 jobs and indirectly 10,000 jobs. The trade and service sector of Jataí would benefit from the sugarcane activities, the increased employment and the income tax incentives; it would result in social and economic development (Vice-mayor Jataí, interview, 2014). Jataí's mayor was very pleased with the interest of Raízen:

*"We want new friends but also want to keep the old friends"* (Manager Comigo, interview, 2014. Translated from Portuguese by author).

Figure 4.11 Raízen production unit for ethanol in Jataí (Goiás)



Source: Author, 2014

Referring to Raízen as a new friend and referring to the grain industry as old friends. Raízen started its expansion in Jataí by buying a small piece of land, 190 hectares, from Fazenda Santo Antônio do Rio Doce (Moreira, 2013). In 2010/2011 their unit already reached productivity of 132 ton/per hectare, according to CONAB-GO (The National Supply Company) (Silva, 2011) (see figure 4.11).

In general land used for agriculture has a higher fertility than pasture land, additionally agricultural land often has a better infrastructural system than pasture land. Therefore Raízen prefers to use land



formerly used for agriculture over pasture land. Thus the sugarcane-ethanol industry becomes a competitor of the agricultural industry for fertile land. According to Franco (2014), in 2011, 13,808 hectares of sugarcane was planted on land that used to be agricultural land (65.4%), pasture land (30%) and natural vegetation (4.5%) in 2006 (Franco, 2014). To limit the competition for agricultural land and prevent sugarcane substituting too much land used for grain production, the municipality made zoning legislation for sugarcane on municipal level in 2010. The idea was to divide the agricultural area of the municipality for specific crops, in order to avoid monoculture. As the Vice-mayor of Jataí explained:

*“The zoning law is not only for sugarcane, it is also to prevent soy to be the only crop in the region”*  
(Vice-mayor Jataí, interview, 2014. Translated from Portuguese by author).

The law states that Raízen is allowed to have 50,000 hectares of land in the municipality Jataí. Today the company has 25,000 hectares in Jataí used for sugarcane production. This is 50% of the total sugarcane area of Raízen; surrounding municipalities like Rio Verde and Montividiu plant the other 50%. According to the zoning legislation sugarcane production should not take place on a rural property with a soil that consists of more than 20% clay because this type of land would be appropriate for grain production (Vice-mayor Jataí, interview, 2014). However the law does not function because it is unconstitutional. According to the Brazilian constitution, landowners have the freedom to produce any crop on their land as long as they use their land productively. The fact that 40% of the land that Raízen uses in Jataí is suitable for grain production shows that the legislation is not functioning. Nevertheless, from 2008 to 2014, the area used for soybean production has increased from 198,000 hectares to 278,000 hectares (40%). This is probably at the expense of pasture land, since the number of cattle heads in Jataí decreased from 329,200 cattle heads to 283,600 cattle heads (14%) in the same period. It could be argued that this increased land use for soybean production illustrates that the competition for agricultural land between soybean and sugarcane production does not occur but this is misleading as the next paragraphs will explain.

#### *4.2.3.1 Motivation for planting sugarcane*

To get a better notion of the sugarcane expansion in the region Jataí, semi-structured interviews were held with sugarcane producers from the region; the data is complemented with data from the previous research to substantiate conclusions. Table 4.2 shows that the sugarcane producers from Jataí are landowners and do not use their land solely for the production of sugarcane but keep producing grains (soybean and corn); in this way they diversify their rural production by producing sugarcane. The total amount of agricultural land that the respondents own in Jataí varies from 650 hectares to 8,000

hectares. In addition, the amount of land that they use for sugarcane production has a range of 100 hectares to 2,300 hectares. Furthermore, table 4.2 shows the different relationships that the sugarcane producers have with Raízen. They supply the sugarcane for Raízen by producing the sugarcane themselves and selling it to Raízen (in Portuguese a supplier is called *fornecedor*); they lease their land to Raízen and let the company produce the sugarcane; and one respondent is a partner from Raízen (this means they share the profit of the ethanol sold). These categories are listed in order Raízen's preference. The choice of respondents to lease their land to Raízen or supply the sugarcane to Raízen does not depend on the size of the land they own. This could be related to the quality of land that the respondent has. If the respondent has a good quality of soil the sugarcane will grow more productively, this means the respondent could make more money. Contrary if the land is less fertile than the productivity of the land would be less and possibly as a consequence the profit for selling sugarcane would be less than when leasing the land to Raízen.

Table 4.2 Respondents that produce sugarcane in Jataí

Respondent	Landowner/lessee	Land use	Relation to Raízen	Rural property in Jataí (ha)	Land use for sugarcane (ha)
Gabriel (2014)*	Landowner	Grains and sugarcane	Raízen renting land	1,500	500
Luiz (2014)	Landowner	Grains and sugarcane	Raízen renting land	-	-
Fazenda Rio Paraíso (2014)	Landowner	Grains and sugarcane	Supplying sugarcane	8,000	2,300
Pedro (2014)	Landowner	Grains and sugarcane	Supplying sugarcane	-	2,000
Fazenda Jatoba (2014)	Landowner	Grains and sugarcane	Partner	-	-
Gabriel2 (2015)	Landowner	Grains and sugarcane	Raízen renting land	650	100
Felipe (2015)	Landowner	Grains and sugarcane	Supplying sugarcane	2,500	320
Bruno (2015)	Landowner	Grains and sugarcane	Supplying sugarcane	790	540
Paulo (2015)**	Landowner	Grains (and sugarcane)	(Supplying sugarcane)	2,000	116

*\*Respondents indicated with '2014' were interviewed during the previous research that took place in 2014; respondents indicated with '2015' were interviewed in 2015 during this research*

*\*\*In 2016 Paulo lost the lease contract for 116 hectares of land because he stopped producing sugarcane on it; he stopped because it was not profitable enough for him.*

Unfortunately five respondents were not willing to do an interview about sugarcane expansion in Jataí and their motives for sugarcane production; they were too busy harvesting crops or simply did not want to express their ideas. Three of these respondents lease their land to Raízen, one returned from sugarcane production to soybean production and one sold a small portion of his land for the construction of the Raízen unit. The respondent that returned to soybean production is a well-known rural producer in Jataí. He owns a hotel, has a large rural property in Jataí and other municipalities like Caiapônia. The respondent that sold part of his land for the construction of the Raízen unit also leases a lot of land to Raízen that used to be leased to soybean producers. It would have been interesting to also capture data from them since they have or had a strong connection with Raízen.

Before constructing the sugarcane-ethanol mill the Cosan Group organized a meeting for the local rural producers of the municipality to discuss the proposed construction of a sugarcane mill in Jataí. The meeting was held with the top 10 landowners of the region (Sugarcane producer Gabriel, interview,



2014). At first the majority did not believe in the benefit of sugarcane. After much debate, the rural producers decided to give sugarcane production a chance. The motives for producing sugarcane are grouped into six categories. Figure 4.12 gives an overview of the motives for planting sugarcane. Respondents often gave various motives for starting with the production of sugarcane. Therefore the figure shows by how many respondents a motive is mentioned. The two main motives are the profit from sugarcane and the possibility to diversify their production. Some of the data from this research is combined with data from the previous research; a reference to data from the previous research is the year '2014' because in this year the previous research took place. There are two slightly different outcomes between the previous research and this research. Firstly, in the previous research the category 'diversify' was mentioned more often than the category 'money' as motive for sugarcane production. It is arguable that the category money will always be one of the most important motives to produce a specific crop while the category 'diversify' became less important for rural producers because the international market price for soybean increased in the period between the two researches (a period of two years) and consequently the income and thereby the financial security of soybean producers increased, thus limiting the need for diversification. Secondly, this research revealed two other underlying motives of soybean producers related to their attitude regarding sugarcane production, namely: 'family history' and 'desire to retain the leased agricultural land'.

Figure 4.12 Motives for sugarcane production



*\*A respondent told about a rural producer that switched from sugarcane production to soybean production after the two families got connected via marriage; this rural producer was not available for interview.*

#### 4.2.3.1.1 Category Money

Raízen offers to pay a higher lease for the land per hectare. The landowner will be paid in money but the lease price is expressed in bags of soybean (*sacas de soja*) or tons of sugarcane (*tonalades de cana*); the market price of the crop determines the lease price. If the market value of soybean is low then the lease price will be low. If the market value is high then the lease price will be high. On the 25<sup>th</sup> of May 2016 the average price of a bag of soybean in the state Goiás was R\$71 (Notícias Agrícolas, 2016). Raízen offers 12 to 18 bags of soybean (R\$852 to R\$1,278) per hectare, while the local farmers were used to pay 6 to 7 bags of soybean (R\$426 to R\$497) per hectare. One bag of soybeans weighs 60 kg and the price depends on the market value (Sollus Capital, 2009). The lease price of the land depends on:

- The soil quality. The composition of the soil (sandy or not) determines the productivity of the land;
- The location of the land. When the land is located closer to the Raízen unit the transportation costs for the sugarcane will be lower and consequently the lease price for the land will be higher than land which is more remote from the Raízen unit;
- The topography of the land. Flat land will be more expensive than hilly land because mechanized harvesting is more accessible.

In addition to offering a higher lease price for the land, Raízen gave landowners the option to be paid monthly instead of annually; this gives more financial security and continuity to the landowners. Since 2015, landowners also have the choice to get payment in the monetary value of bags of soybean or the monetary value of tons of sugarcane. This is beneficial because sugarcane is not commodity crop. Generally sugarcane is directly transported from the field to the production unit. It needs to be processed within 24 hours after harvesting to prevent drying out of the crop (deteriorating of the sugar content) (Shell Global, 2014). Therefore it is impossible to speculate with the price of sugarcane. The price of the day is paid for a ton of sugarcane, which is generally around R\$56 to R\$57. Soybean and corn are commodity crops which means price speculation occurs which leads to instability for the income. Furthermore, Raízen wants to lease the land for a period of 12 years instead of 6 to 7 years. According to sugarcane producer Luiz (2014) this would give landowners more financial security.

*“The income I have now is twice the income I used to have”* (Sugarcane producer Luiz, interview, 2014. translated from Portuguese by author).

#### 4.2.3.1.2 Category Diversify

The price of grains was very low in 2007/2008; this gave Cosan a favorable position among the farmers of Jataí and the City Hall. The sugarcane mill could give farmers the opportunity to plant another crop (sugarcane) and diversify their production (Fazenda Bom Jardim, 2014). The word ‘diversification’ was commonly used by the respondents as a motive for sugarcane. As table 4.2 shows, every respondent that plants sugarcane also uses his land for the production of soybean and corn. Sugarcane is a good growing crop and a relatively safe financial option because the sugarcane industry gets a lot of support from the government of Brazil on all levels. In addition, Raízen is the largest sugarcane-ethanol company in Brazil which gives the respondents a feeling of comfort and trust. By planting sugarcane besides the cultivation of grains (soybean and corn), landowners could spread their (financial) risks; when the market value for one crop would be less profitable, financial returns of the other crop could compensate the loss of the other. Sugarcane producer Luiz (2014) used an old Brazilian expression to express his motive for diversifying his land use.

*“You never leave all the eggs under only one hen (old Brazilian expression)”* (Sugarcane producer Luiz, interview, 2014. Translated from Portuguese by author).

#### 4.2.3.1.3 Category Easy crop

The sugarcane crop is an easy and resistant crop because after it has been planted the crop can be harvested for five to seven years without planting it every year.

*“You have six relax years with sugarcane”.* (Sugarcane producer Felipe, interview, 2015. Translated from Portuguese by author).

Additionally, it can grow in lands with relatively little clay and water. This makes it a good option for farmers with some bad lands; lands that consist of more sand (Fazenda Rio Paraíso, interview, 2014). Sugarcane producer Gabriel<sup>2</sup> (2016) mentioned this as main motive to lease 100 hectares of his land for sugarcane production; the soybean crop did not grow well in this part of his land because of the sandy soil composition. Gabriel<sup>2</sup> (2016) did not choose to produce sugarcane himself because his main profession is in the city Jataí; he has to attend clients because he is a doctor and owns a gym. According to sugarcane producer Pedro (2014), the sugarcane crop grows better in the region of Jataí than in more traditional regions for planting sugarcane, the state of São Paulo, because in Jataí soybean producers invested in making the soil less sandy and more fertile.

#### 4.2.3.1.4 Category Reliable Company

Soybean producers did not always pay the lease of the land on time due to fluctuations in the market price (Sugarcane producer Gabriel, interview, 2014). This made it attractive for landowners to start a relationship with Raízen. For example, when sugarcane producer Gabriel (2014) did not get his money on time he had to go to court.

*“I got tired of going to court every time to get my money. Contrary to the grain farmers, Raízen did always pay on time in the seven years that I do business with them”.* (Sugarcane producer Gabriel, interview, 2014. Translated from Portuguese by author).

Suppliers (*fornecedores*) produce sugarcane for Raízen; they receive more money than lessors of land because they have more responsibilities and risks regarding the harvest. Raízen rather pays a little more and have others produce sugarcane for them than pay a little less for leasing the land and have the responsibility of producing the sugarcane. According to respondents from Jataí (2015) Raízen prefers having suppliers of sugarcane over leasing land because Raízen would not have the responsibility of production.

*“These suppliers are treated like kings; they get privileges like better roads or Raízen organizes bbq’s for them”.* (Raízen employee from Jataí, interview, 2014. Translated from Portuguese by author).

According to Sugarcane producer Luiz (2014), the municipality Jataí has a lack of land wear control, regarding the exploration of the agricultural land. Raízen is committed to recompose the land; they manage the land in a good manner. The leasing contract of sugarcane producer Luiz (2014) states the commitment of Raízen to leave the land never with pH rates inferior to the rates at the start of the contract. Raízen sometimes applies soil plaster, limestone or manna on the land, which makes the land more valuable.

*“you got no idea of how much soil plaster they apply, limestone, manna, their work is beautiful, the investment is really beautiful. Landowners became glad in seeing the land they had before change into the property they have right now. We are just farmers; we are unable to do this”.* (Sugarcane producer Luiz, interview, 2014. Translated from Portuguese by author).

#### 4.2.3.1.6 Family (history)

This category is more an unconscious motive for soybean producers to decide planting sugarcane. There are three respondents where the family history could have had an influence in their decision to produce sugarcane. This paragraph will briefly outline these three examples:

The parents of sugarcane producer Felipe (2015) used to work on a sugarcane farm and eventually started to produce sugarcane themselves. According to Felipe (2015) the production of this crop changed the life of his parents positively. The positive experience of his parents might have influenced his decision on planting sugarcane when he had the opportunity. Felipe (2015) also mentioned about a large soybean producer that used to plant sugarcane for Raízen but after his daughter married the son of another soybean producer the land used for sugarcane production changed back into soybean production. This example illustrates which influence a connection between two families can have on decisions related to land use. The last case is about sugarcane producer Bruno (2015), a 27 years old agronomic engineer. His father and mother divorced when he was a young, he did not live with his father in Jataí but with his mother in the municipality Confresa in the state Mato Grosso (approximately 1,000 km from Jataí). After his father passed away in 2013, he had to migrate to Jataí to take care of the agricultural land of his father. His father used to produce soybeans for many years; He was more conservative and linked to the tradition of the region; planting soybeans. Bruno (2015) did not grow up in Jataí and therefore does not have a strong connection with the traditions of the region. Unconsciously this could have influenced his decision to produce sugarcane instead of soybeans like his father did. If Bruno's parents were not divorced or if he grew up with his father in Jataí he could have been more connected to the tradition of the region to plant soybean and have a different attitude towards the production of sugarcane in the region Jataí.

These three examples illustrate the influence of family history on decisions of soybean producers regarding land use: family experience, marriage and family event.

#### 4.2.3.1.7 Keep agricultural land

The final motive that soybean producers use for the production of sugarcane is that they were forced to produce this crop in order to keep their agricultural land. Many soybean producers lease their land from a landowner. As explained earlier, Raízen offered a higher lease price than the soybean producers paid for leasing the land from landowners. This makes soybean producers anxious to lose their land when their contract ends. Sometimes landowners gave soybean producers a condition not to lose their lease contract; they had to start producing sugarcane and sell it to Raízen if they wanted to renew the

lease contract. This would make soybean producers able to gain more money to pay the higher lease price.

*"I only give a new contract to people that are willing to plant sugarcane on the land, because it will bring more money".* (Landowner Pedro, interview, 2014. Translated from Portuguese by author).

Sometimes this turned out alright for the soybean producer and sometimes it did not. For example, soybean producer Felipe (2015) could lose the lease contract of 1,600 hectares of land if he did not start producing sugarcane. According to him this was a good opportunity to make more money because sugarcane could give the double amount of harvest on his land; he could reach a productivity of 120 tons of sugarcane per hectare instead of 60 bags of soybean per hectare. To recover the soil he uses a rotation system of sugarcane and soybean production. After six years of sugarcane he plants soybean for a certain period on the same land. In 2016 only 320 hectares of the 1,600 hectares is used for sugarcane production the other 1,280 hectares returned from sugarcane production to soybean production to recover the soil.

Nevertheless, there are also less fortunate cases. Paulo is a soybean producer that used to lease 116 hectares for soybean production. After the construction of the Raízen unit his landowner also gave him the option to renew his lease contract if he started to plant sugarcane on the land. Paulo leased the land for already 30 years (every six years the contract was renewed) and invested a lot in improvements of the soil fertility, therefore he decided to plant sugarcane in order to keep the land lease contract. For two years he planted sugarcane, from 2013 to 2015. According to soybean producer Paulo (2016) sugarcane did not give him profit.

*"The shit does not give profit. Sugarcane is a bad business".* (Soybean producer Paulo, interview, 2016. Translated from Portuguese by author).

Sugarcane production did not give Paulo profit. In 2013 he had to spend R\$250,000 for starting sugarcane production but the yield of soybean production was only R\$174,000 (R\$1,500 per hectare in 2014). According to him he was almost giving the sugarcane for free to Raízen.

*"We do not plant crops but money. If we do not have profit we plant nothing and gain nothing".* (Soybean producer Paulo, interview, 2015. Translated from Portuguese by author).

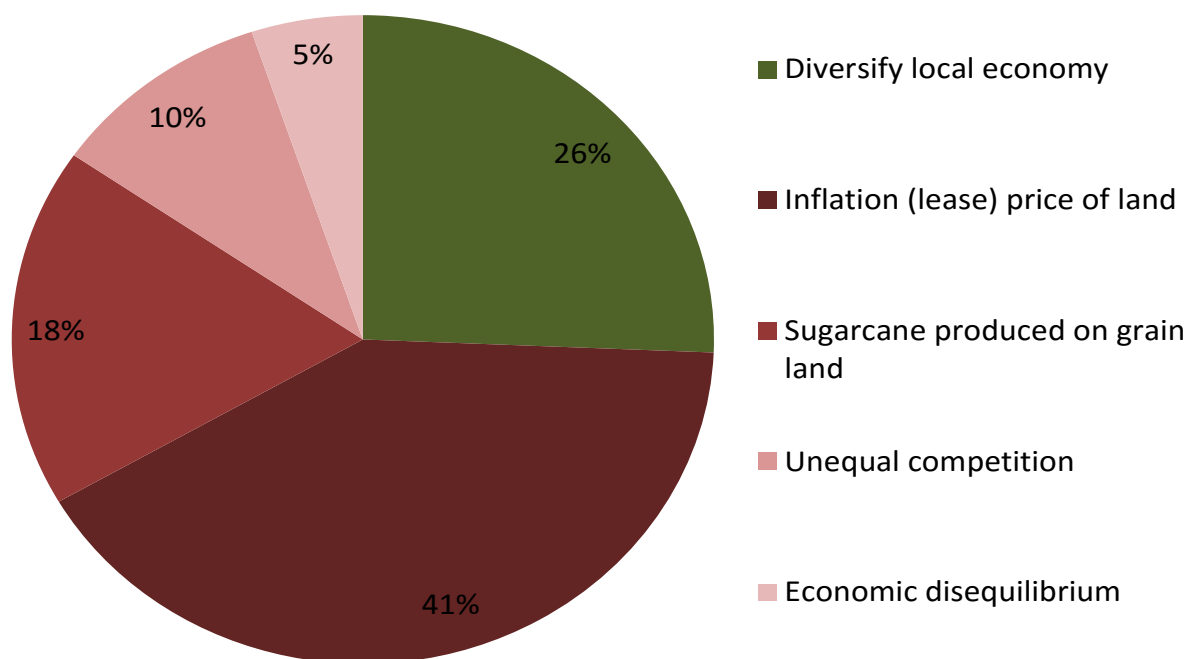
This unfavorable financial outcome made him decide to stop planting sugarcane and lose the lease contract for the land. Raízen took over the lease contract and the 116 hectares of land are still used for sugarcane production. This latter case describes the biggest issue for soybean producers of Jataí. The next section elaborates on the impact of sugarcane expansion on the soybean producers and their way of dealing with the increasing competition for agricultural land.

## **5. Impact of sugarcane expansion on soybean producers**

### **5.1 Opinion of soybean producers on sugarcane expansion**

Among the soybean producers there exist various thoughts on the sugarcane expansion in Jataí; not everyone thinks it is beneficial for the region. The respondents mentioned positive and negative aspects of sugarcane production; of which 50% mentioned both. On the one hand, these 10 respondents did not necessarily have something against the sugarcane production as long as it does not expand more but on the other hand they also did not fully support it. Out of these 10 respondents, 3 (30%) were enthusiastic about sugarcane production. This can be explained by the fact that two of them, Bruno and Felipe, produce sugarcane and one of them, Arthur, is a city councilor with a political role and duty to represent all rural producers of Jataí. Additionally, from these 10 respondents there are 2 who lost land for the production of sugarcane, Soybean producers Arthur and João. Possibly they did not express to be against sugarcane production because they are well known in Jataí as a city councilor or agronomic engineer; expressing negative thoughts on sugarcane production could possibly harm their social relationship with landowners who lease land to them and to Raízen. The other 10 respondents are against the sugarcane expansion. Out of these 10 respondents, 6 lost land to the production of sugarcane, 3 of them are afraid to lose their land to sugarcane production and 1, Gabriel, is against sugarcane production in the region but at the same time leases 100 hectares of his land to Raízen, to be used for the production of sugarcane. Arguments of both groups, in favor or against sugarcane production, are presented in figure 5.1. Often respondents gave multiple arguments to support their opinion. Therefore the figure shows the number of times an argument was mentioned in percentage of all arguments mentioned; the color green is linked to an argument in favor of sugarcane production and red is linked to an argument against sugarcane production. The figure shows that only one argument is used in favor of sugarcane production and the rest are arguments against sugarcane production in Jataí. From the arguments in favor 'diversification of the local economy' is mainly used by respondents; from arguments against sugarcane production the 'inflation of the (lease) price for land' is mentioned the most. Below these arguments will be explained more in depth.

Figure 5.1 Opinion soybean producers on sugarcane expansion in the municipality Jataí (Goiás)



### 5.1.1 Diversification of the local economy

This argument is used by 50% of the respondents (10 out of 20) to support the statement that sugarcane production is good for local rural producers from Jataí. Sugarcane would be an opportunity for local rural producers to diversify their financial income and hereby also diversify the local economy. These respondents argued that there is sufficient space in Jataí for the production of all crops (soybean and sugarcane). However they all agreed that sugarcane production should not become dominant; more sugarcane expansion is not desirable. Of these respondents 20% (2 out of 10) explicitly mentioned that sugarcane is good for the region because it is produced on 'pasture land'; sugarcane would use degraded and underutilized land for production. Rural producers from Jataí would accept sugarcane production because the expansion currently slowed down (Soybean producers Vinicius and Guilherme, interview, 2016).

### 5.1.2 Inflation of the (lease) price of land

Of the respondents 80% (16 out of 20) explicitly said that leasing land became more expensive because of sugarcane production. Raízen offers more for leasing the land than the soybean producers. The company aims to lease land with a flat surface in order to mechanically harvest the sugarcane, a fertile soil composition (more clay than sand), and they prefer to lease land closer to their sugarcane-ethanol unit because that would decrease transportation costs of the sugarcane. Raízen pays more for the land as the land complies with more of these characteristics (Respondent, 2016). For many soybean



producers this is not beneficial as many soybean producers lease land from landowners (cattle ranchers originally from the state Goiás). From these 16 respondents 2 (12.5%) expressed that large landowners, especially those that have sandy land near the sugarcane-ethanol unit, will benefit the most from the sugarcane expansion. As they have the possibility to diversify their land use with grain and sugarcane crops and can make good use of their unfertile sandy land.

### **5.1.3 Sugarcane produced on grain land**

This category refers to sugarcane expansion taking place on land formerly used for grain production (soybean and corn). This land is generally more fertile than land used for cattle ranching (pasture land) as a result of investments in soil improvement from soybean producers; they generally have been leasing the land for over 30 years and all these years invested in improving the soil quality (Respondents Jataí, interviews, 2016). Of the respondents 35% (7 out of 20) said that sugarcane production takes place on land that was used for soybean and corn production before the sugarcane was introduced. This is perceived as negative because soybean producers lost their lease contracts for land and with further expansion more soybean producers will lose their lease contracts.

*“They came to a grain region where they should not have come. They remove the rural producers from the region and use the area of grain production”. (Soybean producer Ercílio, interview, 2016. Translated from Portuguese by author).*

### **5.1.4 Unequal competition**

Of the respondents 20% (4 out of 20) mentioned ‘unequal competition’. It refers to the large financial capital that Raízen holds. Soybean producers argue that it is easy for Raízen to acquire agricultural land with this capital. Additionally, this category is about being dependent on one company. These respondents perceive Raízen as bad for the region. Various soybean producers did not want to produce sugarcane because this would make them dependent on Raízen as it is the only sugarcane-ethanol company in the region to sell sugarcane to (soybean producers Vinicius, Guilherme and Bento, interviews, 2016). It is not an option to sell the sugarcane to another company in another region because sugarcane has to be processed within 24 hours after harvesting; this would make transportation very expensive. Therefore Raízen has a monopoly in Jataí to determine the price for sugarcane. Contrary to sugarcane, soybean and corn offers rural producers more freedom and flexibility because grain companies are competing with each other in the region. This gives grain producers the position to sell the crop to the company that offers the best price. Some of these soybean producers have storage rooms (in Portuguese *armazen*) on their land to store the harvest and

wait for the best moment to sell (see figure 5.2). Fazenda Bom Jardim (2014) gets paid by neighboring soybean producers for storing their harvest in this warehouse. This farm does not intend to produce sugarcane because they would have to change the whole structure of the farm, which means the warehouse would not be used. In addition, the soil of their land has a low fraction of sand which makes their soil good for the production of soy and corn. If substantial parts of their land were sandier they would have considered planting sugarcane.

Figure 5.2 Warehouse to store and speculate with the grain harvest (Fazenda Bom Jardim in Jataí)



Source: Author, 2014

Furthermore, soybean producers also mentioned that they do not want to be dependent on one crop for a long period; this would also create financial risks for them and for the local economy of Jataí. Soybean producers from Jataí plant corn as a second harvest after the first harvest of soybean. They do this to maintain the soil quality and to spread financial risks. Soybean uses different nutrients from the soil than corn. For the production of corn the soil must contain sufficient nitrogen (N) and phosphorus (P) (Virginia State University, 2009). Soybean has a higher demand for nitrogen during seed formation and also potassium (K) is an essential nutrient (Iowa State University, 2007). By planting two crops annually rural producers spread their risks over two crops; when the harvest of one crop is bad, the financial return of the other might compensate this loss. Sugarcane has to be on the land for 6 years; if the sugarcane industry gets in a depression the farmers would not have another crop to compensate their financial loss.

### 5.1.5 Economic Disequilibrium

Of the respondents 10% (2 out of 20) mentioned ‘economic disequilibrium’ to support their opinion. Sugarcane would create disequilibrium of the local economy because Raízen does not buy its supplies and mechanical parts in the municipality but has direct contacts with companies from the state São Paulo (soybean producer Francisco, interview, 2016). As a result more land will be used for sugarcane production than for the production of grains or cattle, which could lead to less selling of products related to the grain and cattle industry. This would have negative effects for the local agricultural companies that sell products related to the grain and meat industry in Jataí. As the majority of the companies in Jataí are related to these industries it could be bad for the local economy. For example, grain producers sometimes hire third parties to harvest; the people that are harvesting already get fewer assignments (person harvesting grain, 2014). According to soybean and sugarcane producer Gabriel (2016), the sugarcane industry will lead to less employment because sugarcane is transported in bigger trucks than soybean therefore less truck drivers will be needed. In addition, sugarcane is planted one time in six years and has only one harvest a year; while grain production has two harvests a year (soybean and corn). The cooperative of grain producers from the micro region south-west Goiás, named Comigo, is also worried that Jataí’s local economy gets destabilized if sugarcane expands more. By 2050 the state of Goiás plans to have 40 sugarcane-ethanol units operating. This concerns the grain industry. The manager of Comigo has nothing against diversification but substitution of grain crops should not take place. In neighboring municipalities, Santa Helena de Goiás, Acreúna, Indiará, Maurilândia, sugarcane took over the municipality for 80%. These cities died due to the monoculture of sugarcane; employment and income generation are compromised because less agricultural inputs were locally acquired (Manager Comigo, interview, 2014). Table 5.1 shows that Jataí has a significantly higher gross domestic product per capita than the formally mentioned municipalities.

Table 5.1 Gross Domestic Product per Capita in 2013

Municipality	GDP per capita (R\$)
Jataí	34,880
Indiará	30,994
Santa Helena de Goiás	23,152
Acreúna	22,39
Maurilândia	13,404

Source IBGE, 2013

In summary it could be argued that there are two groups of soybean producers in Jataí on which sugarcane expansion has a different impact. The first group believes that there is enough space in Jataí for the production of sugarcane and soybean. According to them sugarcane production diversifies the local economy as long as sugarcane production does not expand more and take place in pasture land, otherwise it could cause an disequilibrium of the local economy, which is mainly focused on the grain industry. This group mainly exists of soybean producers that did not lose leased land to the production of sugarcane because they own most of their land and therefore are not worried to lose land to

sugarcane. The second group is against the production of sugarcane in Jataí. For a substantial part the sugarcane production is situated on land that formerly was used for the production of soybean and corn; soybean producers would lose land because of sugarcane expansion. In general, soybean producers that belong to this group lost the land that they used to lease or they lease most of their land and are afraid to lose their lease contract. Additionally, due to sugarcane production the lease for land increases, which makes it more difficult for soybean producers to acquire sufficient land to make a living. Overall it can be stated that the opinion of a soybean producer regarding sugarcane expansion in Jataí mainly depends on two things: does he mainly lease land or is he mainly landowner and did he lose land to sugarcane production.

## **5.2 Relocating or expanding soybean production in other regions**

### **5.2.1 Profile soybean producers that lost land**

This paragraph is about the respondents (soybean producers) that lost agricultural land because of sugarcane production. All the 20 respondents were male and their mean age was 50 years. For two respondents this data was missing, they are not included in this calculation. There are 15 respondents that migrated from another region to Jataí; on average they live 28 years in Jataí. For three respondents this data was missing, they are not included in this calculation. These 15 respondents mainly came from the southern state Rio Grande do Sul (60%). The other respondents came from the states: Paraná (13.33%), Rio de Janeiro (6.66%), São Paulo (6.66%), Mato Grosso (6.66%) and Goiás (6.66%). The other 4 respondents are originally from the municipality Jataí. For 1 respondent the data was missing. These respondents from Jataí did not lose land for sugarcane production and also do not produce sugarcane but soybean and corn (see table 5.2). Possibly they are more connected to the tradition of the region to produce soybean.

From the 20 respondents 8 (40%) partly lost their land in Jataí because the landowner did not want to extend the lease contract; Raízen offered more money for leasing the land, which caused an increase of the lease price for (agricultural) land. In 2008, when Raízen was acquiring land in Jataí, the soybean producers were unable to compete with Raízen regarding the lease price of land. This was caused by a relatively low market price of soybeans. Most soybean producers are not able to produce sugarcane because the investments to make the land suitable for this crop and the procurement of necessary equipment for sugarcane is very high; machines used for sugarcane production are expensive (approximately R\$1,000,000) and differ from the machines used for the production of grain crops because cane must be planted into the ground, unlike grain seeds (Visit Raízen unit in Jataí, 2014). In general soybean producers from Jataí partly lease and partly own their (agricultural) land. This is

reflected by the fact that when they lost land to sugarcane production in the municipality Jataí they did not lose all of their land (table 5.2). From the 8 respondents that lost land to sugarcane production 2 (25%) had another plot of land that they completely leased; 3 respondents (37.5%) own another plot of land (only 1 of these 3 respondents owns less hectares of land than he lost to sugarcane); 2 respondents (25%) partly lease and partly own another plot of land (these respondents own about 50% of their land); and for 1 respondent (12.5%) this data was missing because the interview was taken via the telephone and there was not enough time available to do a full review.

Table 5.2 Profile soybean producers who lost land to sugarcane and who relocated or expanded production outside Jataí

Respondent	Migrated to Jataí from municipality (state)	Rural property in Jataí (ha)	Renting and owning land (%)	Land use	History of the land use	Lost rural property to sugarcane (ha)	Rural property in another region (ha)	Year of acquiring rural property in another region
Pedro	Mineiros (Goiás)	3,000	100% renting	Soybean and corn	Natural vegetation (Cerrado)	Yes (1,300)	Yes (8,000)	1990
João	(Rio de Janeiro)	3,000	100% renting	Soybean, corn and cattle	Pasture (cattle)	Yes (1,300)	Yes (8,000)	1990
Ercilio	(Rio Grande do Sul)	1,500	53% renting and 47% owning	Soybean and corn	Pasture (cattle)	Yes (1,000)	Yes (3,400)	2008
Arthur	(Paraná)	1,200	33% renting and 66% owning	Soybean and corn	Pasture (cattle)	Yes (500)	Yes (2,500)	2012
Luiz	(Rio Grande do Sul)	296	100% owning	Soybean and corn	Soybean and corn	Yes (315)	No	n/a*
Lucas	(Rio Grande do Sul)	600	100% renting	Soybean and corn	Pasture (cattle) and natural vegetation (Cerrado)	Yes (300)	Yes (2,600)	2008
Carlos	Missing data	2,050	Missing data	Soybean and corn	Missing data	Yes (150)	Yes (3,050)	2008
Paulo	(Rio Grande do Sul)	2,000	100% owning	Soybean, corn and cattle	Pasture (cattle)	Yes (116)	Yes (1,000)	2013
Leonardo	(Paraná)	9,700	20% renting and 80 % owning	Soybean, corn and beans	Pasture (cattle)	No	Yes (2,900)	1992
Donatelo	(Rio Grande do Sul)	5,800	20% renting and 80 % owning	Soybean, corn and beans	Pasture (cattle)	No	Yes (5,300)	2012
Felipe	(São Paulo)	2,500	100% owning	Sugarcane, soybean and corn	Soybean	No	Yes (1,600)	1994 and 2009**
Guilherme	(Rio Grande do Sul)	1,000	100% owning	Soybean and corn	Natural vegetation (Cerrado)	No	No	n/a
Vinicius	(Rio Grande do Sul and Paraná)	930	25% renting and 75% owning	Soybean and corn	Natural vegetation (Cerrado)	No	No	n/a
Bruno	Confresa (Mato Grosso)	790	100% owning	Sugarcane, soybean and corn	Natural vegetation (Cerrado)	No	Yes (2,200)	1995
Gabriel	(Rio Grande do Sul)	724	100% owning	Sugarcane, soybean and corn	Pasture (cattle) and natural vegetation (Cerrado)	No	No	n/a
Francisco	Jataí (Goiás)	675	20% renting and 80% owning	Soybean and corn	Pasture (cattle)	No	Yes (1,260)	2012 and 2015
Bento	Jataí (Goiás)	425	100% owning	Soybean and corn	Soybean	No	Yes (430)	2012 and 2015
Alberto	(Rio Grande do Sul)	400	Missing data	Soybean and corn	Pasture (cattle)	No	Yes (400)	2010
Daniel	Jataí (Goiás)	315	66% renting and 33% owning	Soybean and corn	Pasture (cattle)	No	No	n/a
Antonio	Jataí (Goiás)	35	100% owning	Soybean and corn	Missing data	No	Yes (200)	Missing data

\*Question was not relevant for the respondent.

\*\*Rural properties acquired at different moments.

The majority of the respondents, 12 out of 20 (60%), did not lose land for the production of sugarcane. These respondents own a higher percentage of the land that they use for soybean and corn production than respondents that lost some of their farmland due to sugarcane expansion. Table 5.2 shows that 6 of these 12 respondents (50%) own all their land and 4 of these 12 respondents (33%) own 75% or more of their land. There are two exceptions, one respondent owns less land than he leases and for another respondent the data is missing. The respondent that leases most of his land explained that his land is relatively remote from the sugarcane-ethanol unit (60 km) and the soil is sandy. Raízen offered a higher lease for the land than he was paying, which made the landowner increase the lease price

from 8 bags of soybean to 12 bags of soybean per hectare; the lease price increased 50%. To keep the agricultural land, the respondent had to agree with this new lease price. To cover the higher lease price, soybean producer Daniel (2016) chooses to invest in an irrigation system to improve productivity. Nevertheless, Daniel (2016) is afraid of losing his lease contract to sugarcane.

The data shows that if soybean producers own (a higher percentage of) their lands, then they are less vulnerable to lose land to sugarcane production because they have control over how they want to use it (whether or not to use the land for sugarcane production). From overall conversation with respondents (2016) it can be stated that most soybean producers that took part in this research lease land from multiple landowners. In this way they spread their risks; when they lose a lease contract of land from one landowner they still have another contract to compensate the loss. The (financial) impact of losing a lease contract will be smaller for a soybean producer that has multiple lease contracts or owns (a substantial part) of his land. Contrary a bigger (financial) impact will be experienced by a soybean producer that had only one lease contract of land and lost this contract for sugarcane production. According to the respondents from Jataí (2016), these soybean producers had to migrate to another region to relocate their soybean production.

### **5.2.2 Motives to relocate or expand soybean production in another region**

In total 15 from the 20 respondents (75%) relocated or expanded soybean production in another region than Jataí. From these 15 respondents 9 (60%) have more land in another region than in Jataí. From the 8 respondents that lost land to sugarcane production 7 (87.5%) have land in another region than Jataí (see table 5.2). However two of these respondents already had land in Mato Grosso before losing land in Jataí; in the year 1990 they already expanded production in Mato Grosso. So from the 8 respondents that lost land in Jataí, 5 respondents (62.5%) relocated or expanded production in another region after they lost their land for sugarcane production. This is an indication that losing land for sugarcane possibly stimulates soybean producers to relocate or expand their production in another region. These respondents have more land in other regions than they lost; this means that they did not only compensate the loss of land but also expanded their production area. Furthermore the table also shows that 8 from the 15 respondents (53%) relocated or expanded production outside Jataí but did not lose land to sugarcane production. This shows that, although the majority of these respondents (62.5%) expanded production after sugarcane expansion started in Jataí; losing land for sugarcane production is not necessary for soybean producers to relocate or expand production. The increasing lease price for land due to sugarcane expansion also triggered soybean producers which did not lose land to sugarcane, to relocate or expand production outside Jataí. However, not everyone agrees with

this deduction, soybean producers Vinicius and Guilherme (2016) believe that various type of soybean producers relocate or expand production in other regions than Jataí, not only the producer that lost land to sugarcane.

*“Everyone goes to there. If you have five brothers, each is different”.* (Vinicius and Guilherme, interview, 2016. Translated from Portuguese by author).

Figure 5.3 presents the motives for soybean producers to relocate or expand soybean production in another region than Jataí. Respondents often mentioned various motives for relocating or expanding their production. This figure shows by how many respondents a motive is mentioned, thus illustrating the relative importance of a motive. There are seven categories of motives. From these categories, two are related to sugarcane expansion. The first motive (which is mentioned by the most respondents) is the increasing (lease) price for land in Jataí and the relatively lower (lease) price of land elsewhere. This is in line with the perspective from soybean producers on the sugarcane expansion in Jataí; all respondents mentioned their dissatisfaction with the increasing lease price of land. The second motive is the risk of losing the lease contract for their land or the respondent already lost a part of his land. These two motives are interrelated and related to the sugarcane expansion. When sugarcane expansion occurred on land formerly used by grain producers it caused an inflation of the (lease) price of land in Jataí. From the 20 respondents 14 (70%) confirmed that many soybean producers had to migrate to other regions because they lost their lease contract due to sugarcane expansion in Jataí. In addition respondents gave four motives that are not related to the sugarcane expansion:

- *Earn more money by expanding production.*

Four respondents mentioned they wanted to earn more money by expanding production in other states. These respondents expanded production in the states Mato Grosso and Tocantins because here the land prices were 30% of the land price in Jataí; this gave the opportunity for future land valorization (Respondents, 2016).

- *Family (growth).*

Two respondents explained that producing soybean and corn is a traditional activity. These respondents came from the state Rio Grande do Sul, where farming is focused on the family. This means that the family takes care of the farm together; in a community manner. Soybean producer Francisco (2016), explained that he and his brother used to work on the farm of their father in Jataí but when they started a family they had to earn more money to sustain the growth of the family. Therefore he and his brother expanded production outside Jataí. They are still partners and take care of the rural properties with the family.

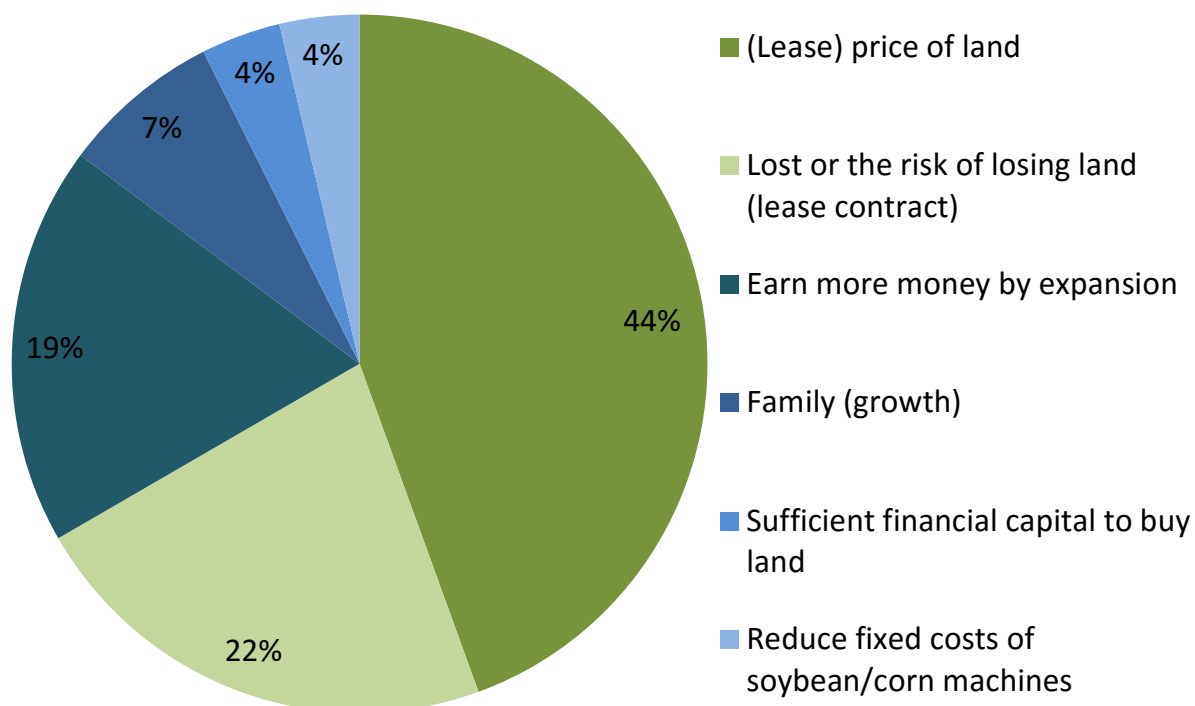
- *Having sufficient financial capital.*

Soybean producer Leonardo (2016), migrated from the north of the state Paraná to Jataí. He forms a partnership with his brother who still lives in Paraná. Just across the border in the state São Paulo they have a rural property. They used to lease this property but after saving enough money they were able to buy this land.

- *Reduce the fixed costs on soybean machines.*

One respondent mentioned that a soybean harvest machine is very expensive. This machine is only used during the harvest period for 15 to 20 days, after this period the machine is not used until the next harvest. However the machine has fixed costs (for example: depreciation costs, costs for maintenance and cleaning etcetera). Expansion of the production area will lead to an increased and thereby more efficient use of the machine.

Figure 5.3 Motivation to relocate/expand soybean production outside Jataí

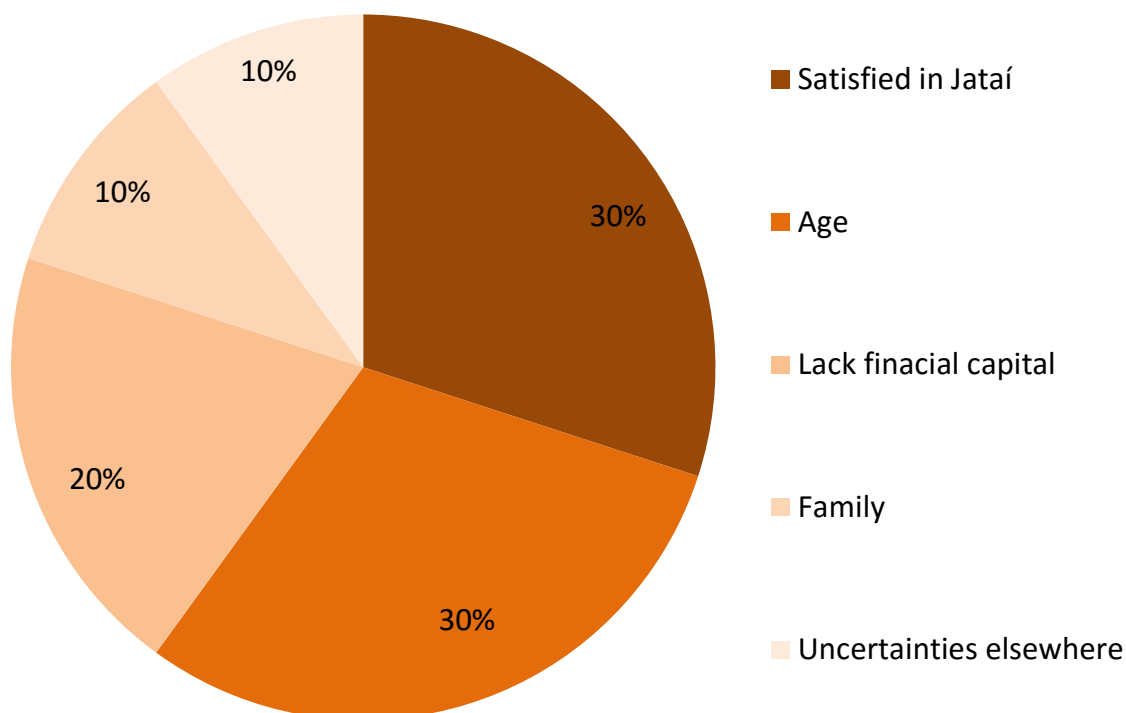


The five respondents that did not relocate or expand soybean production elsewhere gave five motives (see figure 5.4). The majority of these respondents expressed that they are satisfied with what they build in Jataí and that they feel too old to relocate or expand production. These 3 respondents were above the 63 years old and owned 100% or 75% of their land in Jataí; so they had no fear of losing it for sugarcane. The second most mentioned argument was the lack of financial capital. Two



respondents explained that they had no capital to expand soybean production in another region. One respondent had a debt on his land, although he lost land to sugarcane, he had no financial capital at the moment (Soybean producer Luiz, interview, 2016). The other just invested in an irrigation system to increase his productivity. These systems are very expensive. Approximately the respondent paid R\$8,000 per hectare; this is almost equal to the price of 12 bags of soybean (Soybean producer Daniel, interview, 2016). The two last motives to not relocate or expand production elsewhere are related to family and uncertainties. One respondent mentioned that he would not consider relocating or expanding production elsewhere because it would lead to the possibility that he had to migrate. Since he built his family and social life in Jataí he did not consider relocating or expanding soybean production in another region than Jataí. The final motive that was mentioned has to do with insecurities due to climatic conditions. The respondent that mentioned this motive, lost land to sugarcane production and has a debt on the land that he owns; these events resulted in financial insecurity for the respondent and made him anxious for additional uncertainties such as weather conditions. According to this respondent, the weather conditions (rain distribution) have been irregular in the region of Jataí. This brought difficulties in the production of soybean. In other regions the climate consists of more extremes than in Jataí and the soil would be less fertile than in Jataí; an investment in improving the soil quality was financially not possible for him. Except for one respondent, all other four respondents did not lose land to sugarcane production.

Figure 5.4 Motivation to not relocate/expand soybean production outside Jataí



### 5.2.3 Relocation or expansion region for soybean production

This paragraph provides an overview of the relocation and expansion regions of soybean producers from Jataí. Table 5.3 shows the relocation or expansion region of soybean producers from Jataí. Since four of the respondents had multiple properties in different regions, the total number of properties differs from the total number of respondents that have a rural property in another region than Jataí (15 respondents). These four respondents had their rural properties located near Jataí or one of their properties was located near Jataí and one located in another state. It is remarkable that respondents relocated or expanded soybean production in various regions; some close to Jataí in surrounding municipalities and others further away from Jataí in other states. These rural properties are located in four states: Goiás, Mato Grosso, Tocantins and São Paulo. The latter is more an exception because only one respondent (5%) expanded in this state. As table 5.3 shows, the majority of the relocation or expansion regions are municipalities located in the state Goiás. These municipalities are neighboring municipalities of Jataí and represent 50% of all the rural properties that are located outside Jataí. There is a preference for the municipalities Caiapônia and Piranhas. The first municipality, Caiapônia, is located 118km from Jataí and hereby the closest region from all the discussed regions. Contrary, the municipality Campos Lindos, located in the state Tocantins, is located 1,647km from Jataí and hereby located the farthest from Jataí. It seems that there is a preference for relocating or expanding production in a region relatively close to Jataí.

Table 5.3 Relocation or expansion region of soybean producers from Jataí

<i>State</i>	<i>Municipality</i>	<i>Distance (km) from Jataí</i>	<i>Number of rural properties</i>	<i>Percentage all rural properties</i>
Goiás	Caiapônia (4x)*	118	10	50%
	Palestina de Goiás	170		
	Piranhas (4x)	187 and 215		
	Iporá	225		
Mato Grosso	Ribeirão Cascalheira (2x)	655	6	30%
	Gaúcha do Norte	697		
	Nova Mutum	851		
	Santa cruz do Xingu	1012		
	Missing data	Missing data		
Tocantins	Alvorada	849	3	15%
	Crixás do Tocantins	1010		
	Campos Lindos	1647		
São Paulo	Iepê	713	1	5%
<i>Total of rural properties respondents have outside Jataí</i>			20	100%

\* The number behind the municipality name refers to the amount of respondents that had a rural property in the municipality.

Figure 5.5 illustrates the geographical location of these relocation and expansion regions. It shows that on the one hand the regions are closely located to Jataí, in surrounding municipalities, and on the other hand it also shows that regions are scattered across four states and located far from Jataí. In addition, most regions are located within the Cerrado biome, except the municipalities: Iepê (São Paulo) which

is located in the Atlantic forest biome; Gaúcha do Norte (Mato Grosso) which is located in the Amazon biome; and Santa Cruz do Xingu (Mato Grosso) which is also located within the Amazon biome. Furthermore figure 5.5 shows that respondents that have a rural property in the municipalities Iepê (São Paulo), Ribeirão Cascalheira (Mato Grosso) and Nova Mutum (Mato Grosso), acquired these properties before the sugarcane expansion (between the year 1990 and 1995). This means it is certain that the motivation to acquire this rural property was not related to the sugarcane expansion in Goiás but rather to low land prices or to governmental support during the occupation period of the central-west of Brazil. However the other 16 rural properties are acquired after the sugarcane expansion between the year 2008 and 2015. The main argument from these respondents is corresponding with the two main motives to relocate or expand production outside Jataí: the increasing land prices and the risk of losing or already having lost a lease contract for agricultural land. Figures 5.6a, 5.6b and 5.6c confirm what the respondents explained, namely that the (agricultural) land price in the municipality Jataí is almost three times as high as the (agricultural) land price in the state Mato Grosso or Tocantins. These figures present the land price (R\$ per hectare) of agricultural land used for soybean production, pasture land used for cattle and the price for forest land. It is important to note that these figures present data for municipalities that are closely located to the municipalities where respondents relocated or expanded soybean production; the data was not available for every municipality where respondents relocated or expanded. Nevertheless, it clearly shows the difference in land price per state. There are major differences between the prices of these different types of land because the investment needed to prepare the land for agricultural production differs significantly. For example, suitable agricultural land spots generally have specific infrastructure and characteristics suitable for agriculture (farmhouse, warehouse, fences, flat topography, little sandy soil composition) and are already fertile enough for the production of agriculture because of prior investments in the soil structure (Respondents Jataí, interview, 2016). The difference in land price between the states is mainly because of these differences in the characteristics of the land but also due to differences in quality of infrastructure needed to transport the harvest fast and cheap (for example: good road connections, asphalt roads or short distance to the harbor to ship the harvest (grains)). Also the availability and the demand for (agricultural) land in the state are important factors (Respondents Jataí, interview 2016).

Figure 5.5 Map of the relocation and expansion regions of soybean producers from Jataí (Goiás)

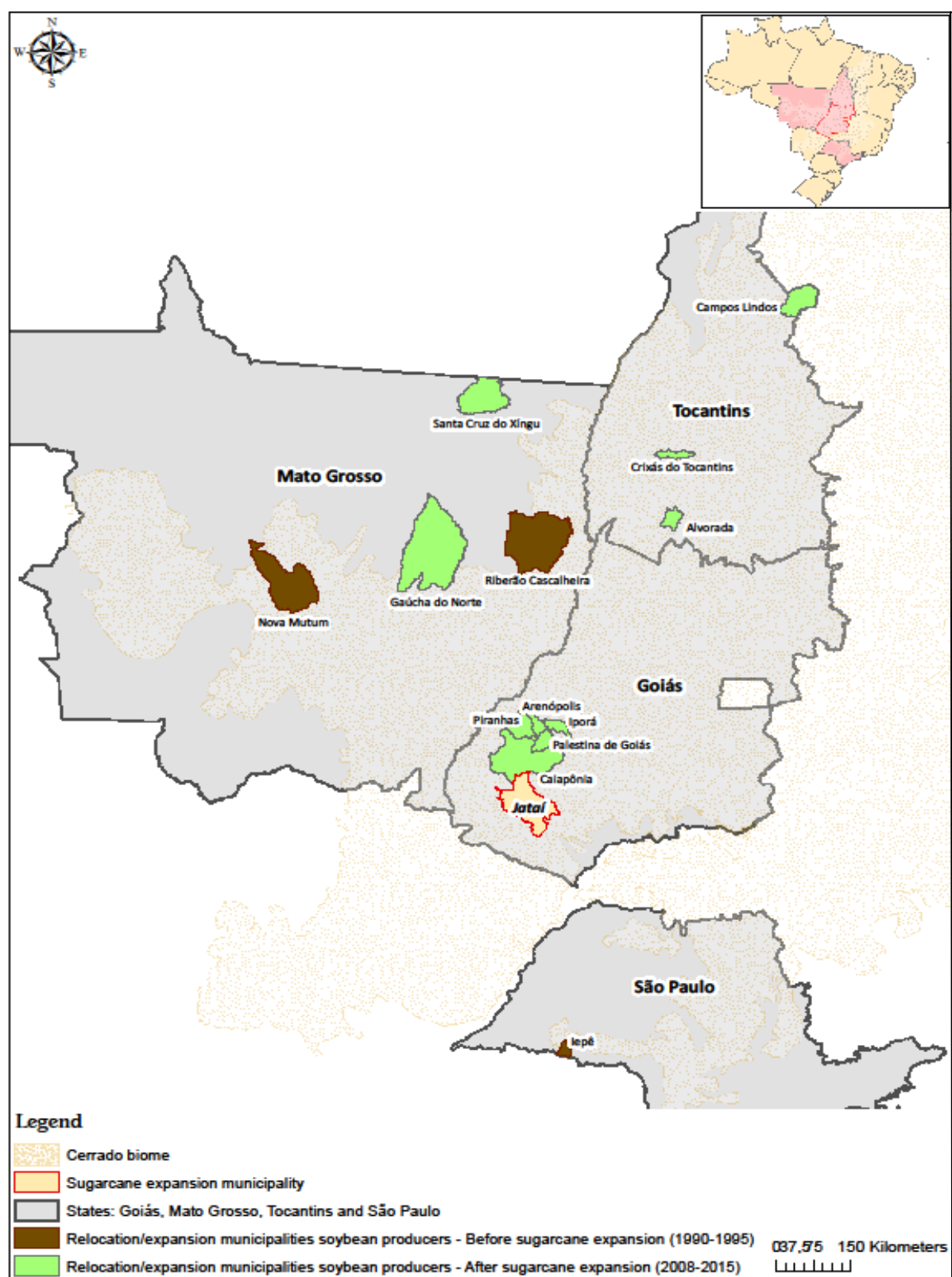


Figure 5.6a Land price of agricultural land per municipality (state) from 2005-2014

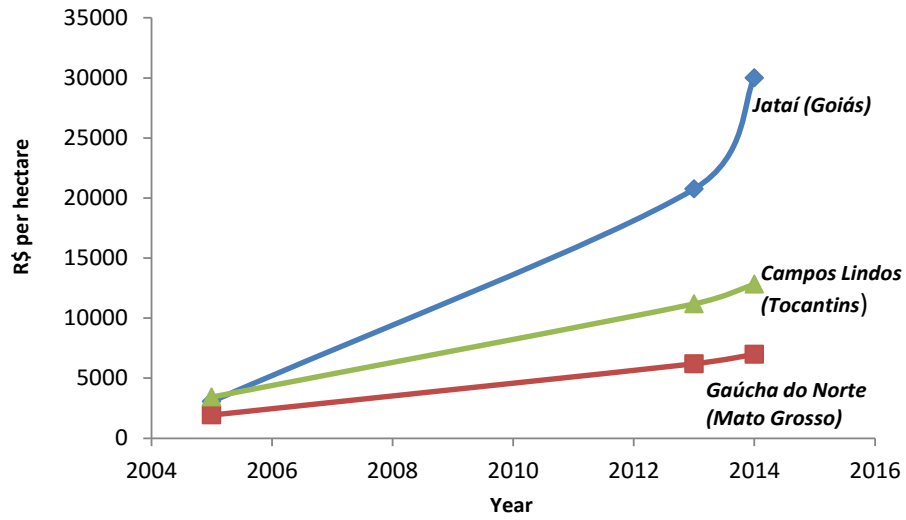


Figure 5.6b Land price of pasture land per municipality (state) from 2005-2014

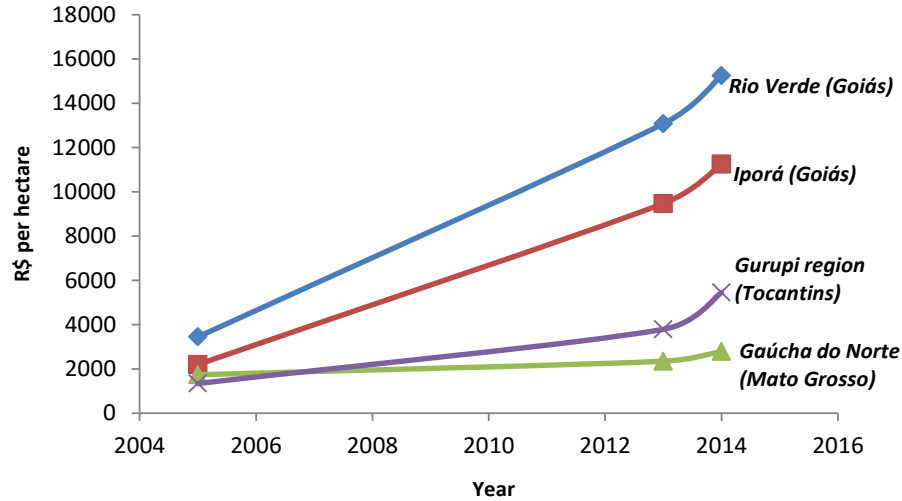
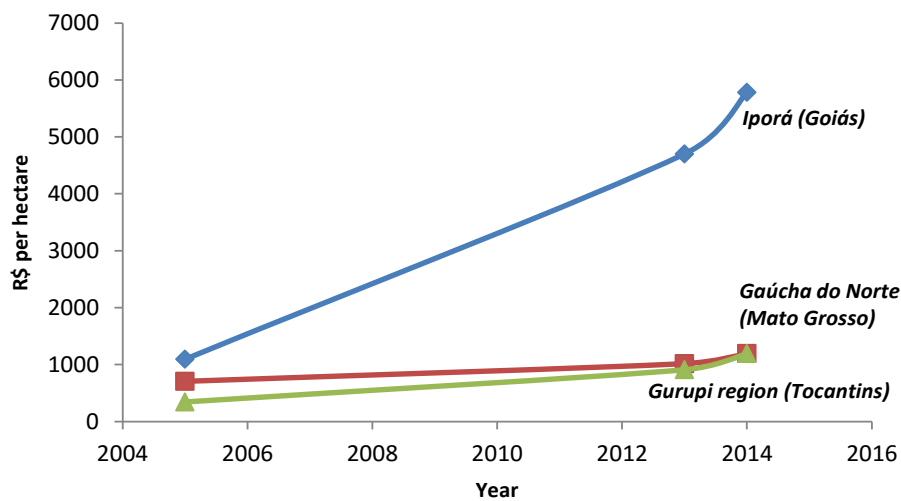


Figure 5.6c Land price of land with natural forest per municipality (state) from 2005-2014

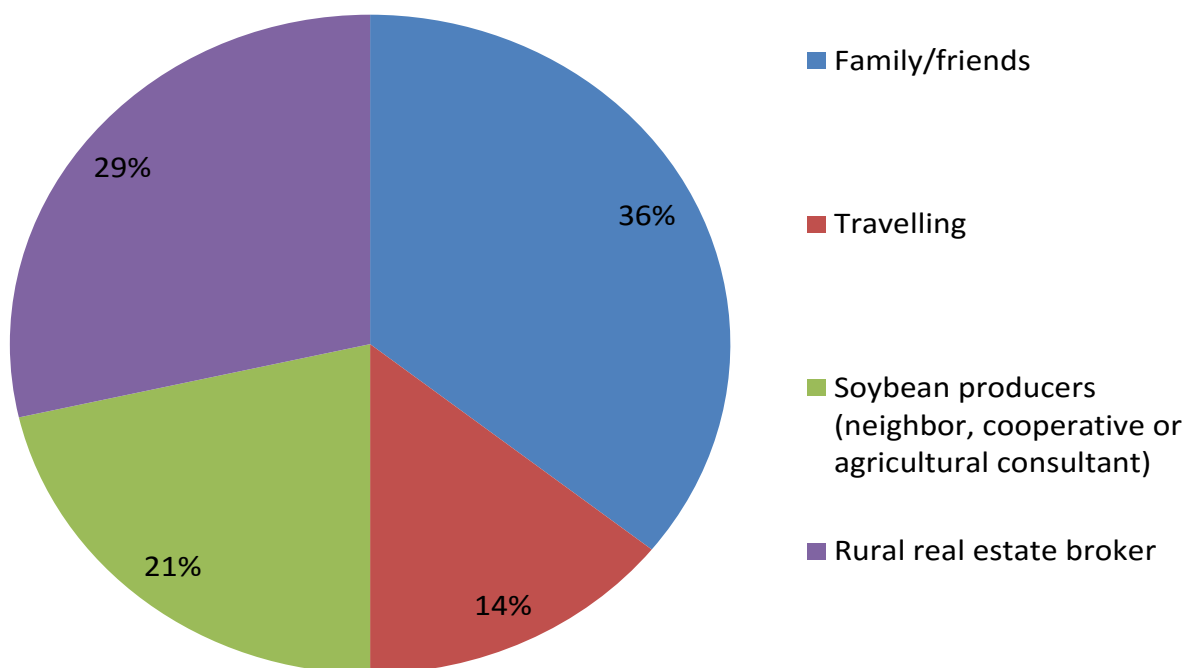


Source: Informa Economics IEG/FNP, 2014

#### 5.2.4 Acquiring agricultural land in these regions

Soybean producers from Jataí have four strategies to find (agricultural) land for relocating or expanding their production (see figure 5.7). The majority of the respondents (36%) found their rural property outside Jataí via their family or friends. They had family or a friend living in the relocation or expansion region; after the respondents received positive information about the opportunities to lease or buy land they went to the region to investigate these opportunities. The second most important channel of finding relocation or expansion opportunities is via a rural real estate broker; 29% of the respondents hired a broker to find opportunities. There are various rural real estate brokers, some only work in one municipality and others in an entire state (Respondents from Jataí, interview, 2016).

Figure 5.7 Ways of finding agricultural land for relocation or expansion of soybean production



Generally the soybean producers hire a broker from the region in which they are interested, because this broker will know the region the best. Another way of receiving information about and help with finding new investment opportunities for agricultural land is via other soybean producers, agricultural consultancy offices or the cooperative; 21% of the respondents found their rural property in this way. One of the respondents expanded production in Mato Grosso after his neighbor from Jataí, which already expanded in Mato Grosso, exchanged information about an opportunity to buy land (soybean producer Paulo, interview, 2016). All respondents explained that the soybean producers are friends among each other. Not only do they exchange information in consultancy offices but also after work, while having a drink at the bar. From observation it can be confirmed that soybean producers act like

friends when, after working on the farm, they meet at the bar to relax and play card games or on periodic agricultural information markets like the '*dias do campo*', or the '*Tecnoshow Comigo*' in the municipality Rio Verde. The '*dias do campo*', which means days on the field, is a day on a farm where companies promote and lecture about their new products or soybean varieties (see figure 5.8). The '*Tecnoshow Comigo*' is the biggest information market on the latest agricultural techniques in the center-west from Brazil. The last category for finding (agricultural) land to buy or lease, is via travelling; only 14% of the respondents found their expansion area by travelling to regions they might be interested in. There they would talk with the local rural producers on the possibilities that the region offers for soybean production (for example, the weather conditions or soil composition).

Figure 5.8 Famous bar where soybean producers meet in Jataí (Goiás)



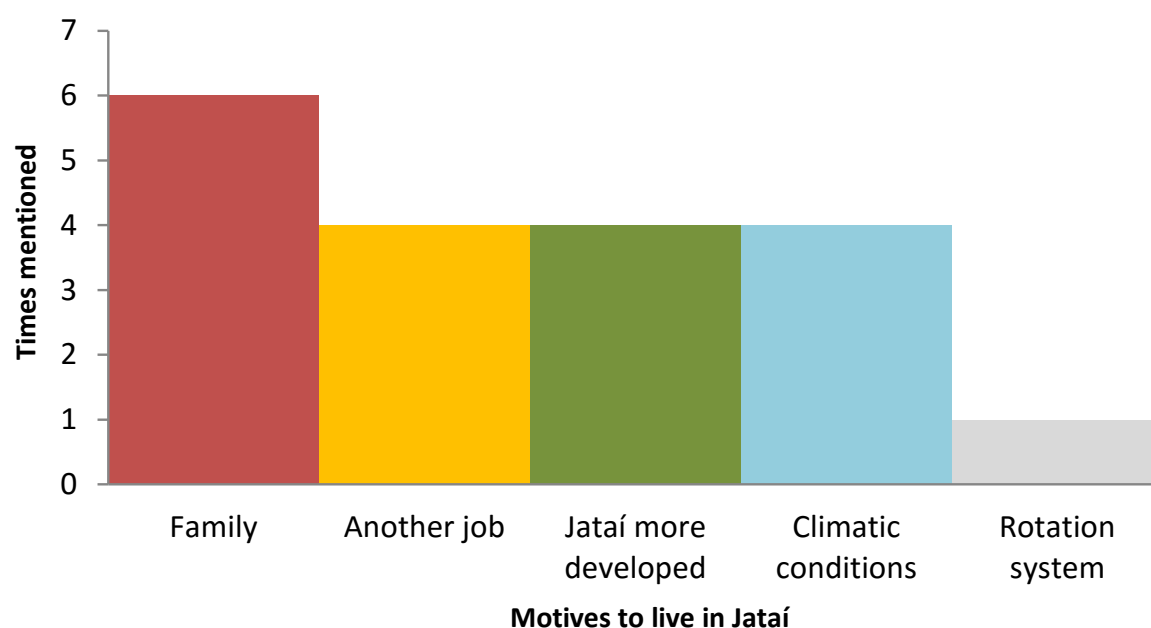
Source: Author, 2016

#### 5.2.4.1 Keeping contact with multiple rural properties

All the respondents that have another rural property outside Jataí did not migrate to the region of the other rural property. The respondents gave some motives for not leaving Jataí. Respondents could have more than one motive, therefore the number of motives differ from the number of respondents that have rural property somewhere else. As figure 5.9 shows, the main motive for not migrating was family. Six respondents mentioned that because of their family they continued to live in Jataí. Three from these six respondents have a brother that migrated from Jataí to the other rural property; the respondents made this deal with their brothers because they had another job in Jataí. Four from the respondents had another job besides being a soybean producer. Three of these four respondents

worked as agronomic engineers at consultancy offices. The other respondent was a city councilor. Four respondents preferred living in Jataí because it is more developed than the region of their other rural property. The municipality has more leisure options like the shopping mall but also better healthcare; for example a nearby hospital. Four respondents mentioned that they did not want to leave Jataí because the climate is comfortable compared to the more extreme climatic conditions in the region of their other rural property. Soybean producer Felipe (2016) explained that he did not want to live in Caiapônia because the temperature is about 2 degrees higher than in Jataí; the dryer and warmer climate of Caiapônia would be less comfortable to live in. The final motive was from soybean producer Paulo (2016); he recently expanded soybean production in the state Mato Grosso. Together with his son he has a rotation system; every two weeks he is staying in the house on the rural property in Mato Grosso. After two weeks his son takes over to take care of the farm. Basically he is living for 50% in Jataí and for 50% on his rural property in Mato Grosso.

Figure 5.9 Motivation to live in Jataí and not in the relocation/expansion region

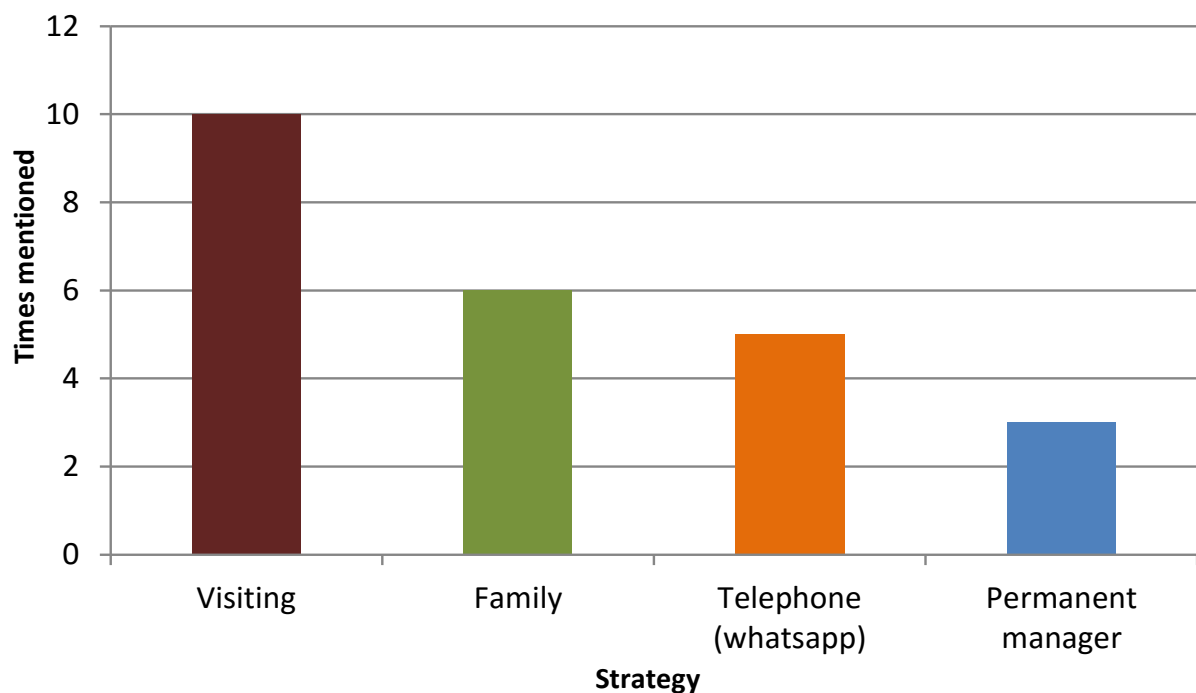


The soybean producers use four strategies of dealing with the distance between their rural properties. The first and major strategy is by simply visiting the farm (see figure 5.10). Ten from the fifteen soybean producers (66.7%) regularly visits their agricultural land in the region outside Jataí. The number of visits depends on the distance between the rural properties in Jataí and the other region. Respondents that have their rural property located in the surrounding municipalities of Jataí pay weekly or even daily visits to both rural properties (in Jataí and in the other region). For the respondents that have their rural property located in another state (approximately 800 kilometers from Jataí) frequency is limited to mostly monthly visits. The second strategy is by using family. Five from the nine respondents (55.6%)



that have a rural property located in another state have a family member living on the rural property. It are always brothers that work together as partners; one of them decided to migrate to the new relocation or expansion region to take care of the rural property. Their family ties probably gave them better access to acquire a rural property in another state because they are able to have better contact with the two properties. The other four respondents that have land in another state employ a manager and employees to take care of the land. They keep contact with the rural property via telephone and WhatsApp. Five respondents mentioned that they have contact with the rural property via WhatsApp. Although they did not mention they employ a manager or employees on their property, they probably have because otherwise they would have not the option to keep contact with the farm via telephone. In summary, the way in which respondents have contact with their rural properties when living in Jataí is largely determined by the distance between their rural property and Jataí. Additionally, having a family member as a partner enlarges opportunities for relocation or expansion because a trustful person could take care of the farm (family).

Figure 5.10 Strategy to keep contact with multiple rural properties



### 5.3 Cases of soybean producers from Jataí

Life trajectories from five different soybean producers from Jataí will be described to create a better understanding for their motivation to relocate or expand production. The aim is to demonstrate the different ways in which sugarcane expansion influenced soybean producers to relocate or expand their production out of Jataí or not. This selection of cases give support to the argument that sugarcane expansion contributed to speeding up the process of soybean expansion; as in some cases it functioned as a final motive for soybean producers to relocate or expand. Additionally, it illustrates that the (lease) price of land and social networks are important factors for soybean producers to choose the region for relocation and expansion. These extended case studies are based on the information given in formal and informal conversations with the respondents.

#### 5.3.1 Case 1 – Arthur lost land and expanded production in Tocantins

Arthur is 48 years old and originally from the municipality Maringá, located in the southern state Paraná. However, he already lives for 30 years in the municipality Jataí. His older brother migrated to Jataí one year before him. This brother informed him about opportunities to acquire agricultural land in Jataí. At this time Arthur was 18 years old and enrolled in an agronomic engineering course in São Paulo. He left the study to go to Jataí.

*“The opportunity to acquire agricultural land was even better than staying in São Paulo as a student. So I decided to leave the faculty and come to Jataí”.* (Soybean producer Arthur, interview, 2016. Translated from Portuguese by author).

In his home state Paraná the agricultural land was very limited therefore it was more difficult to acquire land in Paraná. At a young age Arthur already got interested in agriculture because he is from a rural family. His grandparents and father planted coffee; so Arthur grew up in the world of agriculture. When he and his brothers came to Jataí they bought a small plot of pasture land and slowly started to lease other plots of land. These leased plots of land they had to ‘open up’ which means they had to transform them from Cerrado, pasture or degraded land into suitable land for agriculture (mainly for the production of soybean and corn but also for cattle). After living for many years in the region and being part of the Rural Union he built up a wide network of friends that are also farmers. Nowadays he is, besides being a producer of grains, a city councilor of Jataí. He pictures himself as a moralist that defends the needs of the grain producing class from Jataí.

*“I practically know all the farmers in Jataí. After 4 years being the president of the Secretary of Agriculture and Cattle Ranching they even voted for me to take part in the politics of Jataí”.* (Soybean producer Arthur, interview, 2016. Translated from Portuguese by author).

Arthur believes sugarcane production is good for Jataí as long as there is just one sugarcane-ethanol unit located in the municipality and it does not turn into a monoculture within the municipality. Sugarcane cannot take too much agricultural land in Jataí because the soybean and corn production generate much employment and profit for the city. However, the situation is under control and currently it is good for the municipality because it diversifies the economy of Jataí; the objective of the municipality was to diversify the economy. Arthur does not believe that sugarcane will expand more in the municipality because the profitability of sugarcane is 30% less than that of soybeans and corn. This is because nowadays the market price for grain crops is good. However Raízen has the strategy to offer more money for leasing agricultural land than soybean producers. According to Arthur many soybean producers lost their lease contracts. In this way he also lost *500 hectares* of agricultural land; at that time Raízen paid the price of 15 tons of sugarcane per hectare per year, while Arthur used to pay the price of 13 soybean bags per hectare per year. However, the landowner is regretting his decision to lease his land to Raízen because the profitability of soybeans is good nowadays. This landowner already expressed his thoughts on switching back to leasing his land for soybean production when the contract with Raízen ends. Losing part of his land had financial consequences but he could still produce soybeans on 1,200 hectares of land. He has formed a group together with his two brothers. Together they own 800 hectares of land and lease 400 hectares of land in Jataí.

Besides having land in Jataí, he and his brothers have agricultural land in the municipality ‘Crixás do Tocantins’ in the state Tocantins. They have in total 2,500 hectares of which they own 1,500 hectares and lease 1,000 hectares from cattle ranchers. After a friend of him moved to Tocantins he and his brothers got the idea to possibly also expand in Tocantins. In the year 2000, they went to visit their friend and also got to know the region. They decided to hire a rural real estate broker to help them search suitable agricultural land. In 2012, they decided to buy their first plot of land. It took a while for them to decide to buy a plot of land because they were waiting for improvement of the logistics in Tocantins. They did not expand in a municipality closer to Jataí because the land prices are higher. Their main motive to expand in Tocantins was related to the relatively low land price. In Jataí the land price for one *alquaire* (in Goiás equal to 4.84 hectares) is in between the R\$300,000 and R\$350,000; this makes it unfeasible to buy land in Jataí because it would take 100 years to pay back the investment. Contrary in Tocantins it is possible to buy one *alquaire* (in Tocantins equal to 2.72 hectares) for a price in between the R\$20,000 and R\$40,000. Also there is a big difference in lease price for agricultural land

between Jataí and Tocantins. In Jataí the lease is the price of 15 bags of soybean per hectare per year while in Tocantins this is the price of 5 bags of soybean per hectare per year, with a contract of 10 years. This lease price is low because it is a new region for agriculture; this means that the competition between producers over agricultural land is little. When there is more competition for land the price goes up. Before expanding in Tocantins they were in doubt whether to expand in Tocantins or Mato Grosso (the Xingu region); they had two options in Mato Grosso. However, after comparing the price that grain companies would pay per bag of soybean in each region they decided to expand in Tocantins. In Jataí the price per bag of soybean was R\$42, in Mato Grosso R\$32 and in Tocantins between R\$42 and R\$50. The price of corn in Jataí was R\$18 per bag, in Mato Grosso R\$10 and in Tocantins the price per corn bag was R\$24. This difference in price was related to the quality of the infrastructure and the geographical location in relation to the port of Itaqui located in the northeastern state Maranhão; Tocantins is closer located to the port in Maranhão to where grain companies transport the grains. The farm that they bought was used for cattle ranching; therefore they had to transform the land into suitable land for the production of soybeans. They did not have to deforest but they had to apply limestone on the soil to make it more fertile. In the first year they started planting 500 hectares of soybeans; after that they expanded the area.

*“It is very good there, I should have gone sooner (Arthur is laughing). In 2016 my brother and I intend to expand more in Crixás do Tocantins; there are many areas for good a good price. We try to negotiate with our neighbor”.* (Soybean producer Arthur, interview, 2016. Translated from Portuguese by author).

Having a business with two brothers gave Arthur and his brothers more mobility and options to relocate and expand. Arthur could expand in a region far away from Jataí because one of Arthur's brothers decided to live and take care of the farm in Tocantins. As Arthur describes, these new regions for agriculture attracts adventurers (*aventureiros*). However these people are not always technically skilled, they have no knowledge about agriculture; some of them are speculators (*especuladores*). According to Arthur (2016), they did not learn from other local farmers in Tocantins. Contrary, the few soybean producers that were planting for a longer time in the region had just one harvest a year but Arthur and his brothers were the ones that started planting corn after they harvested soybeans in 2013; in this way they had two harvest periods a year. The second harvest of corn has a shorter period, therefore it is called 'little' harvest of corn, or *safrinha*.

“All of our neighbors in a circle of 100 km visited us and today there are already many people also planting a safrinha of corn. So we brought our knowledge and exchanged it with others”. (Soybean producer Arthur, interview, 2016. Translated from Portuguese by author).

In summary, this case shows that in the first place the social network of Arthur made him interested in possibly expanding in Tocantins; a location far from where he lives. Secondly the ‘land prices’ were an important motivation for Arthur to relocate and expand in Tocantins. Expanding in an area far from Jataí was possible for Arthur because his brother (business partner) offered to live on and take care of the rural property there. It is arguable that the expansion of sugarcane made Arthur expand earlier than he planned and hereby speeding up the process of soybean expansion because, although Arthur and his brothers were searching for expansion opportunities before losing their land to sugarcane, the decision to expand was made after they lost their land. In addition, they started planting 500 hectares of soybeans which is equal to the area that they lost in Jataí to sugarcane production; so they first relocated their production of Jataí and later started to expand.

### **5.3.2 Case 2 – Ercilio lost land and expanded production nearby Jataí**

Ercilio is 55 years old and is originally from the southern state ‘Rio Grande do Sul’. In 1982, 33 years ago, he moved to Jataí. His interest in agriculture came from his family; they produced soybean and corn. Therefore his knowledge about the crop and agricultural techniques came from his father and other family members. However for specific knowledge on agricultural techniques he hired an agronomic engineer in Jataí. This engineer helps him with the decision on planting period, harvest period and which products or seeds to use. In addition he has a manager to take care of the farm. Before moving to Jataí he knew someone that moved some years before him to the region to produce soybeans. This person told Ercilio about the good opportunities to expand in the region of Jataí. This made Ercilio and his brother decide to acquire agricultural land in the region of Jataí. After their study in political economy he and his brother succeeded in buying a small agricultural plot; until today they are partners. Nowadays they have more agricultural land of which the majority is leased. They have 2700 hectares of land spread over the municipalities Jataí, Rio Verde and Serranópolis; these are all neighboring municipalities. This land is divided in 1,500 hectares (located in Jataí and Rio Verde) for the production of soybeans and corn and 1,200 hectares is used for cattle ranching (located in Jataí and Serranópolis). From the 1,500 hectares used for soybean and corn production, 800 hectares (53%) is leased and 700 hectares (47%) is owned by the brothers. All of their land in these municipalities used to be pasture land. To make this land productive enough for the production of soybeans and corn they

had to recover the soil. Generally this takes about 2 to 3 years for the soil to be fully corrected and reach its full productive potential.

Ercilio has mixed thoughts on the sugarcane expansion in the region of Jataí. On the one hand he expressed to have nothing against Raízen but on the other hand he believes it is wrong how sugarcane took land from soybean producers. He believes the strategy of Raízen to acquire agricultural land in Jataí is aggressive and very insincere; almost bribing landowners by paying a higher price for leasing the land that has been used for many years by soybean producers. According to him the sugarcane-ethanol unit should never have been installed in the region of Jataí, a region of grains. However, Ercilio also acknowledges that landowners play a vital role in the sugarcane expansion because they gave permission for sugarcane production on their land; they facilitated Raízen to produce sugarcane on their land. He explains that a rural producer has no power in the decision of the landowner about what happens with the land after the lease contract ends (in general these contracts are for 5 years in Jataí). According to Ercilio (2016), there were two big landowners in Jataí that facilitated the installation of the Raízen unit and helped the company by planting sugarcane. But the majority of the landowners contacted Raízen to negotiate possibilities to lease their land for the production of sugarcane; the owner of the land that Ercilio, really wanted to start with sugarcane production. According to Ercilio it is easy for Raízen to start in Jataí because they have a lot of financial capital and the agricultural land that they take over in Jataí is already fertile enough for production; they do not have to open up the area and fertilize it.

*“It is a fact that inflation on the price for leasing agricultural land took place after sugarcane expansion. It used to be the price of 10 bags of soybean per hectare per year, this increased to 15 bags. Some soybean producers were able to stay on their land by paying the higher lease price but many had to leave because they could not afford the new lease price”.* (Soybean producer Ercilio, interview, 2016. Translated from Portuguese by author).

So because of Raízen many soybean producers had to leave Jataí because they lost their land for the production of sugarcane or they could not afford the higher lease price for the agricultural land. Many of the soybean producers only leased their land and did not own any land. Luckily for Ercilio and his brother they owned a part of the land that they used for production. The land of Ercilio and his brother is closely located to the Raízen unit. Raízen even asked them if they had interest in planting sugarcane for the company. They told them that the production of sugarcane is more profitable than grains but they do not believe this because with the production of grains there are two harvest periods (one for corn and one for soybean production). According to Ercilio (2016), Raízen is focusing on suppliers of

sugarcane (*fornecedores*) rather than on agricultural land to lease because this would be easier for Raízen; it would give them less work and responsibility. Losing your land brings various difficulties because sometimes you cannot find a new area that is fertile enough. Many failed because they had to move to a degraded area; Ercilio believes this is wrong. The same happened with Ercilio and his brother; sugarcane took over a big part of their leased land and they were forced to relocate their production in another region. Today they are afraid to also lose this newly leased area to sugarcane.

*“Soon after Raízen arrived in Jataí we lost our lease contract. More than 1,000 hectares we lost for the production of sugarcane. This was the best land we used to plant on. Because of Raízen we had to relocate our production elsewhere”.* (Soybean producer Ercilio, interview, 2016. Translated from Portuguese by author).

So sugarcane expansion was the main motive for them to relocate their production in an area elsewhere than Jataí. This caused much financial damage because they had to transform a pasture land into land suitable for agriculture and because the transportation became more costly. They relocated in three surrounding municipalities: Caiapônia (120 km from Jataí), Palestina de Goiás (150 km from Jataí) and on the border of the municipality Piranhas with Areadópolis (180 km from Jataí). In the period 2008 to 2009 they started relocating production in Caiapônia by leasing a plot of agricultural land equal to the size of the land that they lost in Jataí (1,000 hectares); by relocating production to Caiapônia they kept the amount of land that they used to have in Jataí. However after seeing that there were more opportunities to expand in Caiapônia and neighboring municipalities, they started to expand. Today they are leasing an area three times the size of the area that they lost in Jataí; they lease 3,400 hectares of agricultural land in the three municipalities. Ercilio and his brother could not afford to buy a plot of land because it would be too expensive. Although the land price is lower than in Jataí, the land has to be transformed from pasture land into agricultural land which takes time and is costly. In addition, land prices in Caiapônia and surrounding municipalities are increasing. Today the lease price is 5 bags of soybean lower than in Jataí. In Jataí the lease price of agricultural land increased to 15 bags due to Raízen; while in surrounding municipalities it increased to 10 bags due to the soybean expansion.

A friend of him, the former manager of Comigo, acted like a ‘rural real estate broker’ and helped Ercilio in searching a new area. In addition, Ercilio knew someone that had rural property in Caiapônia and Piranhas; this person told about his good experiences. Ercilio searched for agricultural land located close to Jataí and not in other states like Mato Grosso or Tocantins because his family lives here and mainly because of his age. According to Ercilio in general younger farmers go more often to those

states. We should leave it for the younger generation, the healthier people. For him it feels like yesterday since he migrated to Jataí but it has already been 33 years. If he would expand and migrate to another state this feeling of 'just' arriving would even be bigger. He does not want to spend all his life in settling somewhere.

*"It is not the lack of courage but more self-indulgence. It is nice here in Jataí."* (Soybean producer Ercilio, interview, 2016. Translated from Portuguese by author).

One of the benefits in having all rural properties close together is that it is possible for Ercilio and his brother to visit them every day. During the harvest season they have to give assistance to the employees that live on their farms. The brothers have daily contact with these employees via the telephone. During the interview Ercilio also had to attend his phone three times to talk with an employee. These employees come from Jataí and Rio Verde, the municipalities that have a longer tradition in soybean and corn production than the other municipalities.

The brothers have to use different seeds than they used in Jataí because the seeds that are used in Jataí do not always grow well in the surrounding municipalities. The reason for this is because the climate is different; there is a higher temperature and the rain period is later in the year and shorter than in Jataí. For example, Caiapônia is 100 km from Jataí but the climate is already very different than that of Jataí. Although there are more risks in the other regions than in Jataí, it is possible to have a good harvest there. Ercilio did not exchange information about agricultural techniques with local rural producers in the other regions because his agronomic engineer had this information. The concentration of grain companies in the region Jataí made it unnecessary to ask information of crop varieties to local rural producers from the relocation region. Therefore it could be stated that the brothers barely have interaction with the local rural producers.

In summary, even though Ercilio works together with his brother just like Arthur, he did not decide to relocate and expand production in another state because he did not want to migrate, neither his brother. This illustrates a contrast with the previous case of Arthur; therefore family could increase the location possibilities for relocation or expansion of soybean production but it can also decrease possibilities.



### 5.3.3 Case 3 – Lucas lost land, expanded production and helped others to expand

Lucas is 53 Years old and migrated from the southern state Rio Grande do Sul to Jataí in 2004. He has family living in Jataí that migrated 32 years ago. His whole family was involved in the agricultural sector except his father. His father decided to leave the agricultural sector by moving from the country side to the capital of Rio Grande do Sul, Porto Alegre. Lucas grew up with his mother; his parents got divorced when he was 2 years old. Lucas started to work as a bank manager. Nevertheless he stayed connected to the agricultural sector as he was involved with the agricultural business sector of the bank where he had personal contact with producers of soybean, corn, rice and cattle. From a cousin, he got an offer to become partner in a store for agricultural pesticides, agro toxics, seeds and technical agricultural consultancy in Jataí; the name of the store is Sarfra Forte (strong harvest). So when they started this store, they could provide agricultural products besides a mix of financial administrative expertise and agricultural knowledge. After they opened the store Lucas continued his study of the agricultural sector as he needed to know more about the products that his store would sell. In this way he gained interest in the production of crops. Then he decided to produce crops himself besides working in the resale or distribution sector of agricultural products. According to Lucas (2016), he learned his agricultural techniques by himself and also via his cousin. Lucas and his cousin, share 3,200 hectares of agricultural land in the municipalities Jataí and Piranhas. Only 600 hectares is located in Jataí (300 hectares leased land) and the other 2,600 hectares is located in Piranhas (300 hectares leased land). So in total they only own 600 hectares of land in both regions, the rest they lease. They plant soybeans, corn, and sorghum and keep cattle. Before they used the land it was for 700 hectares already used for soybean production but the other 2,500 hectares they had to open up; this means they had to transform the land from pasture land to land suitable for soybean production. During this process it is important to make an analysis on the fertility of the soil. Then corrections of the soil are made to reduce its acidity. After this it is possible to plant soybeans on the land; for the production of corn it is recommended to wait two to three years for the soil to become more fertile.

*“We often follow rural producers that are already producing in the region and have a good productivity. When testing other soybean varieties we use about 300 hectares to test each variety to reduce the risk”. (Soybean producer Lucas, interview, 2016. Translated from Portuguese by author).*

Lucas and his cousin try to keep the best relationship with their customers (other producers) by exchanging the information on the best agricultural techniques. Contrary they also capture their best technical skills. In the store much information is exchanged but Lucas is also gaining more knowledge about the newest agricultural techniques during ‘*dias de campo*’ (days on the field), lectures, family

members and neighboring producers. Additionally, he explained that the internet and other media are also helpful in gathering agricultural information.

*“There is an exchange of information, knowledge and experiences. Sometimes we help a neighbor with the harvest when he has to use his machines in another region. To compensate he will finish harvesting my crops”.* Soybean producer Lucas, interview, 2016. Translated from Portuguese by author).

According to soybean producer Lucas (2016), sugarcane expansion took place aggressively. He lost about 300 hectares of the land that he leased. Raízen offered 18 bags of soybean per hectare instead of the 12 bags per hectare Lucas paid; the payment of Raízen was also monthly instead of yearly. Many people started paying 15 or 16 bags of soybean per hectare to keep their land and soybean production in Jataí. So sugarcane expansion in Jataí made the lease price go up. Some people had to pay 18 bags of soybean per hectare to keep their land. Today Lucas pays a lease price of 15 bags per hectare to secure his agricultural land in Jataí. Lucas believes that there is room for both, sugarcane and soybean, but sugarcane should not become a dominating crop in the region. According to him, sugarcane production forced the discovery of other areas for soybean production.

*“This (referring to sugarcane pushing soybean out of Jataí) took development to other areas with soybean having to move”.* (Soybean producer Lucas, interview, 2016. Translated from Portuguese by author).

In 2008 Lucas and his cousin went to Piranhas to replace their lost area from Jataí. They could not relocate in Jataí because the lease price was too high and there were no opportunities to open up an area. Therefore Lucas argues that it is necessary for soybean producers to expand production in new agricultural border regions. He mentioned that many soybean producers also were forced to relocate production in the state Mato Grosso. Lucas was able to relocate and expand production on 2,600 hectares of land in Piranhas; 2,300 hectares leased from 4 landowners (local cattle ranchers). The lease price is lower than in Jataí, between the 8 and 10 soybean bags, but the costs for opening up the land is very high. They had to travel across the country to find the right region to relocate his lost land. Through the use of a rural real estate broker they found available land in Piranhas; they did not know anyone before moving to Piranhas but choose Piranhas as the region for relocation and expansion. Their main motivation was the distance between Jataí and Piranhas. If they would go to Mato Grosso it would be around the 1,200 km away from Jataí, this would be too far. But Jataí and Piranhas is 220 km located from each other, this makes the travelling between the farms faster. Another motivation is that the ‘family’ structure of the partnership between Lucas and his cousin would not have to change

because no one had to migrate to another region. Lucas and his cousin decided to stay in Jataí because they have their store in the city but they also built their family in Jataí. Additionally, it is not necessary to migrate to Piranhas because it is located nearby; if necessary they can stay for 10 days in Piranhas and return to Jataí. Besides this there are cultural and infrastructural factors. The city in Piranhas is much smaller and has fewer resources like doctors, health institutes or commerce; Piranhas has 12,000 inhabitants while Jataí has 100,000 inhabitants. Another benefit of having their farms located relatively close to each other is that they can have a better control on the activities that take place on their farms. They have a manager and employees working on the farm in Piranhas. They are from Jataí but migrated to Piranhas to live on the farm and take care of it. These employees are controlled by the manager but Lucas and his cousin also visit the farm in Piranhas weekly. As a consequence Lucas and his cousin do not have a lot of interaction with the rural producers from Piranhas.

*“If it is necessary I can go to Piranhas in the morning and return in the afternoon on the same day. Additionally, the family structure did not have to change”.* (Soybean producer Lucas, interview, 2016. Translated from Portuguese by author).

However Piranhas did not have a good reputation for soybean production. Nevertheless they went to the region to evaluate the situation. They saw that the region had many adventurers (*aventureiros*), people that had little knowledge and experience in the agricultural sector; they were doctors or had other professions. Many of these people failed. In the period that Lucas went there to evaluate there was many failure in the planting season, failure in the harvest season and failure in the fertilization of the soil. From this evaluation Lucas concluded that the region had a bad reputation partly because of climatic conditions but also because the producers did not have the expertise for a successful production.

*“We went there with more knowledge. In this city we were the pioneers of soybean production. There were some small-scale soybean producers but after we came to the region the area suitable for agriculture increased with 500%”.* (Soybean producer Lucas, interview, 2016. Translated from Portuguese by author).

What can be derived from the latter quote is that Lucas pictures himself as the pioneer of the region Piranhas. According to Lucas about 8 other soybean producers also expanded production in Piranhas after Lucas and his cousin went there; he does not have the exact number. These producers got influenced by Lucas because Lucas was getting good harvest. This information was shared with other producers in the store of Lucas and his cousin. Lucas feels that he stimulated them by selling the right

products to them. However these producers did not always lose land by sugarcane expansion, sometimes they just had other motives to also expand in this region. There were also local rural producers from Piranhas that started to explore their unused agricultural land. Lucas told about two soybean producers which he inspired to relocate production in Piranhas, he called them classic cases. Carlos lost 150 hectares of land to sugarcane production in Jataí (Raízen paid 16 bags of soybean per hectare instead of 13 bags) and has more land in Piranhas today. He still has 2,050 hectares of land in Jataí but after losing land he first relocated and later expanded production to 3,050 hectares of land in Piranhas. In addition to losing a part of his land, he also wanted to expand to gain more money to cover the high taxes in Brazil. Equal to Lucas he has employees from Jataí working on his farm in Piranhas. Another classic case is from Diego. He used to work on his father's farm but he lost all his land to sugarcane production; they lost all 1,570 hectares of land because Raízen paid 6 bags of soybean per hectare more than they did. The father of Diego migrated to Mato Grosso but Diego decided to produce soybeans in Piranhas; he found an area of 1,580 hectares that he could lease from a cattle producer. Both cases mentioned were clients at the store of Lucas. This shows that clients from technical service offices can get influenced by the office to relocate or expand their production in a specific region. This shows that these social networks formed by technical service offices are important for the direction of the soybean relocation and expansion.

Lucas believes that he should expand more in Piranhas because there are many opportunities for expansion. However it is not on his mind to expand more in the next years because he and his cousin first want to secure the current areas (make them fertile enough). In Piranhas all the agricultural techniques are different from those in Jataí. The temperature is higher in Piranhas therefore the cycle of the soybean crop is longer than in Jataí and it is more difficult to plant a second harvest of corn; when it is 33 degrees in Jataí than it is 37 degrees in Piranhas. In Piranhas they have to make sure that the crop is not ready for harvest in the period of February until the beginning of March because it is very rainy in this period which would make harvesting difficult. They have to plant a specific type of soybean (*precocious soybean*) in Piranhas. This type of soybean has a longer cycle. In Jataí they plant the crop and with 105 to 120 days the crop is ready to be harvested. While in Piranhas they have to plant a soybean type with a cycle of 115 to 125 days. Subsequently, the soil texture is more compact in Piranhas which makes it more difficult for water to penetrate the soil and reach the roots of the crop. The region is starting with agriculture and there are no warehouses in the municipality. This brings more costs to the transport of the harvest because they have to be transported to far away warehouses in Jataí. In Jataí Lucas just has to drive 20 km to the closest warehouse but in Piranhas he has to drive 120 km to the closest warehouse. All this makes it more difficult to work in Piranhas than in Jataí but this is a calculated risk.

In summary, the case of Lucas presents how soybean producers that go through the same issue (losing land) can help each other in the search for new agricultural land. It shows the importance that one person can have within a 'social network' because one person within a network can stimulate or convince others from the same network to do something, in this case relocating to a certain region (Piranhas).

#### **5.3.4 Case 4 – Luiz lost land and did not relocate or expanded production**

Luiz is 39 years old and was born in Rio Grande do Sul. His father always had a dream to own a farm. In 1984 his father heard from a friend about the opportunities for buying a plot of land in Jataí. This year he decided to migrate to Jataí and start in the agricultural sector. Before Jataí the father of Luiz worked in the commercial sector. In the beginning his father started leasing a rural property from an Italian company. At this time there were just a few families living in Jataí; owning the rural land of the municipality. These families used to breed cattle and own pasture land. Around the 1980s they started to lease parts of their land to the Gaúchos coming from southern Brazil. In the 1990s, the sons of these landowning families started to plant soybeans and corn because they learned this from the Gaúchos. Luiz studied agronomic engineering and did his internship at the farm of his father. This is how Luiz gained his technical knowledge and experience on taking care of agricultural land and producing grains.

His father produced soybeans and corn on a farm less than 10 km located from the current sugarcane-ethanol mill in Jataí (see figure 5.11). A short time before the mill was constructed in Jataí the father of Luiz lost his lease contract. Today this land is completely converted to sugarcane production. Luckily before he lost his contract the father of Luiz had the opportunity to buy 297 *hectares* of land on the other side of the road. He could buy this land for a low amount of money because the previous landowner had a debt with the bank coupled to this land. The father of Luiz bought this land together with the remaining debt on the land. Unfortunately the brother of Luiz (2016) could not explain any detail of the issue with the bank regarding the debt on the land. Until today this debt is not fully paid yet. Luiz took over this land from his father and together with his father he started leasing 315 hectares of land from a neighbor. This land used to be pasture land so the quality of the land was not high; the soil consisted of sand and gravel. Unfortunately this gave Luiz and his father problems during the harvest period. Nevertheless, Luiz and his father were happy with the land because they could make some extra money. When sugarcane expanded in Jataí many soybean producers were terrified of losing their land. Luiz believes that sugarcane production could take place in Jataí as long as it did not take place on land previously used for the production of soybeans. Unfortunately he and his father lost

the plot of land of 315 hectares after the construction of the sugarcane-ethanol mill (20 km located from their farm). They lost the land because Raízen offered 14 bags of soybean per hectare, instead of the 7 bags that Luiz was paying (Raízen offered 100% more for the land). Luiz was able to pay 10 bags for keeping the land but he could not afford 14 bags because the land was not giving enough profit to pay that price.

*"I remember that my brother was very annoyed when he lost the lease contract for the production of sugarcane".* (The brother of soybean producer Luiz, interview, 2016. Translated from Portuguese by author).

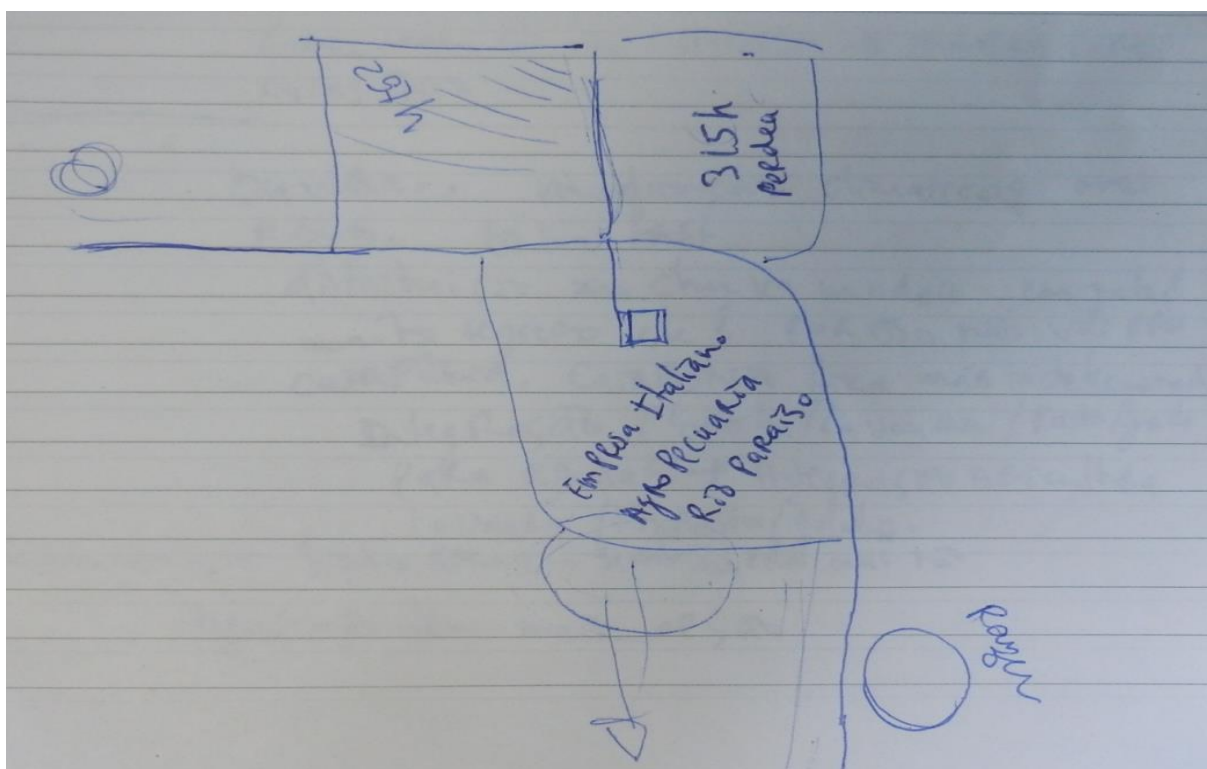
In addition to being a soybean producer, the father of Luiz owns a gas station in Jataí. This gas station is managed by the brother from Luiz. This brother was not pleased with the construction of the Raízen unit in Jataí because there was corruption within the process of distribution of ethanol. Recently the police arrested the owner of a competitor gas station (the owner from this gas station also owns a lot of agricultural land in Jataí). He was arrested because he was stealing ethanol from the Raízen unit for several years. Probably one of the employees reported this to the police. The brother from Luiz was already wondering how this competitor gas station could sell ethanol for a lower price than he did. He was angry that within a big company as Raízen this could happen.

Many soybean producers move to Caiapônia because land prices in Jataí are high and because all the agricultural land is already owned by someone, there are simply no options for expansion in Jataí. However according to Luiz (2016) the agricultural land in Caiapônia is not that good; the land is more hilly and sandy which makes the planting and harvesting (mechanically) more difficult than in Jataí. However Luiz did not relocate or expand his soybean production in another region after losing 315 hectares of land for the production of sugarcane. His motives are: firstly he still has to pay the debt on his agricultural land in Jataí; secondly he has no employees that could help him taking care of various rural properties; and thirdly, he had a bad experience in having land in another region. In the municipality Serranópolis he used to have a plot of land but this did not work out well because the land was not fertile enough. Thirdly, Luiz is very secure; he does not take unnecessary risks. For example, relocating in the municipality Caiapônia would be too risky according to him because the climate is more irregular than in Jataí. The climate change in Jataí already brought more risks for the agricultural sector. The last two years distribution of rainfall was not favorable for soybean production; it was dry for a long period. When Luiz and his family moved to Jataí, the climate was different from today, the rainfall used to be better distributed and lasted a longer period. So if Luiz found a new area in more sandy land than this was risky in two ways: firstly, it would be costly to correct the (degraded)

pasture soil and secondly, in dry period's soybean producers that produce on more sandy land will lose their harvest faster than producers with a more fertile land.

In summary, this case presents that it is not always easy for soybean producers to relocate production when they lost land. In addition, it shows that family actions (e.g. buying land with a debt) can determine future actions of a soybean producer. In this case Luiz decides to make more secure decision than his father did.

Figure 5.11 The location of the farm of Luiz (upper left), lost land (upper right and middle) and Raízen unit (lower right)



Source: Soybean producer Luiz, 2016

### 5.3.5 Case 5 – Bento did not lose land but expanded production nearby Jataí

Bento is 59 years old and contrary to the others, was born in Goiás. He was born in the municipality Itarumã, southern Goiás, but studied administration in the city Castilândia in the state 'Mato Grosso do Sul'. After his study he returned to Goiás where he worked as a manager of a bank. His father and other family members migrated to Jataí, therefore Bento also moved to Jataí in 1974. His father was not a landowner but he worked for others on their farm. Besides this job he made everything from leather for cattle like a loop for cattle (*laço por gado*); his father knew how to work with cattle. Bento married a woman who's a father owned a substantial amount of land (840 hectares). Bento's father in law was one of the first landowners in Jataí that started leasing parts of his land to soybean producers from the south of Goiás. After the wife of Bento received a plot of land from her father Bento became

a landowner. Bento observed that people from the south of Brazil were progressing with the planting of soybeans. Therefore he and his wife decided to experiment on a small piece of land, without machines. Nowadays they already produce soybeans for 14 years. Bento and his wife learned how to produce soybeans on the field by practice. The educational background of Bento was very useful in the financial administration of the farm. They produce on 425 hectares of land in Jataí and only have one permanent employee. Only during the planting or harvesting season they contract temporary employees from the city.

They stated to plant soybean because people from the south of Brazil were also planting this crop. In addition, Bento explained that the concentration of grain companies in Jataí also contributed in their decision to plant soybean because these companies invest in innovation of the crop, sell the necessary products and buy the crops. There are many agronomic engineers or salesmen of pesticides and other products that Bento gains knowledge from. Bento gets technical assistance and always has many conversations with various colleagues. He exchanges much information about agricultural techniques with colleagues and on *dias do campo* (days on the field) he learns a lot about the new techniques or products.

*“We follow the footsteps of people from the south. They brought the crop from there (southern Brazil)”.* (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).

According to Bento there was a lot of fear among the rural population when Raízen wanted to construct a sugarcane-ethanol unit in Jataí. Bento has no bad feelings towards sugarcane production in Jataí; he believes there is space for everyone. He believes that sugarcane diversified the economy of Jataí. However there has to be equilibrium between the land used for different crops. This means that sugarcane production cannot dominate the land use within the municipality. According to Bento the production of sugarcane centralizes the profit.

*“There was a movement in the city when Raízen started having contact with rural producers to get agricultural land for sugarcane production. Rural producers, the rural union and even the city hall were afraid that sugarcane would turn Jataí into a city with just sugarcane production. So there was quite some resistance”.* (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).

The land of Bento is close to the Raízen unit (18 km) and located in between other areas of Raízen. Bento believes Raízen wants to make a road that connects their areas to reduce transportation costs of the sugarcane. Therefore Raízen almost insisted to Bento to plant sugarcane for the company.



*“First a boy that had contact with the producers of sugarcane came to ask me if I wanted to plant sugarcane for Raízen. I had no interest. Then he returned with another person; we talked. After this he returned for a third time with the boss of the hierarchy. I still had no interest”. (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).*

Raízen asked Bento to be a *fornecedor* of the company (a supplier of sugarcane). The company explained to Bento that the profit of sugarcane is higher per hectare than the profit of soybeans. But Bento had no interest in planting sugarcane because he feels that he is still in the process of consolidating his activities, his farm is small for the patterns of the region, and he had machines for the planting and harvesting of grains. Raízen even wanted to pay the costs of planting the first sugarcane and deduct it when Bento would provide sugarcane to them. But even then Bento did not want to plant sugarcane because then he would be needing employees and could not use his grain machines. Bento just wants to focus on the production of soybeans and corn.

*“I want to specialize myself in planting one crop. I believe soybeans and corn have a relation with each other because after harvesting corn the leaves of the corn stay on the soil to protect it from erosion and make it more fertile for the planting of soybeans. Subsequently, sugarcane has to be planted for 5 years on your land while the production of soybeans or corn is more flexible. It is even possible to switch to pasture land if needed”. (Soybean producer Bento, interview 2016. Translated from Portuguese by author).*

According to Bento soybean production distributes the profit in Jataí; it creates a *network of support*. Bento mentioned that when he has a (technical) problem he can call the technician, the mechanic or the salesman for soybean seeds. The people that are part of this support network are very aware of their value.

*“A few days after Christmas and New Year’s Eve companies are closed. At this time I needed urgent help from a mechanic. A part of the motor of my harvest machine needed to be renewed during the harvest season. Inconveniently, the mechanic that would be able to rectify and replace the part was currently at his parent’s house, located in the city Rondonópolis in the state Mato Grosso. He returned all the way from Mato Grosso to attend me in Jataí. Together with three other employees he fixed the motor of my harvest machine in three days. So I notice this importance of soybean production and its distribution of profit among all families that earn money and survive”. (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).*

Before the sugarcane expansion Bento already considered to expand production to cover the fixed costs of his harvest machine outside of the harvest season; without investing in a new machine he could expand 2 times the area he owned. Besides this his family grew and he needed more money to provide for the family. A brother in law married a woman in Piranhas and lives there for many years. This brother in law has a farm in Piranhas and advised Bento that a neighbor was interested in leasing his land. Then Bento travelled to Piranhas to gather information about the region and possibilities for soybean production. At this time many land in this region was opened and transformed from pasture to agricultural land. When Bento noticed this he believed that it could be a good area for expansion. Bento decided to expand in Piranhas during the period of sugarcane expansion in Jataí. According to Bento, one consequence of the dislocation of soybean production is the valorization of land in the relocation region; in this case Caiapônia and Piranhas. Soybean producers invest in the fertilization of soil and their increasing interest for land in these regions causes an increase in the land price.

*“If we want to expand we have to do it now because otherwise the land price will be inflated. It will be more difficult if we wait”.* (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).

In 2012 he was able to lease 270 hectares for 8.5 bags of soybean per hectare in Piranhas. He did not migrate to Piranhas because he owns land in Jataí, his wife likes Jataí and it is a better and more developed city with more opportunities. He also did not buy the land because it is a high investment that could have a financial impact for a long time; if they have one bad harvest then the financial impact would be bigger than when they save their money. The first year they had a bad harvest because they planted the same type of soybean as he used in Jataí. Additionally, the climate was not favorable in their first year; not much rainfall. After this bad result he started to exchange information on the soybean type with soybean producers that were producing in the region for a longer period; the next year Bento started planting the type of soybean which was adapted to the conditions in the region.

In 2015 his nephew had difficulties in producing his land in Caiapônia and asked for help. Bento took over the work and now leases 150 hectares of land for a period of 1 year for 10 bags of soybean per hectare. After that year he wants to see if he can keep leasing it because it is right in between his two rural properties of Jataí and Areadópolis. All of his expansion opportunities were found via his family. Managing the farm in Tocantins or Mato Grosso would be difficult because it is far away but Piranhas is relatively close to Jataí; within 2.5 hours Bento arrives on his farm. Only when Bento has to move his machines from Jataí to Piranhas it takes about 3 days because these are large agricultural machines.

*"We have nothing there, not even bread. Nothing stays there. We bring everything from Jataí".* (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).

No one is living on the farm of Bento in Piranhas. Bento works together with his son, a truck driver and one permanent employee from Jataí. They just lease the land they use for soybean production. Their land only has a *tapera* (abandoned house) where they can stay if needed. Their neighbor, an old man that used to live and work on the farm (*caseiro*), has a small area of land where he produces various crops and keeps cattle. This man provides Bento and his employees with lunch; this is an income for the man and an interesting factor for Bento.

*"We arrive and sometimes do not have to talk with him, in this way we do not lose time. So we are focused. We arrive and unload everything in 15 to 20 minutes then we work hard. Sometimes we even bring the pesticides, insecticides and poison from Jataí. Sometimes we even bring the exact quantity (5.5 liters) in the truck and bam! We do everything very fast and it works well. We have just a few people but it is very efficient".* (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).

Bento employs the same people from Jataí to work on his rural property in Piranhas and Caiapônia because it is difficult to find skilled people in these regions. The production of soybeans is new in that region and therefore there are almost no skilled operators for machines. According to Bento these local people are willing to learn but he does not want to go through the same process of a slow production like it used to be in the beginning in Jataí when he had to learn.

*"The local people do not have experience to be honest. Therefore we bring most of our employees from Jataí".* (Soybean producer Bento, interview, 2016. Translated from Portuguese by author).

In summary, this case illustrates that soybean producers that lost land to sugarcane production, triggering soybean producers that did not lose land to sugarcane expansion to expand production in other regions. Bento was afraid that the (lease) price of land in surrounding regions would become higher as a result of the relocation of soybean producers that lost land. In this perspective sugarcane expansion is indirectly stimulating the expansion of soybean production.

## 6. Soybean producers from Jataí moving to Caiapônia and Piranhas

### 6.1 Soybean expansion in Caiapônia and Piranhas

#### 6.1.1 Background information municipalities

This chapter is about two of the new soybean production municipalities: *Caiapônia* and *Piranhas* (see figure 6.1 and figure 6.2). As the previous chapter presented, these are the municipalities to where most of the respondents relocated or expanded production. Both municipalities are part of in the Cerrado biome and located relatively close to the municipality Jataí: Caiapônia 180km and Piranhas 186km.

##### 6.1.1.1 Caiapônia

Caiapônia has an area of 8,638 km<sup>2</sup>; this makes it the fourth biggest municipality in the state Goiás (Niquelândia, Mineiros and Rio Verde). In 2015 the estimated population number is 18,148 inhabitants (IBGE, 2016). Its average altitude is 735, but some areas are 1,000 meters above sea level. The topography is mainly hilly (inclination angles up to 60 degrees) but it has flat parts (Caiapônia Net,

Figure 6.1 The entrance of the municipality Caiapônia



Source: Author, 2016

2016). Furthermore, the average temperature is 28 °C (Meteoblue, 2016). The municipality is located at the intersection of highways GO221 and BR158; especially the latter is an important highway for the transportation of soybeans. These highways provide a good connection with neighboring municipalities; including Jataí and Piranhas. Originally the region is located on land from an indigenous tribe. In the late 18<sup>th</sup> century the region was inhabited with the indigenous tribe 'Caiapó'. Around 1839 the families Vilela, Goulart, Cardoso, Faria and Leite migrated from the state Minas Gerais and settled in the region. These families brought a small herd of cattle and horses and had slaves to do the work; they expelled the indigenous tribe to the north of Brazil. At this time people had to register the land that they occupied in the capital of the state Goiás. In 1856, these families successfully registered four plots of land located close to the rivers Rio Caiapó, Rio Claro and Rio Bonito. On January 7<sup>th</sup>, 1874 the settlement became officially a municipality, at that time named 'Torres do Rio Bonito'. However in 1943 the name changed to 'Caiapônia' to remember the first inhabitants of the region, the Caiapós (IBGE, 2016). For several years the municipality confiscated various other (surrounding) districts to its territory like, Piranhas, Bom Jardim, Aragarças, Palestina de Goiás and even districts across the state

border in Mato Grosso. Today these districts are independent municipalities (Caiapônia Net, 2016). Until today the economic base of Caiapônia is cattle ranching and agriculture.

#### 6.1.1.2 Piranhas

Piranhas has an area of 2,048 km<sup>2</sup>; this makes the municipality significantly smaller than the municipality Caiapônia (8,638 km<sup>2</sup>) or Jataí (7,174 km<sup>2</sup>). In 2015 the estimated population is 11,164 inhabitants. The municipality is located 389 meters above sea level. This is lower than Caiapônia (735 meters) or Jataí (755 meters). This results in an average temperature of 31 °C, which is slightly

Figure 6.2 The entrance of the municipality Piranhas



Source: Author, 2016

higher than the average temperature of the municipalities at higher altitudes (Meteoblue, 2016). The average temperature of Caiapônia is 28 °C and of Jataí 22 °C. Highway BR158 connects Piranhas with the municipalities Caiapônia and Jataí and even with the north of the state Mato Grosso. Around 1948, when this highway between Caiapônia and Aragarças (a border city of Goiás and Mato grosso) was built, the construction workers used to camp at the left bank of the river 'Rio Piranhas'. When the construction work was completed, some of the workers stayed at this location and founded the town Piranhas (IBGE, 2016). They named the settlement after the name of the local river Piranhas. The town used to be part of the municipality Caiapônia but became an independent municipality in 1954. Until today the economy of this municipality is focused on cattle ranching and agriculture.

The municipality Arenópolis used to be a district of the municipality Piranhas. In 1956, it started with the settlement of one person, Albino Borges, who was attracted by the rich and fertile land of the region. More people followed his lead and the region grew into a small rural town named after the local creek, 'O Patrimônio do Areia'. In 1972 the town had grown and became a district of the municipality Piranhas; the name changed into Arenópolis. After increasing the district changed into a municipality in 1983. Arenópolis consists of 1,078 km<sup>2</sup> and has an altitude of 416 meters above sea level (Geografos, 2016). Nowadays it has an estimated population of 3,066 inhabitants. Although it is separated from municipality Piranhas, soybean producers still consider Piranhas and Arenópolis as one region (IBGE, 2016).

### 6.1.2 Land use from 2003 to 2014

In this paragraph the land use change in the municipalities Caiapônia and Piranhas from the year 2003 until the year 2014 is analyzed. In 2003 the sugarcane expansion started in the southwest region of Goiás. The Brazilian Institute of Geography and Statistics (IBGE) only had data available until the year 2014. Therefore the analysis does not cover a longer period.

#### 6.1.2.1 History land use

In 2014, Caiapônia was the municipality with the third most cattle heads in the state Goiás. In this year Piranhas did not reach the top ten of municipalities with the most cattle heads (see table 6.1). According to Ipeadata (2010), on the pasture lands in the Cerrado biome there is an average of *1.5 cattle head per hectare*. Table 6.1 illustrates that Caiapônia uses approximately 50% less of its municipal area than the municipalities with more cattle. This could mean that Caiapônia has relatively more areas with dens natural vegetation or that the municipality has a more diverse land use.

Table 6.1 Top three municipalities with cattle in the state Goiás (1.5 cattle head/ha) in the year 2014

Municipality	Cattle heads	Hectares used for cattle (1.5 cattle head/ha)	Area of municipality (ha)	Percentage of area used for cattle (1.5 cattle head/ha)
Nova Crixás	751,000	500,667	729,878	69
São Miguel do Araguaia	586,000	390,667	614,44	64
Caiapônia	406,000	270,667	863,787	31
Piranhas	203,000	135,333	204,776	66

Source: IBGE, 2016

All of the six interviewed soybean producers from Jataí that relocated and expanded soybean production in the municipalities Caiapônia and Piranhas relocated or expanded in pasture land (see table 6.2). Except for one respondent who started producing soybeans in Caiapônia on land that was already used for soybean production. However, one year before he started using the land it was pasture land. This shows that soybean expansion takes place at the expense of pasture land.

Table 6.2 Land use before soybean producers relocated or expanded on the land

Land use (history)*	Number of rural properties	Municipality (state) rural property
Pasture (cattle)	12	Caiapônia (Goiás) (3x); Piranhas (Goiás) (4x); Iporá (Goiás); Palestina de Goiás (Goiás); Santa Cruz do Xingu (Mato Grosso); (Mato Grosso); Crixás do Tocantins (Tocantins)
Soybean	4	Caiapônia (Goiás); Gaúcha do Norte (Mato Grosso); Alvorada (Tocantins); Campos Lindos (Tocantins)
Natural vegetation (Cerrado)	3	Ribeirão Cascalheira (Mato Grosso) (2x); Nova Mutum (Mato Grosso)
Sugarcane	1	Iepê (São Paulo)

\*The history of the land use refers to how the land was used before the soybean producer from Jataí relocated or expanded soybean

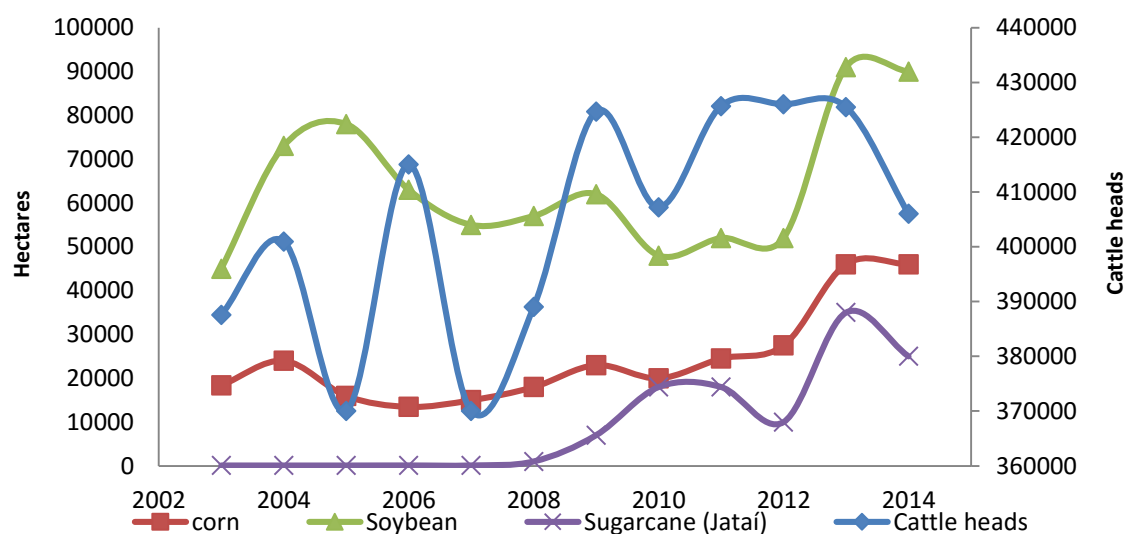
### 6.1.2.2 Correction of the soil

All respondents from Jataí mentioned that the climate in Caiapônia and Piranhas is more extreme (higher temperatures and stronger rainfall) than in Jataí. This is the result of the low altitude of both municipalities. The municipality Jataí is a plateau (*chapadão*) while Caiapônia and Piranhas are located on a mountain range (*serra*) (Agrodefesa Caiapônia, interview, 2016). As a result the rain season and production of soybeans start later in Caiapônia and Piranhas than in Jataí. In Jataí the rain season starts in September and ends in March. While in Caiapônia and Piranhas the rain season starts in October and ends in April. From May until September is the dry season without rainfall (Soybean producer Victor, interview, 2016). In Piranhas the weather is more extreme than in Caiapônia because the topography of Piranhas is lower than that of Caiapônia (Soybean producer Rafael, interview, 2016). Due to its climate the production cycle of soybeans is about 10 days shorter in Piranhas than in Caiapônia and Jataí. Therefore the production of soybeans is more difficult in Piranhas. In Caiapônia it is possible to have two harvest periods annually but in Piranhas only one yearly harvest is possible (Soybean producer Fernando, interview, 2016). According to agronomic engineers from Piranhas (2016), soybean producers tried over 40 different soybean varieties to find out the best type to plant. Soybean producer Fernando (2016) also conducted research on finding the most profitable soybean variety. Eventually he chose the varieties 7739, 7337 and 9144. These varieties gave a productivity of 50 bags of soybeans per hectare; this is the average productivity of soybean production in Piranhas. In general soybean producers use a small part of their land to try out several (new) soybean varieties. After more soybean producers started to produce in regions with extreme climatic conditions Embrapa started to do research on the production of soybean and corn in regions with similar conditions.

Managing a rural property is difficult because every rural property is unique. The soil type in the southwest region of Goiás is a medium to very sandy *latosol*; it is a type of soil with a very low fertility (Reatto et al., 2004). In the Cerrado region almost all flat areas, *chapadas*, consist of latosols (Reatto et al., 2004). Over time the fertility of the pasture land decreased even more due to: overcrowding the land with cattle and the lack of soil maintenance (fertilization). Studies have indicated that phosphorus and nitrogen deficiency are the most frequent cause of the productivity loss of pasture lands (Reatto et al., 2004). In Caiapônia and Piranhas pasture land was never correctly managed; in the sense that cattle ranchers did not use products to maintain or increase the soil fertility (Soybean producer Fernando, interview, 2016). For over 20 years cattle ranchers did not recover the soil of their land. Therefore the soil has a low fertility, is often compact and in some cases even degraded (Agronomic engineers Piranhas, interview, 2016). All respondents from Jataí, Caiapônia and Piranhas mentioned that they had to recover the soil (*correct the soil*) before planting soybeans on the land. To correct the soil of pasture land, *lime*, *plaster* and *fertilizer* are used by soybean producers. Additionally they level out the land and removed the vegetation (Soybean producer Thiago, 2016). According to Agrodefesa Caiapônia (2016), some cattle ranchers plant rice for one year in order to make the soil more fertile before planting soybeans. It is recommended to recover the soil fertility of pasture land with annual crops because: firstly, the costs of soil correction will be reduced by the profit of the annual crop; secondly, the sprouting of native vegetation will be reduced; thirdly, the pasture land will be more productive in soil that has been corrected for agriculture (Reatto et al., 2004). The need for lime and fertilizer will depend on the soil characteristics but also on the intensity of land use and pasture management (Reatto et al., 2004). According to soybean producer Victor (2016), the price of correcting the soil of pasture land depends on how degraded the land is and on the value of the dollar because the products for soil correction are imported from the United States (US). It is often expensive to correct the soil of pasture land. In Caiapônia soybean producer Victor (2016) needed 6 ton of lime and 30 kg fertilizer or 1 ton of plaster. In 2006, Victor paid R\$1,450 to fertilize one hectare of his land. In addition he paid R\$9,910 for the *micronutrient Mabi Color* per hectare. The first year his productivity was 35 bags of soybean but in the fourth year the productivity already increased to 61 bags of soybean per hectare.

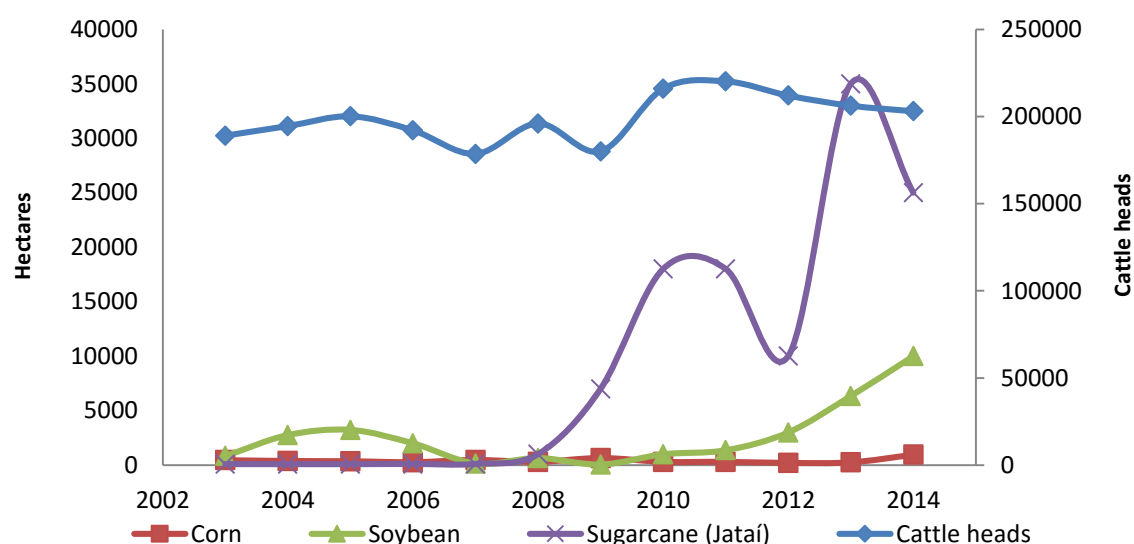


Figure 6.3a Land use in the municipality Caiapônia before and after sugarcane expansion in Jataí (2003 – 2014)



Source: IMB, 2016

Figure 6.3b Land use in the municipality Piranhas before and after sugarcane expansion in Jataí (2003 – 2014)



Source: IMB, 2016

### 6.1.2.3 Land use from 2003-2014

In Caiapônia and Piranhas there is very little sugarcane production. In 2014 Caiapônia has 200 hectares of sugarcane production and Piranhas 8 hectares (IMB, 2015). The sugarcane is used as feed for the cattle (Agrodefesa Caiapônia, interview 2016). According to soybean producer Anderson (2016), a study into the possibility of constructing a sugarcane-ethanol unit in Caiapônia was done by the sugarcane-ethanol company Plantar Usina. This study was focused on the hydraulic system of the municipality because the production process of ethanol requires a lot of water. A hydroelectric company (*Usina Hidrelétrica do Rio Bonito*) is already located next to the main river of the municipality,

river *Rio Bonito*. The construction of a sugarcane-ethanol unit would interfere with this hydroelectric power plant and therefore it was not built.

Since 2003, soybean and corn production expanded in the municipalities Caiapônia and Piranhas. Figures 6.3a and 6.3b show the land use of the municipalities Caiapônia and Piranhas for the period 2003 to 2014. The land use for soybean and corn production is presented in hectares. Additionally, the number of cattle heads is presented. Data regarding the number of hectares used for cattle is not present on IBGE because cattle is not bound to a specific piece of ground but moves around in herds. Furthermore, the sugarcane expansion in Jataí is included in the figures to support the comparison between sugarcane expansion and soybean and corn expansion in Caiapônia and Piranhas. It shows that before the sugarcane expansion started in Jataí (in 2008) the production of soybean and corn already occurred in both municipalities. However in the municipality Piranhas the production of soybean and corn is very limited in comparison to the municipality Caiapônia. After the sugarcane expansion in Jataí, corn and soybean production did not increase significantly in both municipalities. In the period 2008 to 2009 the area used for soybean production increased 8.7% from 57,000 hectares to 62,000 hectares in the municipality Caiapônia. In the same period there was a decrease of 91.1%, from 650 hectares to 58 hectares, in the municipality Piranhas. This could be the result of the low market price of grains, making it not appealing to expand soybean production. Another explanation could be that soybean producers who lost land in Jataí to sugarcane production needed time to find suitable land to where they could relocate soybean production. In the period of 2011 to 2012 the sugarcane expansion slowed down and even started to decrease with 44.5% (from 18,000 hectares to 10,000 hectares) in Jataí. However from 2012 to 2013 the sugarcane expanded for a second time with 250%, from 10,000 hectares to 35,000 hectares. This time the land used for soybean and corn production increased in both municipalities, Caiapônia and Piranhas. In Caiapônia the land use for soybean production increased with 75%, from 52,000 hectare to 91,000 hectares and the land use for corn production increased with 67.3%, 27,500 hectares to 46,000 hectares. In Piranhas the land use for soybean production increased with 111.4%, from 3,000 hectares to 6,343 hectares and the land use for corn production increased with 25%, from 200 hectares to 250 hectares. It can be concluded that after the second period of sugarcane expansion in Jataí the municipalities Caiapônia and Piranhas experienced a higher expansion of soybean and corn production than after the first period of sugarcane expansion. However, the municipality Piranhas shows a higher expansion of soybean production than Caiapônia. From 2013 to 2014 land use for sugarcane production decreased in Jataí with 28.6%, from 35,000 hectares to 25,000 hectares. This could be the result of rural producers making a rotation from sugarcane production back to soybean production to recover their land that has been used for sugarcane for five years (Respondents Jataí, interview, 2016). In this period the land

use for soybean production in Caiapônia slightly decreased with 1.1%, from 91,000 hectares to 90,000 hectares; the land use for corn production remains equal, 46,000 hectares. Noticeable is that in the same period the land use for soybean production in Piranhas increased with 57.7%, from 6,343 hectares to 10,000 hectares and the land use for corn production increased with 280%, from 250 hectares to 950 hectares. This illustrates that in the municipality Piranhas the expansion of grains is relatively stronger than in the municipality Caiapônia, although in absolute sense the area used for these crops in Piranhas is smaller than in Caiapônia. Additionally, the figures show that the grain expansion in Piranhas is more recent than in Caiapônia.

Since all respondents from Jataí relocated or expanded soybean production on former pasture land, the expectation was that the area for pasture land be reduced along with the number of cattle heads. However the graphs show a slight increase in cattle heads in both municipalities in the period 2008 to 2014. In Caiapônia the number of cattle heads increased from 389,000 to 406,000. In Piranhas the number of cattle heads increased from 196,000 to 203,000. This moderate increase does not necessarily mean that deforestation of natural vegetation occurred to accommodate the cattle expansion. It could be that the efficiency of cattle ranching increased, resulting in a number of cattle head per hectare, higher than the average number of 1.5.

#### *6.1.2.4 Productivity of grain and cattle*

According to soybean producer Victor (2016), the number of cattle heads decreased when soybean production started in Caiapônia but after a while the efficiency and techniques improved. As a result the number of cattle heads increased again. Cooperative Comigo in Caiapônia (2016) agrees with soybean producer Victor. An agronomic engineer from Comigo Caiapônia (2016) explained that cattle ranchers were triggered by the soybean expansion to keep more cattle per hectare on their land. In addition their technique to maintain the soil quality improved. Cattle ranchers now divide their land in two parts and use a rotation system. They keep all their cattle on one part of the land and do not use the other part of the land so the soil can recover. After a certain period they put the cattle on the part of the land that recovered its fertility. According to Comigo in Caiapônia (2016) the average amount of cattle per hectare increased from 0-3 to 3-5 cattle heads per hectare in the period 2008 to 2016. This means that the average number of cattle heads per hectare increased from 1.5 to 4 cattle heads per hectare. An assumption is that the efficiency of cattle ranching also increased in Piranhas. If this assumption is true then 101,500 hectares of land would be used for cattle ranching in Caiapônia and 50,750 hectares in Piranhas (see table 6.3). This is equal to 12% of the municipal area of Caiapônia and to 25% of the municipal area of Piranhas. Table 6.3 shows that the number of cattle heads per hectare

is an important factor in the amount of land used. In 2014 the land used for grain production (soybean and corn) in Caiapônia was 136,000 hectares and in Piranhas this was 10,950 hectares. In 2014, 16% of the total area of municipality Caiapônia was used for grain production while in Piranhas 5% of the area of the municipality was used for grain production. Therefore it could be argued that the competition for pasture land is higher in Caiapônia than in Piranhas.

Table 6.3 Hypothetical increased productivity for cattle ranching in the municipalities Caiapônia and Piranhas

Municipality	Cattle heads	Area of municipality (ha)	Hectares used for cattle (1.5 cattle heads/ha)	Percentage of area used for cattle (1.5 cattle heads/ha)	Hectares used for cattle (4 cattle heads/ha)	Percentage of area used for cattle (4 cattle heads/ha)
Caiapônia	406,000	863,787	270,667	31	101,500	12
Piranhas	203,000	204,776	135,333	66	50,750	25

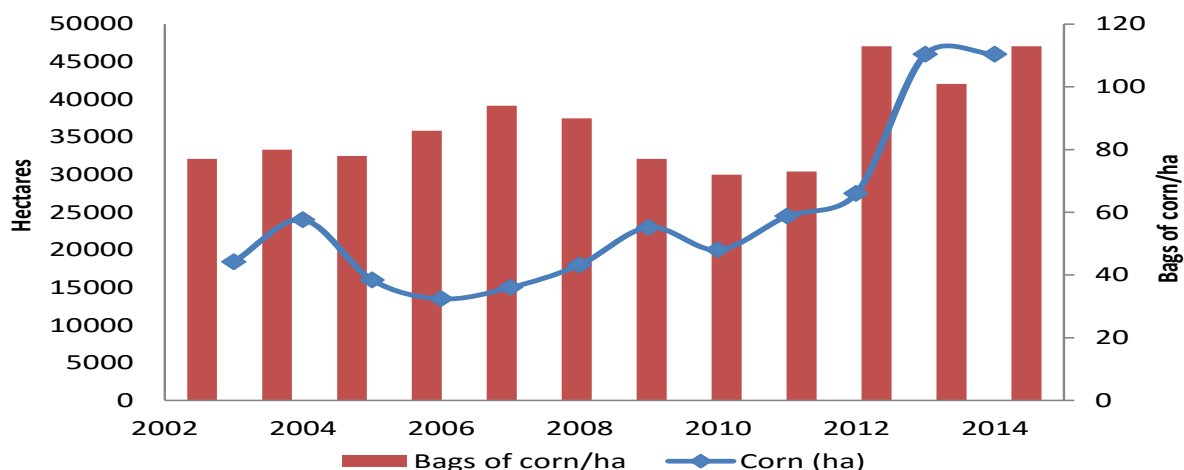
Source: IMB, 2016

Figures 6.4a, 6.4b, 6.5a and 6.6b show the expansion of grains in hectares and the productivity in bags per hectare for both municipalities. The productivity of both crops is calculated by dividing the total production with the amount of hectares used for the production. IBGE data on corn and soybean production per municipality was available in tons of production per year. This data was converted into kilograms by dividing the number of tons by 1,000 (one ton equals 1,000 kilograms). Subsequently this outcome was multiplied with 60 because one bag of corn or one bag of soybean weighs 60 kg (Opere Futuros, 2016). The figures illustrate that the area used for grain production and the productivity of grain production increase at the same time. Caiapônia has a higher productivity of corn than Piranhas. In 2014 the corn productivity was 113 bags of corn per hectare in Caiapônia while in Piranhas the corn productivity was 77 bags of corn per hectare. This shows that the production of corn is more challenging in Piranhas than in Caiapônia; respondents from all Jataí, Caiapônia and Piranhas explained that this was due to the weather conditions in Piranhas. Furthermore the graphs related to soybean production show that the productivity in Piranhas is overall slightly higher than in Caiapônia. In Piranhas the productivity is 53 bags of soybean per hectare while in Caiapônia the productivity is 46 bags of soybean per hectare. Possibly this is the result of a difference in soil fertility. According to respondents from Jataí (2016), the soil in Piranhas has naturally a higher fertility than the soil in Caiapônia.

In the period 2008 to 2014, after the sugarcane expansion in Jataí, the corn productivity in Caiapônia increased from 90 bags of corn per hectare to 113 bags of corn per hectare (26%). In Piranhas the productivity of corn increased from 57 bags of corn per hectare to 77 bags of corn per hectare (35%) in the same period. Although the corn productivity increased more in Piranhas than in Caiapônia the actual yield per hectare is lower. The area used for corn production in Caiapônia increased from 18,000

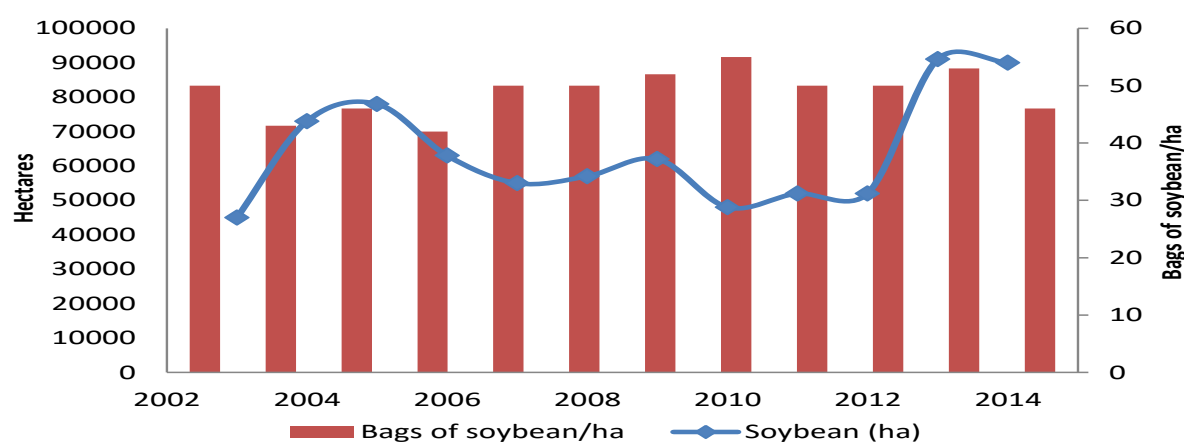
hectares to 46,000 hectares (126%) in the period 2008 to 2014. In the same period the area used for corn production in Piranhas increased from 300 hectares to 950 hectares (217%). In relative terms the area for corn production increased more in Piranhas than in Caiapônia; in absolute terms it did not.

Figure 6.4a Land use for corn production and productivity in Caiapônia



Source: IMB, 2016

Figure 6.4b Land use for soybean production and productivity in Caiapônia

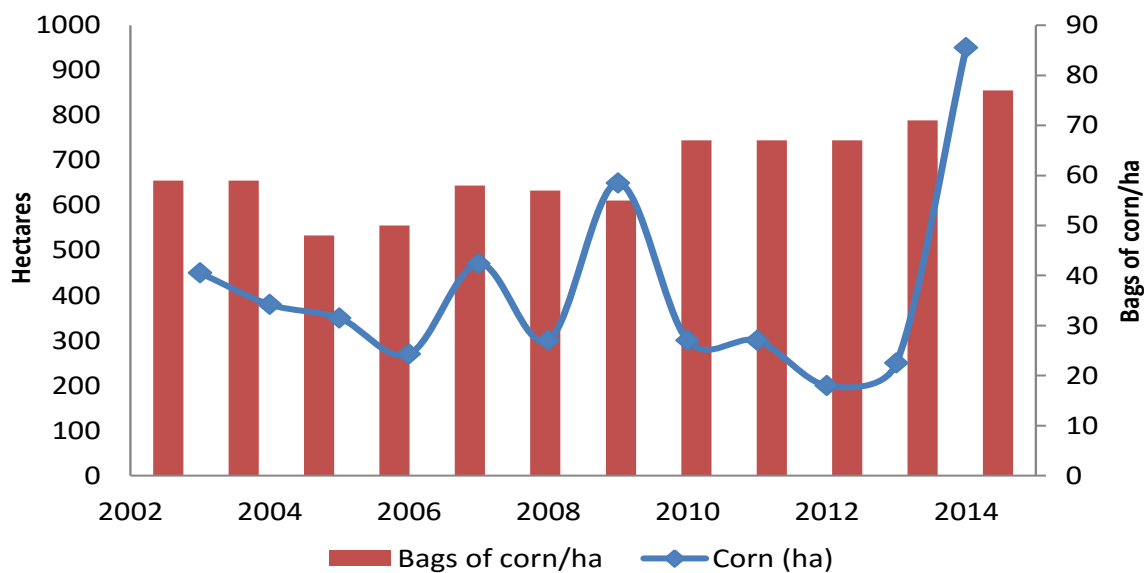


Source: IMB, 2016

In the period 2008 to 2014, the soybean productivity in Caiapônia decreased from 50 bags of soybean per hectare to 46 bags of soybean per hectare (8%). In Piranhas the soybean productivity decreased from 56 bags of soybean per hectare to 53 bags of soybean per hectare (5%). This illustrates that in both relative terms and absolute terms the soybean productivity decreased less in Piranhas than in Caiapônia. The underlying cause for this is not yet clear. The area used for soybean production in Caiapônia increased from 57,000 hectares to 90,000 hectares (58%) in this period. In Piranhas the area used for soybean production increased from 650 hectares to 10,000 hectares (1,438%) in the same

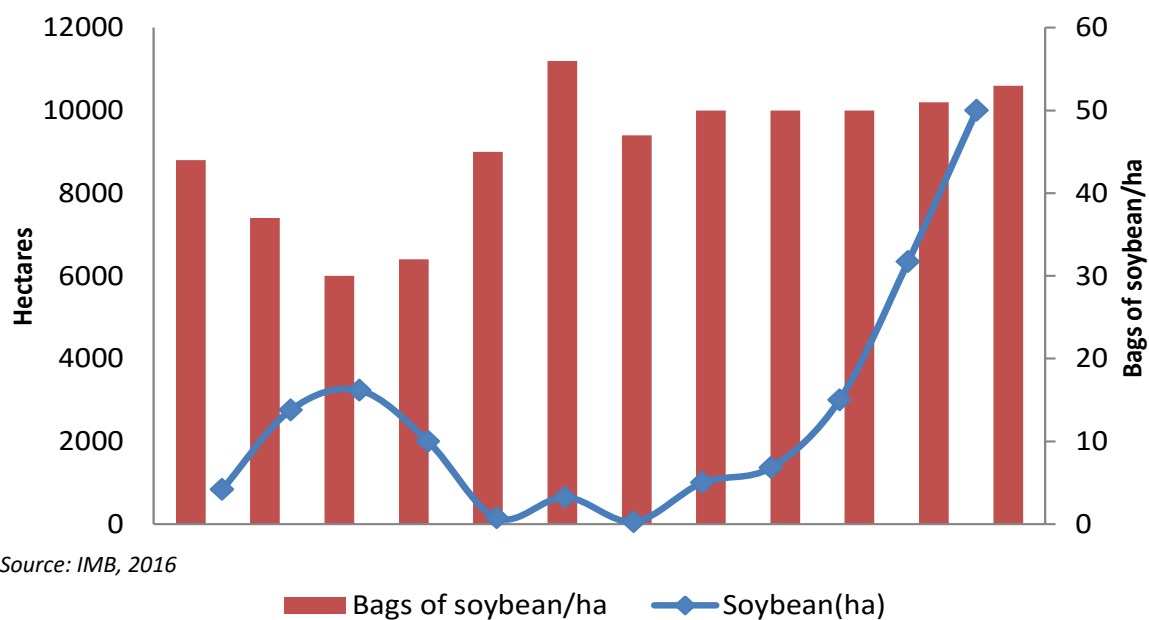
period. This shows that the expansion of soybean production is relatively higher in Piranhas than in Caiapônia.

Figure 6.5a Land use for corn production and productivity in Piranhas



Source: IMB, 2016

Figure 6.5b Land use for soybean production and productivity in Piranhas



Source: IMB, 2016



#### *6.1.2.5 Natural vegetation and legal reserves*

According to respondents from Caiapônia and Piranhas (2016), a substantial part of the municipalities consist of natural vegetation (from the Cerrado biome) and waterfalls (see figure 6.6). Both municipalities make effort to attract tourists with their potential for ecotourism; national television (TV broadcast Globo) made an item about the waterfalls from both municipalities and both municipalities are presented on the new tourist map of the state Goiás in 2016 (Municipality Piranhas, 2016).

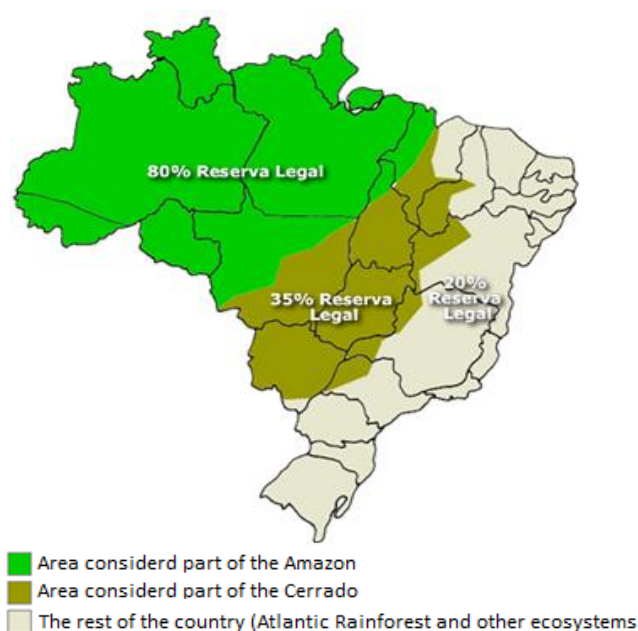
Figure 6.6 Mountainous landscape in Caiapônia and the waterfall São Domingos in Piranhas



Source: Author. 2016

Brazil's main law to protect natural vegetation on rural properties is the 'New Forest Code' (Lei nº 12.651, from 25-05-2012). This law states that every rural property must preserve a certain percentage of the rural property's natural vegetation; it can be natural forest or artificial forest. This area is called the 'Legal Reserve'. The percentage of Legal Reserve depends on the geographical location of the rural property. For rural properties located within the Amazon biome 80% of the property needs to be preserved; for rural properties located

Figure 6.7 New Forest Code – Legal Reserve per region



Source: Guia da Carreira, 2016

within the Cerrado biome 35% of the property needs to be preserve; for rural properties located in the rest of the country, 20% of the property needs to be preserved (see figure 6.7). The Legal Reserve must be maintained by the rural property owner, possessor or occupant under any title, person or entity, public or private (Presidência da República, Casa Civil, Subchefia para Assuntos Jurídicos, 2012). The law consists of two key conservation measures that could support the commodification of standing forests in all biomes. The first measure is the option for landowners to trade surplus forests that could be legally deforested on one property to offset restoration requirements on another (see figure 6.8). The second measure is the creation of an online registration system for landowners to register their rural property boundaries and environmental information. This will improve monitoring of rural properties and create transparency of land use (Soares-filho et al., 2014).

From the 15 soybean producers from Jataí, which expanded production elsewhere, 3 (20%) had their Legal Reserve located in Caiapônia to compensate for the lack of natural vegetation on their land in Jataí. Caiapônia is a municipality where many rural producers have their natural reserve as the municipality has a substantial amount of natural vegetation and mountainous land that is not useful for agriculture (Agrodefesa Caiapônia, interview, 2016). From the 15 soybean producers from Jataí, that expanded production elsewhere, 3 (20%) have a natural reserve in the municipality Serranópolis, adjacent to Jataí. The rest of the people have their Legal Reserve on their rural property in Jataí or they lease land and do not have a Legal Reserve. According to the respondents from Jataí (2016), the landowners are responsible for maintaining a Legal Reserve while rural producers that partly lease the rural property are not responsible for maintaining a Legal Reserve because they only lease the land



they use for production. It could be argued that leasing land is a way to get around the New Forest Code. According to Agrodefesa Caiapônia (2016), this New Forest Code is not beneficial for wildlife as these animals need corridors of natural vegetation to migrate to other regions. In addition it would lead to selected preservation of certain regions that are not useful for agriculture.

Figure 6.8 Rural producers from other municipalities in Goiás with legal reserves in the municipality Caiapônia



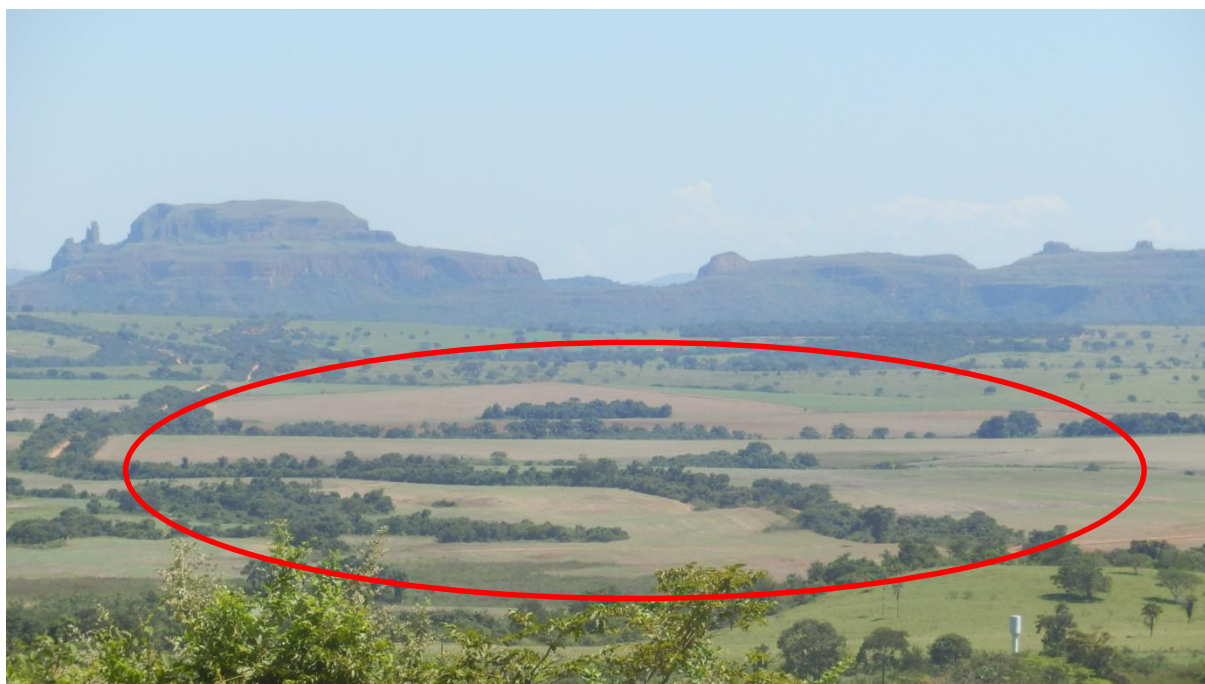
Source: Author, 2016

According to the respondents from Caiapônia and Piranhas the soybean expansion takes place on pasture land (see figure 6.9). Agrodefesa Caiapônia (2016) mentioned that the transformation of pasture land to land suitable for soybean production involves the removal of natural vegetation (deforestation); rural producers call it euphemistically, *limpeza da terra* (cleaning of the land) (see figure 6.10). Soybean production is one of the top four agricultural supply chains driving deforestation in Brazil (The Global Canopy Program, 2015). Little recent data is available on deforestation rates in the municipalities Caiapônia and Piranhas. IBGE only offers data on natural vegetation for the year 2006. However according to a report from the Environmental Ministry of Brazil (2007), the municipality Caiapônia was in the top five of municipalities from Goiás with the most deforestation in the period of 2002 to 2009 (Castro, 2012). In the period of 2002 to 2008, 9,898 km<sup>2</sup> was deforested in the state Goiás. From this deforestation 4,455 km<sup>2</sup> was deforested in the municipality Caiapônia (Goiânia no Coração, 2011). In the period 2003 to 2004, Caiapônia was the municipality with the second most deforestation of Goiás, 8,169 hectares were deforested. In the period 2004 to 2005, Caiapônia was on the tenth place of municipalities in Goiás with deforestation; 350 hectares were deforested (Silva & Ferreira Júnior, 2010). The lack of recent data on natural vegetation and deforestation shows the

challenges towards monitoring it. According to various respondents (Agrodefesa Caiapônia and the representative of CPT Caiapônia) there is no monitoring in the municipalities Caiapônia and Piranhas. The monitoring of deforestation takes place on the state level and not on the municipal level (Agrodefesa Caiapônia, interview, 2016). Both municipalities do not have an environmental secretary to monitor the state of the environment. An example on the lack of monitoring; natural reserves should be fenced in order to keep cattle out. However according to the CPT representative from Caiapônia (2016) compliance with the law is minimal (see figure 6.11). The City Hall of Caiapônia mentioned that the environmental secretary does not function properly.

*“The environmental secretary is only on paper present. There is no person I could send you to for an interview”* (Secretary of Administration Caiapônia interview, 2016. Translated from Portuguese by author).

Figure 6.9 Pasture land transformed into land used for soybean production (Caiapônia)



Source: Author, 2016



Figure 6.10 Cleaning of pasture land before planting soybeans (Caiapônia)



*Source: Author, 2016*

Figure 6.11 No fence to protect the natural reserve from cattle (Piranhas)



*Source: Author, 2016*

## 6.2 Three phases of soybean expansion

Findings from the research show that soybean expansion in Caiapônia is going on for a longer period than in Piranhas. The process of soybean expansion in Caiapônia and Piranhas can be divided into three phases, where Caiapônia is in phase three and Piranhas in phase two.

The three phases are:

1. Phase1: A few local cattle ranchers start producing soybean.
2. Phase2: Soybean producers from outside the municipality start leasing land from cattle ranchers to plant soybean; others observe that soybean production is feasible and get interested.
3. Phase3: Companies and consultants related to the grain industry start to settle in the municipality; accessibility to soybean production increases.

### 6.2.1 Phase one

In both municipalities local cattle ranchers were the pioneers of soybean production. The president of the grain department from the Rural Union and soybean producer Rafael (2016), explained that his father (local cattle rancher) started producing soybean on a part of his land in Caiapônia in 2003. Before soybean production this cattle rancher used his land for rice and cattle production in a rotation system. However this turned out to be unfeasible because the production of cattle was not going well. It became more difficult to gain profit with cattle because the price of meat declined and the land was poor. Due to this low fertility it was not possible to produce enough grass on the land to sustain or expand the number of cattle. At the time, soybean production offered an opportunity to make more profit. According to Marcos (2016), one of the pioneers of soybean production in Piranhas, the difference in profit between cattle ranching and soybean production was R\$300 per hectare in 2010; nowadays the difference is minimal. In Piranhas the pioneers of soybean production had equal motives to partly use their land for soybean production. According to soybean producer Henrique (2016), soybean and cattle are partners because the soybean production makes the soil more fertile (degraded soil will recover). He expressed that a rotation system with cattle and soybean production is workable because after soybean production more grass (*capim*) can be planted on the land and as a result more cattle can kept per hectare. In other words the pioneers used soybean production as a *strategy to recover their degraded lands* and subsequently get *more profit* with soybean production or cattle production (Respondents from Caiapônia and Piranhas, 2016). Pioneers Marcos and Henrique (2016) are using a rotation system with soybean production and cattle; although they will not apply the rotation system on the flat parts of their land because flat land is good for mechanical planting and harvesting. A distinctive characteristic of these pioneers of soybean production is that they do not use

their entire land for the production of soybeans. For example, pioneer Henrique (2016) plants 800 hectares with soybeans but still uses 200 hectares for cattle. He uses the flat parts of his land for soybean production because his hilly land does not allow mechanical planting and harvesting. Caiapônia and Piranhas have a lower altitude than the municipality Jataí. This results in a climate with more extremes (warm and irregular rainfall). According to soybean pioneer Rafael (2016), soybean production in Caiapônia started by using the soybean variety that was used in Jataí. It turned out that this type was not productive in Caiapônia. According to Rafael (2016), there was another factor that hindered the development of the soybean expansion in Caiapônia. In 2006 the soybean production got hit by a crisis of the aggressive fungus disease (*ferrugem*); he lost 70% of his harvest.

### 6.2.2 Phase two

In the second phase of soybean expansion soybean producers from outside the municipalities started to get interest in producing soybeans in Caiapônia and Piranhas. Local cattle ranchers were anxious towards soybean production in their region because they did not know how to produce the crop and were afraid to lose their land to the crop (Rural Técnica Caiapônia, interview, 2016). According to the agricultural consultant, Rural Técnica in Caiapônia (2016), the beginning of the soybean expansion in Caiapônia was slow because soybean producers from Jataí were reluctant; it was not certain whether the soybean variety that was used in Jataí would be profitable in Caiapônia. Most of the soybean producers in Caiapônia and Piranhas are not originally from these municipalities. They are mainly from municipalities with a longer tradition of soybean production like the neighboring municipalities Jataí and Rio Verde.

*“There are approximately 30,000 soybean producers in Caiapônia of which approximately 15,000 to 20,000 producers come from other regions (more than 50%)”.* (Soybean producer Thiago, interview, 2016. Translated from Portuguese by author).

Rural Técnica in Caiapônia (2016) estimates that 70% of the soybean producers in Caiapônia are from the two neighboring municipalities Jataí and Rio Verde; from this 70% only 30% would actually live in Caiapônia. Furthermore, Edison (2016), a rural real estate broker, confirms that many soybean producers in Caiapônia are from Jataí. In order to increase his network of clients he uses a snowball method by asking his existing clients if their neighbors are interested to sell, lease or buy land. In this manner he gets a wide social network of rural producers from the region. According to Edison (2016), he is friends with everyone in Caiapônia; however many of his clients (that are looking for land to lease for soybean production) are from Jataí and still live in Jataí. He explained that these soybean producers

from Jataí got interested in expanding in Caiapônia because they observed that soybean production was feasible in that municipality; besides this Caiapônia has a lot of pasture land that could be transformed into agricultural land.

*“More movement created more movement”* (Rural real estate broker Edison, interview, 2016. Translated by author).

In Piranhas also various respondents confirmed that the majority of the soybean producers came from another region and leased land from the cattle ranchers (landowners). A cattle rancher from Piranhas (2016) stated that most soybean producers that lease land in Piranhas are from the municipality Jataí and live in Jataí; this respondent knew only three local cattle ranchers that switched to soybean production.

*“From the soybean producers in Piranhas, 80% are not from the municipality and live in the municipality Jataí”*. (Local cattle rancher and soybean pioneer Marcos, interview, 2016. Translated from Portuguese by author).

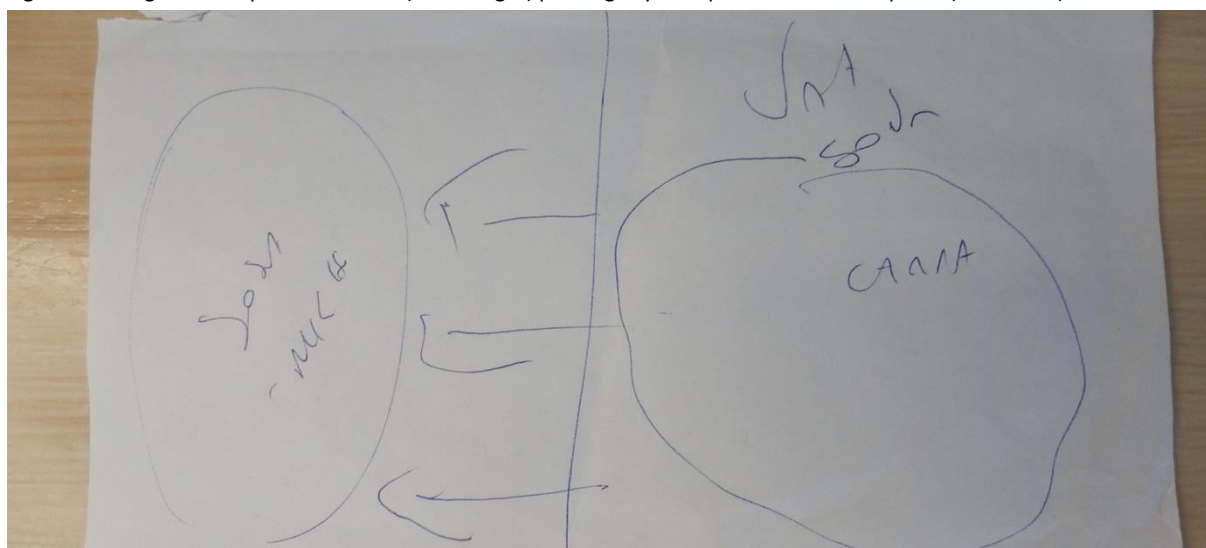
From the 19 respondents, in Caiapônia and Piranhas, 10 (53%) confirm that the sugarcane expansion in neighboring municipalities like Jataí contributed to the soybean expansion in Caiapônia and Piranhas because soybean producers that lost land to sugarcane production migrated to the municipalities. However these respondents also explained that it are not just soybean producers which lost land to sugarcane that came to Caiapônia and Piranhas. The regions would be attractive because the lease price for land is lower than in Jataí or Rio Verde. From the 19 respondents 5 (26%) confirm that that many soybean producers came from the municipalities Jataí and Rio Verde but that they not necessarily lost land to sugarcane and that therefore the sugarcane production did not influence the soybean expansion in Caiapônia and Piranhas. The last 4 respondents (21%) said nothing on this matter. It can be conclude that the majority of the respondents believed that sugarcane expansion in neighboring municipalities (especially in the municipality Jataí) pushed soybean producers to the municipality Caiapônia and Piranhas. According to Rural Técnica (2016), there was another wave of soybean expansion in Caiapônia after the construction of the Raízen unit in Jataí in the years 2007 to 2008. Furthermore, the manager from ‘Plano Terra’, a financial advice bureau for cattle ranchers, believes that sugarcane in Jataí is pushing soybean producers from Jataí towards Caiapônia (see figure 6.12). This respondent lives in Caiapônia since 1974 and knows the region well, therefore his information seems reliable.



*“Sugarcane expansion in Goiás had a big influence on the soybean expansion in Caiapônia”.* (Soybean producer Anderson, interview, 2016. Translated from Portuguese by author).

For example, soybean producer Leandro (2016) had to relocate his production from Jataí to another region because he lost his land to sugarcane production. He decided to migrate to Caiapônia to produce soybeans. Despite earlier assurances and a scheduled appointment, it was not possible to meet with Leandro for an interview because he stopped answering his phone. Leandro and soybean producers like him invested for 20 to 30 years in the soil quality of the land they used to lease in Jataí. It is arguable that these soybean producers perceive it as shameful to talk about the land that they lost to sugarcane production.

Figure 6.12 Sugarcane expansion in Jataí (on the right) pushing soybean production to Caiapônia (on the left)



Source: Manager from Plano Terra in Caiapônia, 2016

After soybean producers from other regions (like Jataí) got interested in producing soybeans in Caiapônia and Piranhas, local cattle ranchers from Caiapônia and Piranhas (landowners) had the opportunity to lease or sell a part of their land to these soybeans producers. Local cattle ranchers never managed their soil (corrected their soil) for many years which led to soil degradation. According to soybean pioneer Rafael (2016), the grass died on the degraded soil which resulted in a bad situation for cattle ranchers because the cows could not graze on the land. At this time the meat price was low so the cattle ranchers had no financial resources to correct their soil. Soybean producers from other regions offered the solution; they could lease the (degraded) land from cattle ranchers and make the soil corrections. Especially from the years 2012 to 2013 soybean producers from other regions came to Caiapônia to lease land (Soybean pioneer Rafael, 2016). For example, former cattle rancher Douglas (2016), leased 2,000 hectares of his land to a soybean producers from the municipality Rio Verde in

2003; leasing his land for soybean production was more profitable than keeping cattle on the land at that time. The soybean producer reformed the pasture land into land suitable for soybean production. Former cattle rancher Douglas (2016), observed that soybean production was profitable on his land and decided to not extend the lease contract after 12 years. In 2015 cattle rancher Douglas started to produce soybeans himself. This example shows how the strategy to use soybean producers to recover degraded lands can lead to soybean production by the local cattle ranchers. In Piranhas the cattle ranchers (landowners) also start to lease a part or all of their land to soybean producers from other regions, mainly from Jataí (Respondents from Piranhas, interview, 2016). For example, landowner Maria (2016) leased her rural property of 48 hectares to a soybean producer from Jataí; the lease contract runs from 2011 to 2021 (for 10 years). She did not plant soybeans herself because she did not have the required knowledge and experience.

Not all cattle ranchers can change to soybean production because the machines to manage the land (plant and harvest seeds) are very expensive (Soybean producer Rafael, interview, 2016). Usually cattle ranchers do not own these machines because often they leave the land unmanaged. A cattle rancher from Piranhas (2016) explained that he considered to produce soybeans but decided not to start with soybean production because the investment in machines would be very large. In addition, soybean producer Fábio (2016) argued that many cattle producers start leasing their land for soybean production instead of producing the crop themselves because the machinery is very expensive.

*“If I would change to soybean production I would have to invest in machines. It would take 10 years for me to payback the investment. I do not want to be financially bound for such a long time and live less comfortable during this period. It would change my life”.* (Cattle rancher from Piranhas, interview, 2016. Translated from Portuguese by author).

This cattle rancher also explained that his age played a role in not wanting to be financially bound to a large investment. He is 50 years old and would be 60 years old by the time he is done paying for the machines. He explained that many of the cattle ranchers are old and do not want to start a new activity and get another financial responsibility (paying back the soybean machines). This is also the case for the father of soybean producer Julio.

Before soybean producers from other regions came to Caiapônia and Piranhas local cattle producers were not used to lease their land to others or to lease land from others. After soybean producers from other regions started to lease land some local cattle ranchers started to imitate these soybean producers by also leasing land for soybean production. Examples are former cattle rancher Rafael from



Caiapônia, former cattle rancher Marcos from Piranhas and soybean producer Thiago from Caiapônia. After Rafael and Marcos started to get profit with soybean production they wanted to expand production; the solution for expansion was to lease extra land from their neighbor (cattle producer). Hernani started to lease 450 hectares and Julio 220 hectares. Soybean producer Thiago (2016) was a different case. After graduating in agronomic engineering he started a consultant office in Caiapônia in 2009. After saving money he started to lease 150 hectares of land for soybean production in 2012.

The lease price for pasture land starts low in the first year but increases the following six years. The reason for this is that the profitability of the land is low during the first six years because the soil of the pasture land has to be corrected; it is also a large investment for the land leaser. The lease price in Piranhas is about three bags of soybean less than in Caiapônia. In Caiapônia the general lease price for pasture land is:

1. The first year the harvest is about 25 bags of soybean per hectare and the lease price is 5 bags of soybean per hectare.
2. The second year the harvest is 30 bags of soybean per hectare and the lease price is 6 bags of soybean per hectare.
3. The third year the harvest is 35 bags of soybean per hectare and the lease price is 7 bags of soybean per hectare.
4. The fourth year the harvest is 40 bags of soybean per hectare and the lease price is 8 bags of soybean per hectare.
5. The fifth year the harvest is 45 bags of soybean per hectare and the lease price is 9 bags of soybean per hectare.
6. The sixth year the harvest is 50 bags of soybean per hectare and the lease price is 10 bags of soybean per hectare.

### **6.2.3 Phase three**

In this last phase more soybean producers from other regions and local cattle ranchers start to produce soybean in the municipality; the soybean production is starting to get stable which attracts grain industry related companies and facilities (like the construction of warehouses). After the settlement of these companies and facilities the accessibility to soybean production increases for local rural producers and for soybean producers outside the municipality because soybean producers need to travel less to the municipalities Jataí or Rio Verde (neighboring municipalities with the highest grain production of the state) to acquire technical assistance for the production of soybeans and to store the harvest in warehouses (Respondents from Caiapônia, interviews, 2016). This phase is applicable to

the municipality Caiapônia because in the municipality Piranhas the soybean expansion started later and no warehouses or agricultural companies are located there yet. The cooperative, Comigo, was planning to construct a warehouse for grains in the municipality Piranhas but it was postponed indefinitely due to financial issues related to the bad grain harvest in the past two years (Agronomic engineers from Piranhas, interview, 2016). The years 2013 and 2014 had a shortage of rainfall and the temperature was higher than usual, which led to a bad harvest for the municipalities Jataí and Rio Verde. This had financial consequences for Comigo because less grain (harvest) was sold to the cooperative. Agronomic engineers from Piranhas (2016) expect that in a few years the cooperative will construct a warehouse in Piranhas. In addition to Comigo, the company Safra Forte from Jataí was also considering to construct a unit in the municipality Piranhas.

Contrary the municipality Caiapônia has a longer tradition in producing soybean. Ten years ago when the soybean production started in Caiapônia, there were no warehouses to store and dry the grain nor companies to offer technical assistance for soybean production. But after more soybean producers started to produce in the municipality and good results were achieved, companies and facilities related to the grain industry were attracted to the municipality. In 2008, Comigo was the first company in Caiapônia to help soybean producers. This cooperative supports agricultural and cattle producers with maintenance of the soil and with technical assistance. According to agronomic engineer Getúlio from Comigo (2016), the establishment of Comigo was followed by other companies that offer technical assistance to soybean producers (see figure 6.13). Two of these companies are: Rural Técnica from Jataí and Casa Fertil from Rio Verde; Rural Técnica came to Caiapônia in 2013 and Casa Fertil in 2014. All of these companies are retail stores for agricultural products (fertilizers, pesticides etc.) and technical agricultural consultancy and stores to offer veterinarian products and services. It is remarkable that these companies expanded in Caiapônia after the sugarcane expansion in the municipality Jataí; this indicates that the soybean expansion in Caiapônia increased after the sugarcane expansion in Jataí.

Figure 6.13 Cooperative for grain producers in Caiapônia (Comigo)



Source: Author, 2016

“The company started a unit in Caiapônia because the soybean production became stable in the municipality and we saw that the soybean producers from Caiapônia needed a company like us” (The manager of Rural Técnica in Caiapônia, interview, 2016. Translated from Portuguese by author).

According to agronomic engineer Getúlio from Comigo (2016), the establishment of Comigo was equally beneficial for the cattle ranchers as it was for the soybean producers because they offer technical assistance for both activities. According to him the efficiency of the land use by cattle ranchers increased significantly after Comigo came to Caiapônia; it used to be 0 – 5 cattle heads per hectare but now it is 3 – 5 cattle heads per hectare. The establishment of companies related to the grain industry increased the expansion of soybean production. According local soybean producer Anderson (2016), the increase in agricultural businesses, Comigo and the construction of three warehouses for grains stimulated other soybean producers to expand in Caiapônia or local cattle ranchers to start producing soybeans (see figure 6.14). For example, the former local cattle rancher and nowadays also soybean producer, Victor (2016), started producing soybeans. His grandfather was a colonel and employed people to work on his farm (*meieros*). The sons of these *meieros* started planting soybeans. This stimulated Victor and his brother to start producing soybeans. Victor already had experience in producing soybeans because he and his brother produced soybeans in the state São Paulo. Victor moved to Caiapônia because his wife lived there. In Caiapônia he used his land for cattle because there were no facilities to produce soybeans. Although he already had experience in producing soybeans, because his brother is a soybean producer in the state São Paulo, only after the structure for soybean production improved in Caiapônia he also started to produce soybeans (structure refers to companies and warehouses related to the grain industry).

Figure 6.14 Warehouse for grains in the municipality Caiapônia



Source: Author, 2016

*“Comigo gave the opportunity for agriculture in Caiapônia”.* (Soybean producer Victor, interview, 2016. Translated from Portuguese by author).

To summarize; in the municipality Caiapônia the soybean production started to expand with soybean producers and companies from the neighboring municipalities Jataí and Rio Verde. Caiapônia is the beginning of the regional soybean expansion according to soybean producer Thiago from Caiapônia and soybean producer Marcos from Piranhas (2016). According to them the soybean production started in Caiapônia and later (around 2012) expanded in surrounding municipalities of Caiapônia like Doverlândia, Palestina de Goiás, Bom Jardim, Arenópolis and *Piranhas*.

## **6.3 Interaction new soybean producers with the local rural population**

### **6.3.1 Cattle ranchers**

As outlined in the previous paragraphs, the majority of the soybean producers in Caiapônia and Piranhas are from Jataí and Rio Verde and also live in these municipalities. This paragraph looks into the interaction of these soybean producers with the local rural population of Caiapônia and Piranhas. Since cattle ranchers are the majority of the rural population the focus is on them.

The majority of the soybean producers lease land in Caiapônia and Piranhas. Therefore the contact between local cattle ranchers and soybean producers from Jataí is on a professional basis. As many from these soybean producers do not live in Caiapônia or Piranhas they barely visit the city of the municipalities. Juarez (2016), a consultant for cattle ranchers in Piranhas, is not against the production of soybean in the region because soybean production only recently started and the impact on cattle ranchers is still limited. However he is afraid that there might be less demand for consultancy when cattle ranging is widely replaced by soybean production.

*“Soybean producers come for 99% from other municipalities like Jataí and Rio Verde. They just pass the city Piranhas or live on their leased farm land. They barely live here therefore I do not know them”.* (Cattle rancher consultant Juarez, interview, 2016. Translated from Portuguese by author).

The case of soybean producer Bento from Jataí (see paragraph 5.3.5) illustrates that he expanded towards a neighboring municipality instead of a remote location because this is more efficient, as he is able to travel quickly to and from this farm without the need live on that location for long periods. Therefore contact with the local cattle ranchers was limited to the necessary. This soybean producer only had contact with the cattle rancher (landowner) from whom he leased the land in Piranhas and Caiapônia. However there are cases in which contact between soybean producers and neighboring cattle ranchers inspired cattle ranchers to also produce soybeans. The interactions are primarily related to leasing land, borrowing tractors or exchanging agricultural knowledge.

- Soybean producer Marcos from Piranhas got inspired to plant soybeans after he got in touch with his neighbors. His neighbors are soybean producers from Jataí and asked Julio to lease them 600 hectares of his land for soybean production. Today these soybean producers lease the land for six years and the contract will run until the year 2020.
- As machinery for soybean production is expensive not every cattle rancher can afford it. Therefore cattle ranchers that recently switched to soybean production sometimes borrow machines to plant and harvest from soybean producers from Jataí (Soybean producer Tiago, interview, 2016). These interactions sometimes lead to the exchange of employees. For example, Tiago was the manager from a soybean farm belonging to a local soybean producer who used to borrow machinery from a neighboring soybean producer from Jataí. The farm on which Tiago previously worked stopped because the owner could not produce soybeans in a profitable manner. At that time the soybean producer from Jataí asked Tiago if he wanted to work on his farm as a manager. This was very beneficial for the soybean producer from Jataí because now Tiago could look after the farm in Piranhas while the soybean producer from Jataí could continue to live in Jataí.
- From the 6 soybean producers from Jataí that relocated or expanded production in Caiapônia or/and Piranhas 4 explained (66%) that they first tried to plant the soybean variety they also used in Jataí. However they all mentioned that the climatic conditions are different than in Jataí (warmer and irregular rainfall); therefore the soybean seeds used in Jataí were not suitable for Caiapônia and Piranhas. After a bad harvest they consulted local soybean producers, who already planted for a longer period in these municipalities, about the right soybean variety and the best periods to plant and harvest. It is remarkable that information exchange only starts after a soybean producer has had a poor harvest. The currently used soybean varieties that are profitable in regions like Caiapônia and Piranhas were developed by Embrapa. For 2 of the 6 respondents (34%) the data was missing.

According to two agronomic engineers from Seara in Piranhas (2016), the agricultural machines, employees and financial inputs like loans/credits from banks come from the municipalities Jataí and Rio Verde. A financial credit for the financing of agricultural inputs is called '*Custeio Agrícola*'. A bank for rural producers, Sicoob, offers these financial credits for rural producers that want to diversify, modernize, or expand production. The amount of credit is linked to the profile of the rural property. Financial credit might be granted for investments in machinery, animals for breeding and rearing, warehouses, irrigation, soil correction and the recovery of pasture land among others (Sicoob, 2016). From the 3 local soybean producers from Caiapônia 5 (60%) had contact with soybean producers from other region by visiting farms on '*Dia do Campo*', the '*Techno Show*' in Rio Verde (market for the

newest technology for agriculture), by contacting technical consultants from Jataí or Rio Verde and by informal conversations with other soybean producers in Caiapônia. However since more agricultural facilities get located in Caiapônia, for two from the five respondents (40%) the contact with Jataí decreases.

*“I used to have more contact with Jataí but my agronomic engineer is now from Caiapônia and the warehouse where I store my grains is now located in Caiapônia instead of Jataí. However I am still a client at Agromaq, a store for agricultural machinery in Jataí”.* (Soybean producer Anderson, interview, 2016. Translated from Portuguese by author).

Local soybean producers from Piranhas also had contact with soybean producers from other regions via ‘Dia do Campo’, importing technical assistance and agricultural machinery. These agronomic engineers live in Jataí and make visits to the farms in Piranhas once every two weeks (Respondents Piranhas, interviews, 2016). Contrary to soybean producers from Caiapônia whom sell their soybeans to warehouses/ companies in Caiapônia or Jataí, the soybean producers from Piranhas sell their soybeans harvest only to the warehouses/companies located in Caiapônia because it is closer than the warehouses located in Jataí (Respondents Piranhas, 2016).

*“When I started producing soybeans I had to import the techniques, technical assistance and machinery from Jataí and Rio Verde because Piranhas did not have the tradition and structure for agricultural production. I still import technical assistance from Jataí”.* (Local soybean producer Henrique, interview, 2016. Translated from Portuguese by author).

According to soybean producer Thiago (2016), in the beginning local soybean producers had to travel to the municipalities Jataí or Rio Verde to find technical assistance and to store their grain in warehouses. Nowadays warehouses are constructed and companies that offer agricultural inputs are slowly expanding in the municipality Caiapônia. Therefore it can be argued that the connection of local soybean producers from Caiapônia with Jataí will get weaker when more facilities related to the soybean industry get located in Caiapônia. As large (international) grain enterprises are still located in the municipality Jataí and Rio Verde (like Cargill, Coinbra, Nestlé, Gale Agroindustria etc.) connection will probably not completely disappear in the near future. Warehouses for grains and companies that offer agricultural inputs are not located in the municipality Piranhas. Therefore it can be argued that the connection with Jataí of local soybean producers from Piranhas will be stronger than that of local soybean producers from Caiapônia.

### 6.3.2 Small-scale farmers and occupation camps

The municipalities Caiapônia and Piranhas do not solely have large and medium sized cattle ranchers but also family farmers (small-scale farmers) are part of the rural population. This paragraph is about the attitude of small-scale farmers towards the recent expansion of soybean production.

#### 6.3.2.1 Small-scale famers

In total four small-scale farmers were approached for the research. All farmers came from the municipality Caiapônia. Two of them were interviewed on a local market and two on their rural property (see figure 6.15). These small-scale farmers produce a variety of products from different vegetables to *rapadura* (a candy made from sugarcane). The land of two from

Figure 6.15 Market for small-scale farmers in Caiapônia



Source: Author, 2016

the four respondents used to be surrounded by pasture land. Since a few years their land is surrounded by land used for the production of soybean and corn. These respondents were against the production of soybeans, the other two respondents did not have an opinion on soybean production because their land was not surrounded by land used for soybean production but with pasture land. Motives for being against soybean production are that a lot of poison is used for soybean production; this poison is used to repel insects. As a result these insects migrate to the land from the small-scale producers (neighboring land) because they do not use poison on their products. It was observed that some of the products from the small-scale farmers on the market were eaten by insects and therefore unsellable. These small-scale farmers produce organically without poison, but it is difficult to get it certified because poison that is used for soybean production sometimes lands on their crops; poison is spread by airplane and the wind takes it to neighboring lands. Additionally, the poison used for soybean production regularly kills crops from neighboring small-scale farmers. Small-scale farmers that are surrounded by land used for soybean production believe that they were better off in the times that they were surrounded by cattle ranching, because no poison was used with cattle ranching. In the municipality Jataí the same problem with poison occurs but also with the production of sugarcane. Soybean production has a bad impact on small-scale farmers. However representatives from the social movements Committee Pasture Land (CPT) and the National Federation of Family Agricultural Workers of (Fetraf) mentioned that some small-scale producers from a settlement from Incra started leasing



their land to a soybean producer in Caiapônia (See figure 6.16). This is illegal but Incra does not monitor the settlements. Unfortunately these farmers could not be located for an interview on their motives for leasing their land for soybean production.

Various respondents admit that the poison used by soybean production eventually gets in natural reserves and waterbodies, for example Agrodefesa Caiapônia and CPT representative Caiapônia (2016). According to Agrodefesa it is difficult to monitor the farms because many times the owner is not present on the farm. In addition the CPT representative from Caiapônia (2016)

Figure 6.16 Settlement from Incra used for soybean production (red circle)



Source: Author, 2016

argues that monitoring does not take place. The chemical used by soybean producers to prevent fungus or insects eating the crop is very poisonous. This is also acknowledged by soybean producers. An employee of Comigo in Caiapônia told a story of a soybean producer in the municipality Rio Verde that accidentally touched a poison with his fingertips, after two years his fingertips are still recovering from the burning. This product could not be transported together with other products because it was too poisonous. Unfortunately the employee from Comigo did not remember the name of this poison.

*"Tomorrow I will use this poison on the corn. It has a red label which means it is very poisonous not only for the insects but also for humans".* (Soybean producer Victor, interview, 2016. Translated from Portuguese by author).

A day after the interview with soybean producer Victor, an airplane was spotted spraying the poison on the land (see figure 6.17). This agricultural land is located next a natural reserve. it is very likely that the poison is also sprayed over the reserve and the waterbody from the reserve (reserves often have natural water springs). According to the representative of Fetraf in Caiapônia (2016), the wind can take poison up to 20 km. Besides this he argues that protected animals could get killed by the poison because these animals drink the poisoned water and eat the crops on the land (see figures 6.18a and 6.18b).



Figure 6.17 Airplane above natural reserve returning to corn field to spray pesticides



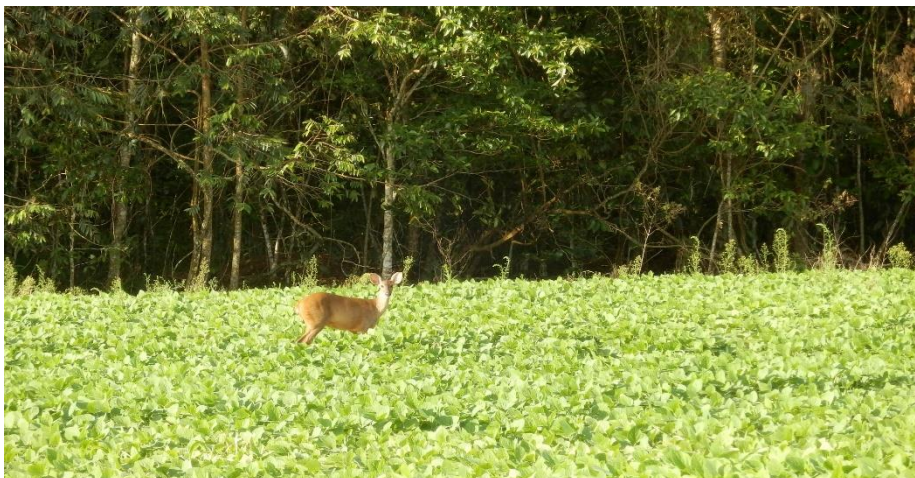
*Source: Author, 2016*

Figure 6.18a Protected animal named Ema on pasture land (Caiapônia)



*Source: Author, 2016*

Figure 6.18b Protected animal named Veiado Campeiro on land planted with soybeans (Jataí)



*Source: Author, 2016*

### 6.3.2.2 Land concentration and social movements

According to Jover Sino (2016), a descendent of the slaves that built Caiapônia, the first migrants came from the state Minas Gerais and founded the municipality Caiapônia. The grandfather of Jover Sino was born in a slave house (*senzala*) but he is also a descendent from one of the first families that settled in Caiapônia, the family Vilela; a mixture of slaves and masters (slave owners) arose. Jover Sino (2016) explained that the slaves were treated like animals, they were marked like the animals and had to be registered at the registration department for real estate (*cartório*).

In 1871 the law 'Lei do Ventre Livre' (Law No. 2040 of 09-28-1871) was created to slowly stop forced slavery. This law granted freedom to slaves born in Brazil after the enactment of the law. It gave slaves the option to stay with their master until the age of 21 (Unicamp, 2016). According to Jover Sino (2016), this law was actually the same as slavery because the slaves were prisoned on the farm; Slaves had nothing and nowhere to go because farms were located far from villages. Many slaves stayed with their master and did the same services as slaves. After the former slaves (freemen) reached the age of 21 the masters would say that they invested in taking care of the freemen and in this way a debt was created. To pay this debt the freeman had to provide service, which was in fact slavery (Historia Brasileira, 2016). Eventually on 13<sup>th</sup> of May in 1888 the slavery was completely forbidden with the creation of the law 'Lei Áurea' (Law No. 3353, of 13-05-1888). This law intended to free all slaves that were dependent on their masters (Unicamp, 2016). However an effective integration project for freemen to support their process towards independency was not introduced. Therefore many freemen continued to provide services to their former masters for housing and food. Brazil was the last country in the America to abolish slavery (Info Escola, 2016).

About 90 years ago the father of Jover Sino occasionally saw people from the indigenous group Caiapó close to the farm. There were many bloody fights between farmers and the indigenous group, which eventually led to the migration of the Caiapós to the north of the state Mato Grosso (to the Xingu region). The history of the municipality Caiapônia is comparable with the history of Brazil. It resulted in the high concentration of landowners in the municipality. Until today the land concentration is high in Caiapônia and agrarian reform did not take place according to Jover Sino (2016). The respondent mentioned that descendants of slaves did not get any land; his brother acquired a plot of land via Incra.

This high concentration of landowners in Caiapônia and Piranhas attracts social movements that struggle for less concentration in landownership. Various social movements are active in the municipalities Caiapônia and Piranhas. Examples of active social movements are CPT, Fetraf, Central Union of Workers (CUT) and Union of Rural Workers (STR). According to a representative of CPT in

Caiapônia (2016) there are currently 20 camps and 15 settlements in the municipality. These social movements do not have a positive image among the society in Brazil. An agronomic engineer from Agrodefesa Caiapônia (2016) explained that not every person from a social movement is really looking for agricultural land to produce on but often aims to gain agricultural land from the government and sell it to others.

*“Social movements are deceptive (malandragem). One part of the people just wants to obtain land from the government to sell it eventually for more money. This is illegal but it happens”* (Agronomic engineer Agrodefesa Caiapônia, interview, 2016. Translated from Portuguese by author).

Observation and conversations with people that are living on camps lead to the conclusion that the people on these camps are diverse. One group of people only live on the camp and grow their food on the camp; they had to give up their house in the city because of high living costs in the city (lease, water and electricity bills) and they do not have a car to visit the camp on a regularly basis. On the other hand there is a group of people that can afford to keep their job in the city and live in the city during the week. This group of people lives in the city during the week but visits the camp in the weekend. Another difference between people on the camp is that some have more expertise in farming (in a structured way) than others (see figure 6.19). The people are often portrayed as people that do not want to work and obtain land without having to make any effort; however contrary many of these people do want to work (produce food) and are therefore struggling to obtain a plot of land from the government (Respondents from occupation camps, informal conversation, 2016). Living on the camp is difficult because they neither have running drinking water nor electricity. Incra supports the camps in the first week by providing food, water and materials to build a shelter but after this week the people are on their own; often they drink the water from the nearest river.

*“I was able to keep my job in a store to gain money to provide food for myself. You need money to feed yourself. So I come during the weekends on the camp when I am free from my job”* (Rural worker on occupation camp in Caiapônia, interview, 2016. Translated from Portuguese by author).

Figure 6.19 Difference in farming expertise on an occupation camp (Caiapônia)



Source: Author, 2016

The situation for these people is very insecure because they do not know when they get a plot of land assigned; this can take years because the juridical process to expropriate land and the negotiation between the landowner and Incra to buy the land are time consuming (Respondents from occupation camps, interviews, 2016). Two respondents from a camp expressed that they were waiting for 10 years already. Each camp has a leader who maintains contact with Incra and follows the juridical process. Sometimes the negotiation process between Incra and the landowner takes too much time or does not go well. This has consequences for the people on the camps. There are cattle ranchers who use this situation to sell unproductive lands. An example happened in the municipality Caiapônia. A cattle rancher with a lot of land (nine rural properties) declared to Incra himself that his land was unproductively used and he wanted to sell his land to Incra. During the negotiation process this cattle rancher gave permission to the social movements Fetrat and STR to let people camp on his land. However when the negotiation did not go as the cattle rancher wanted the camps had to be removed from his property; Incra did not want to pay the amount that the landowner wanted or Incra took too long to decide. On a Friday the cattle rancher sent the police to the camps to announce that they had to be gone from his land after the weekend. This meant that 35 families had to relocate their camp within one weekend. These families are poor; often all their belongings are on the camp and most of the families do not have access to a car to relocate their belongings.

On the day that the camp had to be removed the cattle rancher hired 90 policemen, 30 policemen on horses, two helicopters and two vans to remove people from the rural property. The representatives from the social movements tried to negotiate with the policemen to give the people from the camp extra time to relocate the camp. In addition, representatives from social movements visited various camps to stimulate the people on the camps to stay strong and be united at this difficult moment. One of the camps that were visited is 30 km removed from the city Caiapônia; communication between people from that camp and other camps or social movements is therefore limited. The CPT representative (2016) explained that on the one hand the cattle rancher was right because it is his

property but on the other hand the cattle rancher was wrong by sending these poor people from his land for two reasons: firstly, he gave permission to poor people to camp on his land and he knows that many people cannot relocate their belongings in one weekend and secondly, he is not following the law. The law states that after an announcement from the police the camp has to be removed from the property within 24 hours but weekends do not count starting from Friday 18:00. This cattle rancher made the announcement on Friday afternoon but send the police to remove the camps on a Monday morning; these were no 24 hours. Leaders from the social movements explained the situation of these people to the court and asked an extension. The judge gave 10 days extra for the people to leave the rural property and relocate their camp. The representative of CPT suspects that the landowner wants to sell his land to Incra in order to buy more agricultural land in northern Brazil where the land is cheaper (Representative CPT, 2016). According to soybean producer Hernani (2016), some cattle ranchers from Caiapônia sold their land or lease their land to soybean producers in order to buy four times more land in the north of Brazil (in the states Mato Grosso, Pará or Tocantins). Fábio, a cattle rancher and soybean producer from Piranhas (2016), explained that after he started producing soybeans on his land in Piranhas he relocated his cattle partly on land in the state Mato Grosso. He is a big landowner: 2,500 hectares used for soybean production in the municipality Piranhas, 1,200 hectares used for cattle in municipality Piranhas, 1,780 hectares used for cattle in the municipality Bom Jardim and 1,960 hectares used for cattle in the state Mato Grosso.

The next situation describes the complications of high land prices for social movements to acquire agricultural land via Incra. Increasing land prices make it more difficult for the government to buy land for agrarian reform (Superintendent Incra Goiás, interview, 2015). According to Incra the land price is very high in the state Goiás because many federal highways (with double roads) run through the state which makes the state very accessible and interesting for agriculture. In addition the agribusiness is increasingly present in the state (soybean, corn or cotton production). This means that much land is productively used and cannot be easily expropriated by Incra. Before the soybean expansion, pasture land was not expensive in Caiapônia and Piranhas. The price for pasture land in the municipalities increased because the demand for the land increased and soybean producers invested in the fertility of the soil. Therefore soybean expansion resulted in an inflation of the land price in Caiapônia and Piranhas. Agronomic engineers from the consultancy office Seara (2016) agree that soybean expansion in Piranhas increased the land price; they argue that for the price of one hectare in Jataí it is possible to buy four hectares of land in Piranhas. According to soybean producer Tiago (2016), the land price in Piranhas for one alqueire (equal to 4.8 hectares) used to be R\$32,000 in 2012 but increased to R\$50,000 in 2016. This respondent believes that the perspective of landowners on soybean producers caused the land price to increase. Landowners think that soybean producers are rich and therefore ask



more money for their land. According to soybean producer Tiago (2016) this does not necessarily have to be reality since high investments have to be done in machinery and other agricultural products. The superintendent of Incra Goiás (2016), mentioned that Incra has many inspections and negotiations in the municipality Caiapônia and the southwest region of Goiás. Anyhow, the valorization of land by soybean expansion in Caiapônia and Piranhas makes agrarian reform more difficult because access to land decreases. Therefore soybean expansion is not beneficial for the social movements and people that are struggling to obtain a plot of land.

## 7. Conclusions and discussion

### 7.1 Conclusions

#### 7.1.1 Sugarcane expansion in Jataí – Goiás

The first and the second sub-question will be discussed:

- *How did sugarcane production expand in Jataí?*
- *Who is producing sugarcane in Jataí?*

The state of São Paulo is the center of sugarcane production in Brazil. However the possibility to expand production in São Paulo is declining since little agricultural land is still available. Nevertheless, the demand for biofuel is nationally and internationally growing, putting pressure on expanding production outside the state of São Paulo. A couple of factors contributed to the decision of Raízen (previously under the name Cosan S.A.) to expand its production to the state Goiás. The governmental zoning legislation (Sugar Agroecological Zoning of 2009) pushed sugarcane expansion towards the hearth of Brazil, the Cerrado biome. Additionally, different governmental levels were supportive of the expansion of Raízen to the state of Goiás; because ethanol could make Brazil energy self-sufficient and it contributes to the industrialization of Goiás. This confirms the role of institutions in the investment decision of Raízen and in the changes in land use. There were given tax exemptions to Raízen by the federal and state government, to build their production unit in Goiás. These tax incentives were given via the state program PRODUIR. Raízen gained support of Jataí by convincing the municipality that sugarcane would be a profitable option to diversify the crop production. Besides the financial and legislative support of the government, the municipality Jataí in the state Goiás has a favorable micro-climate which allows for two harvest periods per year. The amount of rain and its rainfall periods are evenly distributed over the year, making a climatically favorable environment for (sugarcane) cultivation. Additionally, good logistic conditions made Jataí attractive. Finally, Raízen would have less

competition for land in Jataí because unlike the neighboring municipality Rio Verde, no other large sugarcane enterprise was located in Jataí. Raízen strategically located the production unit close to the border of Jataí and Rio Verde so they could lease land from both municipalities.

In Jataí the sugarcane producers are landowners. The amount of land that they own varies a lot. Additionally, the amount of land that they use for sugarcane production has a wide range as well. Landowners often had various motives to start with sugarcane production. Noticeable is that the sugarcane producers use their land also for the production of soybeans and corn. Sugarcane provided the opportunity to diversify production and the source of financial income. At the start of sugarcane expansion in 2008, the market value of grains was low which made sugarcane an interesting option for diversification. Therefore it can be argued that international market prices of crops can have an impact on the change in land use. Additional to the low market price of grains at that time, sugarcane grows well on less fertile land (land with a sandy soil composition) making the crop interesting for landowners with sandy land. Besides diversifying production, the high profit on sugarcane was mentioned as the main motive for sugarcane production. Raízen offers a higher lease price for the land than soybean producers. Raízen offers 12 to 18 bags of soybean per hectare (R\$852 to R\$1,278), while soybean producers used to pay 6 to 7 bags of soybeans per hectare (R\$426 to R\$497). In addition, these landowners argue that Raízen is a reliable company because it pays on time and offers the option to get paid monthly or annually, which gives financial security and continuity to the landowners. There is a variety of relationships between Raízen and landowners. Some produce sugarcane and supply the sugarcane to Raízen, some lease their land to Raízen and some are a partner of Raízen and share profits.

Furthermore, landowners with relatives who successfully grow sugarcane tend to start growing sugarcane. Finally, it is important to note that some land tenants are pushed into sugarcane production in order to keep their lease contract. These land tenants switched from soybean production to sugarcane production and sell the sugarcane to Raízen. By this switch the land tenant could generate more income to pay the higher lease price and compete with Raízen in order to keep his lease contract. However this does not turn out to be profitable for every land tenant. Assumingly this depends on the fertility of the land; fertile land gives a higher productivity and subsequently more profit.

In summary, the sugarcane expansion in Jataí started with the construction of the Raízen unit. This company got attracted to Jataí by the topographical and climatic characteristics. In addition, governmental support on federal, state and municipal level made the municipality Jataí in Goiás an

attractive region for sugarcane expansion by Raízen. The sugarcane producers in Jataí are predominantly landowners with less fertile land for soybean production.

### **7.1.2 Impact sugarcane expansion on soybean producers**

The third sub-question will be discussed:

- *What opinion do soybean producers from Jataí have on the sugarcane expansion?*

Sugarcane expansion in Jataí appears to have different outcomes for soybean producers. The interviewed soybean producers can be divided into two equally sized groups: one group which is not necessarily against the sugarcane expansion and another group which is against sugarcane expansion in Jataí. The first group mentioned one argument in favor of sugarcane production together with arguments against sugarcane production. Soybean producers from this group had the following characteristics: they partly produced sugarcane or leased a part of their land to Raízen for sugarcane production; the majority of these soybean producers did not lose a lease contract of land to sugarcane production; the majority of them own most of their land and therefore are not worried to lose land to sugarcane production. This group believes that sugarcane production is beneficial for the rural population and for the municipality Jataí. According to them soybean and sugarcane can coexist in the municipality without interfering with each other. There would be enough space in Jataí for both as long as sugarcane production occurs on pasture land that is less suitable for the production of soybeans. The main argument in favor of sugarcane is that it offers the opportunity to diversify the financial income of rural producers and benefits the local economy. However they mention that sugarcane should not expand more because then it could cause disequilibrium of the local economy, which is mainly focused on the grain industry. Today many soybean producers tolerate the sugarcane production in Jataí because the expansion slowed down.

The second group is against the production of sugarcane in Jataí. These soybean producers have the following characteristics: they own a small plot of land and lease the majority of their land from landowners (cattle ranchers); they lost lease contracts of land to the production of sugarcane or they are worried to lose a lease contract of land for sugarcane production. This group argues that a substantial part of sugarcane production is taking place on land that was formerly used for the production of soybean and corn. Therefore the competition for agricultural land increased between soybean producers and Raízen. Raízen prefers rural properties that have a flat surface to make mechanical harvesting easier, rural properties that have a fertile soil composition (not a sandy soil composition), and rural properties that are located closer to the sugarcane-ethanol unit in order to



reduce transportation costs of the sugarcane harvest. For these types of rural properties Raízen is willing to pay a high price. The argument most mentioned against sugarcane expansion in Jataí is the inflation of the lease price. Raízen offers more money to lease the land. In some cases Raízen offered 100% more than the soybean producers were paying. Therefore many soybean producers could not compete with Raízen and lost lease contracts. The average lease price of land in Jataí increased from 7 bags of soybean (R\$479) to 15 bags of soybeans (R\$1,065) per hectare per year; an increase of 8 bags (R\$568) of soybean per hectare.

In summary, the opinion of a soybean producer on sugarcane expansion in Jataí mainly depends on the characteristics of the soybean producer; does the soybean producer own the majority of his land or leases the majority of his land; has the soybean producer lost a lease contract of land or is he in risk of losing a lease contract to sugarcane production. The main arguments that are used by soybean producers in favor and against sugarcane expansion are:

- Opportunity to diversify the financial income and local economy (argument in favor)
- Inflation of the lease price of land (argument against)
- Sugarcane production situated on former grain land (argument against)

### **7.1.3 Motivation to relocate or expand soybean production in other regions**

The fourth and fifth sub-question will be discussed:

- *What motivates soybean producers to relocate or expand production outside Jataí?*
- *Where do these soybean producers expand or relocate their production?*

The majority of the soybean producers in Jataí migrated approximately 28 years ago from the southern state Rio Grande do Sul. Only minority of the soybean producers are originally from the municipality Jataí. These soybean producers do not produce sugarcane and did not lose land to sugarcane production. These soybean producers did not lose land for the production of sugarcane. They own a higher percentage of their land than soybean producers who lost land to sugarcane production. Soybean producers that did not lose land to sugarcane production owned more than 75% of their rural property. It can be argued that this reduced their vulnerability to lose land as they have the *power* to decide whether or not to use the land for sugarcane production and do not have to compete with Raízen on lease prices. Land tenants do not have this decision making power. Soybean producers from Jataí that lost a lease contract of land to sugarcane production still own or lease another plot of land in Jataí. According to the soybean producers, the impact of sugarcane expansion was larger on soybean producers that leased all their land and lost the lease contract to sugarcane production. These soybean

producers lost their livelihood as they cannot produce soybeans without land. In order to find affordable land as a replacement, they had to migrate to other regions.

The majority of the soybean producers that lost land to sugarcane production relocated or expanded soybean production in another region than Jataí. From this group, 29% already had another rural property before the sugarcane expansion took flight. However the other 71% of these soybean producers only relocated or expanded production in another region after losing land in Jataí. This is an indication that losing land for sugarcane stimulates soybean producers to relocate or expand their production in another region. The tendency is that these soybean producers acquire a larger rural property outside Jataí than they lost in Jataí. This illustrates that soybean producers that lost land to sugarcane do not only compensate the loss of land but also expand their rural property. The data showed that also soybean producers who did not lose land are expanding production in other regions than Jataí. However, it is noticeable that the majority of these soybean producers (62.5%) expanded production after the sugarcane expansion in Jataí. Soybean producers mentioned various motives for their decision to expand production elsewhere. The two motives that were mentioned the most are related to the sugarcane expansion. This shows that the sugarcane expansion is perceived as a major factor in the decision to relocate and expand soybean production. These motives are related to the increasing lease price caused by sugarcane expansion and the subsequent risk of losing or loss of lease contracts. The relatively low lease price of land in other regions was also an important factor that triggered the relocation and expansion of soybean producers in other regions. In addition four motives were mentioned which are not related to the sugarcane expansion. Those motives are: the possibility to earn more money with the valorization of land in another region; the need to increase financial income to sustain a growing family; having sufficient financial capital to expand; and making more efficient use of expensive agricultural machinery. Soybean producers that did not relocate or expand production in another region generally own the majority of their land and did not lose land to sugarcane expansion. These soybean producers are satisfied in Jataí or they do not have sufficient financial capital available due to financial debt or investments previously made to increase productivity in Jataí.

The relocation and expansion regions of soybean producers from Jataí are scattered across four states, where the land is approximately 66% cheaper than in Jataí. The majority of the rural properties are located in the Cerrado biome. The rural properties are for 50% located in the state Goiás in neighboring municipalities of Jataí. The other 50% of rural properties are located in the state Mato Grosso, Tocantins and São Paulo. The rural properties located in the state Goiás are closer to Jataí than the rural properties in the other three states. In Goiás the relocation and expansion regions are located

less than 225 km from Jataí, while in the other three states the relocation and expansion regions are located over 655 km from Jataí. Despite the fact that 50% of the rural properties is scattered over other states, it seems that there is a preference to expand production in the state Goiás in neighboring municipalities; as most of the rural properties are located in the neighboring municipalities Caiapônia and Piranhas. In addition this illustrates that soybean producers from Jataí prefer to expand production close to their rural property in Jataí.

Most information regarding suitable regions for the relocation or expansion of production was obtained in an informal way via social contacts and conversations. Soybean producers from Jataí use four strategies to find suitable land to relocate and expand production on. Making use of their *social network* is the most important strategy. In most cases soybean producers started to investigate a region after they received positive information about investment opportunities from family or friends that had a rural property in the region or lived in the region. The second most important information sources are *rural real estate brokers*. They are often hired by soybean producers to find suitable rural properties. In addition, soybean producers mentioned that contacts between fellow soybean producers are generally friendly. Much information regarding suitable regions for relocation and expansion is obtained via colleagues, at agricultural consultancy offices and informal places like bars. Only a small part of the respondents found their rural property in another region by travelling and searching for themselves.

All soybean producers kept living in Jataí after expanding soybean production in another region, mainly because they had built their family and social contacts in Jataí. Some soybean producers that expanded production in another state had the luxury of a brother, who migrated from Jataí to the new rural property to take care of it. This increased their capability to keep contact with another rural property located far from Jataí. Not all soybean producers mentioned having a permanent manager and employees to take care of the rural property in the other region. The main strategy to keep contact with the rural property in the other region is by regular visits. The number of visits depends on the distance of the rural property from Jataí; rural properties in surrounding municipalities are weekly or even daily visited by the soybean producer but rural properties in other states are visited monthly.

In summary, the relocation and expansion regions for soybean producers from Jataí are scattered across the states Goiás, Mato Grosso, Tocantins, and São Paulo. However, there is a preference to relocate and expand production in the neighboring municipalities Caiapônia and Piranhas located in the state Goiás. Social networks of the soybean producer are an important factor in the selection of

the relocation and expansion region. The main motives of soybean producers from Jataí to relocate and expand production are related to the recent sugarcane expansion:

- Inflation of the lease price of land in Jataí as a consequence of sugarcane expansion and the lower lease price of land in other regions
- Having lost or the risk of losing a lease contract of land to sugarcane production

#### **7.1.4 Translocal relation between Jataí and new soybean region**

The sixth sub-question will be discussed:

- *To what extent could these soybean producers be considered as agents of translocal development and land use change in the region of relocation and expansion?*

As most soybean producers from Jataí expanded in the municipalities Caiapônia and Piranhas the analysis of translocal development and land use change is focused on these municipalities. By using the definition of Sen (1999), *'development is a process of the expanding of real freedoms that people enjoy and greater freedom enhanced the ability of people to help themselves and also influence the world'*, two perspectives on soybean producers as *'agents for translocal development'* can be distinguished. For some of the local rural population soybean producers can bring more freedom and benefits and for others it cannot.

On the one hand the soybean producers can be considered as agents for translocal development from the perspective of the local cattle ranchers. For more than 20 years the local cattle ranchers had not recovered the soil quality. Therefore the land degraded and the fertility of the pasture land got low. Soybean producers relocate and expand production on pasture land by leasing the land. This leasing of land to soybean producers is used as a strategy by cattle ranchers to recover the degraded soil of their land, as soybean producers enrich the soil with lime, plaster and fertilizer. Embrapa recommends using agriculture as a strategy to recover soil fertility. Soil recovery can be expensive when the soil is highly degraded. Soybean producers offered cattle ranchers the opportunity to recover their soil quality and at the same time receive payment for leasing their land. In addition, soybean producers showed cattle ranchers that soybean production is profitable in Caiapônia and Piranhas. In some cases cattle ranchers got inspired to start producing soybeans themselves. In summary, soybean producers increase the freedom of cattle ranchers by providing them a higher income and a better quality of land, which gives cattle ranchers the option to start soybean production themselves when the lease contract expires.

On the other hand soybean producers cannot be considered as agents for translocal development from the perspective of social movements and small-scale rural producers. The increasing demand for pasture land by soybean producers and the improvement of soil quality cause inflation in the (lease) price of land. This makes it more difficult for the government to buy land for agrarian reform. The struggle of social movements for agricultural land gets more challenging; as the access to land decreases. The situation for rural workers that live on camps is already difficult. Increasing land prices will worsen their insecure situation because negotiations between the government and landowners will probably become more time consuming. Cattle ranchers use the increased land price as an opportunity to earn money and start negotiating with the government about selling their land. Additionally, the chemicals used in soybean production are very poisonous for humans and a variety of plants. Occasionally it kills crops from small-scale farmers. In summary, soybean production decreases the freedom of rural workers who want to make a living with agriculture on their own plot of land.

In both municipalities the soybean expansion started with local cattle ranchers in 2003. Further expansion can be described on the basis of three phases: in the first phase a few local cattle ranchers start producing soybeans to recover their degraded soil; in the second phase soybean producers from outside the municipality start leasing land from cattle ranchers to plant soybean and subsequently inspire others to also plant soybean; in the third phase companies and consultants related to the grain industry start to settle in the municipality which increases the accessibility for the local rural population to produce soybean. In Caiapônia and Piranhas most soybean producers are from Jataí and Rio Verde. They keep living in these municipalities. Information in the form of technical assistance does not only flow from Jataí to Caiapônia and Piranhas but also from Caiapônia and Piranhas to Jataí. For soybean production to expand in a region it is important for the region to convey a positive image for soybean production. The soybean producers from Jataí contribute towards this positive perception by sharing information about Caiapônia and Piranhas to other soybean producers and agricultural companies in Jataí.

Both municipalities had soybean and corn production before the sugarcane expansion in Jataí. After the first period of sugarcane expansion in the period 2008 to 2010, the grain production did not increase much in both regions. However after the second period of sugarcane expansion in Jataí, 2012 to 2013, the municipalities Caiapônia and Piranhas experienced a higher expansion of soybean and corn production than after the first period of sugarcane expansion. Piranhas used to have a bad image for grain production because the harvest was low; local soybean producers did not have much expertise. After soybean producers in Jataí lost land to sugarcane production they relocated and

expanded production in Piranhas in 2012. The profit that these soybean producers gained improved the perception of Piranhas as a region for soybean production and attracted other soybean producers from Jataí. Therefore sugarcane expansion indirectly triggered soybean expansion in Piranhas.

Since all soybean producers from Jataí relocated or expanded soybean production on former pasture land it is expected that the area for pasture land decreased. However the number of cattle heads in Caiapônia and Piranhas showed a moderate increase over the period 2008 to 2014. In Caiapônia the number of cattle heads increased with 4.4% and in Piranhas the number of cattle heads increased with 3.6%. This does not necessarily mean that more land is needed for cattle and that pressure on natural vegetation increased. The efficiency of cattle ranching could have increased. According to Comigo the efficiency increased in Caiapônia; the average of 1.5 cattle heads per hectare changed to 4 cattle heads per hectare after the sugarcane expansion in 2008. At the end the cattle ranchers are a key factor in translocal development and land use change because they are the landowners and have the power to decide whether or not to lease their land to soybean producers.

## **7.2 Discussion**

The overall aim of the research was to get a better understanding of the impact of sugarcane expansion on the land use in other regions. By applying the concepts of translocal development and telecoupling, the connection between sugarcane expansion in one region and the relocation and expansion of soybean in other regions is analyzed. In this section the answer to the central question of this research will be discussed by resorting to the theories of translocal development and telecoupling. In addition, suggestions for follow-up research are outlined. The main question is:

*To what extent is the sugarcane expansion in the municipality Jataí motivating soybean producers to relocate or expand their production in other regions and hereby causing land use changes?*

This research shows that the majority of the soybean producers got motivated to expand production in other regions by the increase of (lease) price of land and the risk of losing their lease contract of land to sugarcane production. The majority of soybean producers that lost lease contracts to sugarcane production relocated and expanded production in other regions, preferably close to Jataí. At first these soybean producers relocated their production. After having experienced that production in the new region is profitable and (lease) prices of land are low, they started to expand their production to a larger area than what they had lost to sugarcane. In the majority of the cases they relocated and expanded in pasture land, thereby changing the land use to soybean production. In this sense it can be

argued that sugarcane production in one region is indirectly contributing to land use change in other regions. Additionally, it can be argued that it contributes to the expansion of soybean production as these soybean producers eventually expand production on a larger rural property than they lost as a result of the sugarcane production.

In Caiapônia and Piranhas there seems to be a correlation between soybean expansion and the sugarcane expansion in Jataí. Before the sugarcane expansion in Jataí, a substantial area in Caiapônia was already used for soybean production. It is plausible that the sugarcane expansion boosted the soybean production in this municipality. In absolute sense the increase in soybean production in Caiapônia was larger than in Piranhas, but in Piranhas the increase is more apparent because at the start of the sugarcane expansion there was only little soybean production in this municipality. Caiapônia was already known as a suitable region for soybean production. Piranhas was not seen as particular suitable for this crop. After soybean producers from Jataí, who relocated after losing land to sugarcane, had proven that it was possible to successfully produce soybeans in this area, more soybean producers were drawn to Piranhas. This illustrates the benefits of multi-sited research.

The expansion of the monocultures sugarcane and soybean appear to have a distinct outcome for landowners and land tenants. According to Gnansounou et al. (2008), research on indirect land use change is often centered on the negative impacts of land use change like the destruction of natural vegetation (deforestation). This research showed that land use change by soybean producers can be perceived as a positive change in land use by the cattle ranchers. Landowners, which are predominantly cattle ranchers or retired cattle ranchers, have the advantage when sugarcane or soybean production expands in their region for two reasons: firstly the increased demand for land valorizes their land and secondly, they have the opportunity to lease parts of their land to sugarcane-ethanol enterprises or to soybean producers; leasing land to soybean producers is a strategy to improve their often degraded pasture land because soybean producer will need to make the financial intensive soil corrections to improve the fertility of the soil before soybean production can take place. As the cattle ranchers make the decision whether or not to lease their land to soybean producers or sugarcane enterprises they can be considered a key factor in land use change.

This research shows that soybean producers do not have to live in the region where they produce to form a corridor of information exchange on agricultural expertise. Soybean producers from Jataí constitute a *translocal development corridor* between Jataí and the municipalities Caiapônia and Piranhas in two ways: firstly, they inspired cattle ranchers to start produce soybeans, simultaneously these cattle rancher need to import technical assistance and machinery from Jataí because this is not

available in their municipality; and secondly, they stimulated agricultural enterprises and consultancies to settle in Caiapônia. The situation of Caiapônia supports the idea of Zoomers & van Westen (2011) that development corridors can materialize and lead to path-dependency when migrants (in this case soybean producers) decide to buy a plot of land in the destination location and services related to the migrants (soybean producers) will be established in the destination location. The translocal linkage between Jataí and Caiapônia slowly will decrease as local soybean producers will be able to use warehouses and technical assistance in Caiapônia. According to the telecoupling concept, several actors can stimulate or hinder flows of information (Friis & Nielsen, 2014). Climatic conditions can become hindering factors in the materialization process of development corridors. For example the cooperative Comigo was planning on settling a unit in the municipality Piranhas but the dry climate caused bad harvests and Comigo decided to postpone the establishment in Piranhas indefinitely.

The outcome of the research is in compliance with the argument of Zoomers & van Westen (2011) that improvements for one group of people are not necessarily an improvement for another group of people. The increasing land prices decrease access to agricultural land for small-scale rural producers. In addition, chemicals that are used for soybean production end up in adjacent nature reserves and water bodies; likewise they kill the crops of small scale farmers. Brazil was the worlds' largest importer of toxic herbicides, fungicides and insecticides in 2013 (Prada, 2015). Besides this, a substantial area of natural forest was lost in Caiapônia before the sugarcane expansion in Jataí occurred. Although this research does not clarify whether soybean expansion motivates cattle ranchers from Caiapônia and Piranhas to relocate their cattle to the periphery of the forests, it might be driving deforestation. There is barely any monitoring since there is no environmental secretary in the municipalities. Searchinger et al. (2008) states that an increased productivity in the livestock sector is key in limiting pressure on natural reserves by indirect land use change. According to the cooperative Comigo, soybean production makes it in the long run possible for cattle ranchers to keep more cattle on less land, because it increases the fertility of the formerly poor pasture lands. If this is the case, than soybean expansion would not push cattle ranchers to other rural areas and competition for land would be limited, thus reducing the pressure on natural reserves. More research could be done on how cattle ranchers are increasing their productivity and which factors drive their decisions for a specific approach.

The Amazon biome is considered a hot spot of indirect land use change by sugarcane expansion while the impact on the Cerrado biome is barely studied, even though this is the biome in which the recent sugarcane expansion occurred. The majority of research on indirect land use change by sugarcane expansion is primarily focused on the land use change on national level, while land use change on



regional level is often not taken into consideration. This research shows that soybean producers relocate and expand production dispersed over various regions. This indicates that it is complex to determine future relocation and expansion regions of soybean producers. The majority of the soybean producers (60%) that expanded soybean production in a region remote from Jataí (in another state than Goiás) have a good friend or family member who takes care of the rural property. This illustrates that social networks influence the choice for a specific expansion location. In many cases soybean producers did not have family or friends who could take care of a rural property located far from Jataí. Therefore it is plausible that surrounding regions are a likely choice for soybean producers to relocate or expand production, because then there is no need for a permanent supervisor on location to look after the rural property as it can be visited easily (in one day). This research showed that 50% of the respondents expanded production in neighboring municipalities. Additionally, almost all respondents (soybean producers) expanded production in the Cerrado biome. Therefore it could be argued that indirect land use change on regional level and in the Cerrado biome would be an interesting topic of research for future studies on indirect land use change due to sugarcane expansion. This argument is in line with the recommendation of Dauriat et al. (2008); he believes that further research on indirect land use change could be focused on down-scaling the effects to the regional level. According to this research the development of regional models of land use change could include factors related to the distinctive impact of sugarcane expansion on landowners and on land tenants. Additional research could also focus on the effects on the carbon economy of the area, when pasture land is cleared and substituted by the production of soybean.

There are many soybean producers living in the city, but also many living in the country side at their farm. The group of respondents represents a small fraction of the total number of soybean producers that live in the region and only soybean producers that live in the city participated. It can be argued that this group of respondents is not fully representative. It is assumed that this group constitute a legit representation of the soybean producers of the region who live in a city, because the outcome of interviews was not contradictory. Further study will be needed to assess whether the outcome of this research will also be applicable for those soybean producers that live in the country side.

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# Appendix

## Topic list Agricultural Secretary (Jataí)

### The zoning law for sugarcane of Jataí

- What is the difference between the zonings law for sugarcane and the rural development plan?
  - How does Jataí tries to develop the rural area?
  - How does the municipality Jataí work together with other municipalities with regards to the management of the rural area?
- How do you monitor the rural properties
  - What are the difficulties in monitoring the rural properties
  - How many times per year do you monitor the rural properties?

### Sugarcane producers

- Which rural producers generally produce sugarcane?
  - Are they landowners or land leasers?
  - How do they have contact with Raízen?
- What are their motives for planting sugarcane?
- How many rural producers plant sugarcane in Jataí?
- How is sugarcane production impacting the local soybean producers?
- Do you believe that sugarcane production is influencing the land use of neighboring municipalities?
  - How is it influencing land use in other municipalities?

## Topic list COMIGO (Jataí)

- How do you think that sugarcane production is influencing the land use in neighboring municipalities?
  - How do rural producers generally communicate and exchange information related to agriculture?
    - How do rural producers generally buy or rent rural properties?
- How do rural producers make decisions on land use?
  - What are important factors that the rural producer takes into account for land use decisions?
  - To what extent is it possible for rural producers to switch from one specific crop to another?

- Do you know if rural producers are migrating from Jataí (a region with sugarcane expansion) to regions without sugarcane (lower land prices) inside Goiás?
  - Do you know a municipality that would be interesting to visit to meet these migrating rural producers?
- What type of rural producers are searching for other rural properties for produce soybean on?
  - How did sugarcane expansion change the landscape (land use) of Goiás?

### **Topic list rural producer from Jataí/Caiapônia/Piranhas**

#### **Background rural producer**

- Is your family from this region?
- How did you get interested in agriculture?
- How did you learn your agricultural techniques?

#### **Decision on land use**

- What crops do you produce?
- What is your motivation to produce these crops?
  - How was your rural property used before you?  
What crops used to be produced on the land?
- How many hectares is your rural property?
  - How many hectares of this rural property do you own and how many do you lease?
    - How much do you pay for leasing the land?
    - How much would you pay for buying the land?

#### **Relation with other rural producers**

- How would you describe your relationship with other local rural producers?
  - To what extent do you exchange information about agricultural techniques or opportunities to invest in agricultural land with these rural producers?
  - How do you learn new agricultural techniques?
    - Could you please give an example?
- Did some of your relationships change after the sugarcane expansion in Jataí?
  - What changed?

#### **Sugarcane expansion in Jataí?**

- How did the region Jataí change after the sugarcane expansion?

- What is your opinion about sugarcane expansion in Jataí?
- Would you produce sugarcane?
  - Please, explain your answer?
- How many hectares did you lose to sugarcane production?
- To what extent is sugarcane stimulating soybean producers to buy agricultural land outside Jataí?
  - In which regions these soybean producers buy land?

#### **Rural property in another region than Jataí**

- Do you have a rural property in another region than Jataí?
- What are your motives for having a rural property outside Jataí?
- What are your motives for not having a rural property outside Jataí?
- Where do you have another rural property?
  - Which state and municipality is the rural property located?
    - What is the reason that it is not located in Jataí?
- When did you buy the rural property?
- What do you produce on the land?
- How was the land used before you?
  - What crops were produced on the land?
- How did you find the opportunity to acquire the rural property?
- How many hectares of the rural property do you own and how many hectares do you lease?
  - How much do you pay for leasing the land?
  - How much would/did you pay for buying the land?
- How do you keep in contact with the rural property while you live in Jataí?
  - Who is taking care of the rural property while you are not present?
    - Who is managing the rural property?
- How do you interact with other rural producers from that region?
  - To what extent do you learn from those rural producers?
    - Which agricultural knowledge do you exchange?
      - What do you learn?
- What are the difficulties in having multiple rural properties in different locations?
  - What are the difficulties in producing soybeans in that other region as Jataí?

## **Topic list governmental officials (Caiapônia or Piranhas)**

### **Soybean expansion in Caiapônia/Piranhas**

- What factors make Caiapônia/Piranhas attractive for the production of soybeans and corn?
  - When did the soybean production start to expand in the region?
  - How did the soybean production started to expand in the region?
  - Where in the municipality is the soybean production expanding?

### **Producers of soybeans/corn**

- Who is planting soybeans and corn here?
  - Where do the soybean producers come from?
    - Do they come from neighboring municipalities or are it local producers?
  - How did the local rural producers learn to produce soybeans?
- What type of contact do the local producers of soybeans have with the more traditional municipalities of soybean production (the municipalities Jataí and Rio Verde)?
- Which rural producers are leasing rural property to soybean producers?
  - What agreements are generally made with regard to the lease of land?

### **Resistance towards soybean expansion**

- How did the local rural population react when soybean started to expand in the region?
  - Was there resistance from local rural producers against the soybean expansion in the region?
- Did the situation for the local producers of cattle and milk change?
  - Explain your answer please?

### **Support grain expansion**

- How does the municipality support soybean and corn production and expansion in the region?
  - What did the soybean production bring to the municipality?
    - Did it bring more employment opportunities for the local community?
- What kind of relationship does the municipality has with municipalities where the soybean industry has a longer tradition (the municipalities Jataí or Rio Verde)?
  - What kind of information exchange related to agriculture takes place between this municipality and Jataí?

## **Topic list for small-scale rural producer (Caiapônia or Piranhas)**

### **Land use by farmer**

- What do you produce?
  - How many hectares do you have?
  - Are you based in a settlement?
    - What is the name?
    - Where is it located?
- Could you explain a bit the process of getting your land?

### **Opinion soybean production/expansion**

- What is your opinion on soybean production in Caiapônia/Piranhas?
  - Did it bring development for Caiapônia/Piranhas?
  - How is soybean production benefitting you?
  - Did you get the offer to plant soybeans?
  - Are you involved with soybean production?

### **Change of surrounding land use**

- Since when are you producing on your land?
- Did the surrounding landscape change the last 7 years?
  - How did it change?
- Would you rather have pasture land (cattle) or soybean production on neighboring land?
  - Explain why?

### General characteristics rural producer (Jataí)

Name	
M/F	
Age	
Opinion sugarcane expansion in Jataí/GO	
Lived where before Jataí	
Motive moving to Jataí	
Years living in region Jataí	
Hectares of land in Jataí	
Crop/other	
% LU crop	
% LU natural vegetation	
History of the land use	
%Renting %Owning the land	
Hectares before migrating to Jataí	
Rural property in another region	
Where (region/municipality)	
When acquired the land	
Motive for having land in another region	
Motive for not having land in another region	
Future plans related to expansion	
Hectares of land	
Crop/other	
% LU crop	
% LU natural vegetation	
History of the land use	
%Renting %Owning the land	
How found the rural property	
How to keep in contact with both rural properties	
Difference in managing land here and there	
How learned managing land there	
Motive for staying in Jataí	



## Respondents

Respondents	number	How contacted	(In)formal	Location	Type of interview	Duration in minutes
Dimas Peixinho and Williams Ferrari - UFG geography professors	2	Visiting (2x) and also interviewed for previous project*	Informal	Class room UFG, car and PhD defense	Non-structured	360
IBGE Jataí	1	Agronomic engineer from Agrodefesa (1) and visiting	Informal	Office	Semi-structured	20
Agronomic engineer from Agrodefesa	1	Visiting	Informal	Corridor from Agrodefesa	Semi-structured	30
President of the grain association	1	Campo Bom (office for agricultural advice)	Informal	Office	Non-structured	20
Raiz - store for grain products	1	Visiting	Informal	Office	Semi-structured	20
Geo-measuring - company that measures land for Incra	2	Visiting	Informal	Office	Semi-structured	30
Manager Comigo - cooperative of grain producers from south west Goiás	1	Visiting	Informal	Comigo store	Non-structured	20
Secretary of Agriculture and Cattle ranching	1	Visiting and phone	Formal	Office	Semi-structured	60
Manager Tec Agro - office for agricultural advice	1	Visiting Tec Agro (2x)	Formal	Office	Semi-structured	20
Francisco - agronomic engineer at Tec Agro and grain producer	1	Visiting Tec Agro	Formal	Office	Semi-structured	40
Alberto - grain producer	1	Visiting	Informal	Jama (store for agricultural machines) and farm	Non-structured and semi-structured **	420
João - grain producer	1	Visiting	Formal	Rural Técnica (office for agricultural advice)	Semi-structured	20
Pedro - grain producer	1	Visiting	Informal	Rural Técnica (office for agricultural advice)	Non-structured	30
Antonio - grain Producer	1	Visiting Soagro (office for agricultural advice)	Informal	Office	Semi-structured	30
Bruno - sugarcane producer	1	Soagro and phone	Formal	Corridor from UFG	Semi-structured	60
Gabriel - grain and sugarcane producer	1	Gym and guest family	Informal	Car and farm	Semi-structured	180
Paulo - grain producer and ex-sugarcane producer	1	Visiting a bar	Informal	Bar	Semi-structured	45
Lucas - grain producer	1	Juvenilde and visiting Safra Forte (office for agricultural advice)	Formal	Office	Semi-structured	60
Matheus - grain producer	1	Agro Fertil (store for grain seeds) and visiting (2x)	Formal	Office	Semi-structured	40
Leonardo - grain producer	1	Agro Fertil (store for grain seeds) and visiting (2x)	Formal	Office	Semi-structured	30
Arthur - grain producer and city councilor	1	Carlos Alberto Gorgen, Secretaria Agricultura and Cattle Ranching, phone and visiting the City Council (2x)	Formal	City Council	Semi-structured	40
Ercilio - grain producer	1	Via Dirceu P. Giombelli and Roberson from Tec Agro and visiting office Irmãos Belo (2x)	Formal	Office	Semi-structured	60
Felipe - grain and sugarcane producer	1	Visiting Núcleo Agrícola (2x)	Informal	Waiting room from Núcleo Agrícola	Non-structured	45
Vinicius - grain producer	1	Visiting a bar	Informal	Bar	Non-structured	15
Guilherme - grain producer	1	Visiting a bar	Informal	Bar	Non-structured	15
Daniel - grain producer	1	UFG geography professors and also interviewed for previous project	Formal	Office	Non-structured	20
Bento - grain producer	1	Sindicato Rural, Silomar and phone	Formal	Home of respondent	Semi-structured	83
Luiz - brother from a grain producer	1	English school AB and phone	(In)formal*	Office of gas station and bar	Non-structured and semi-structured	30
Carlos - grain producer	1	Soagro and phone	Informal	Phone	Semi-structured	20
Eduardo - sugarcane producer	1	Soagro and phone	Informal	Phone	Semi-structured	10
Ibama - Ran - ICMBio	2	Visiting (2x)	Informal	Office	Semi-structured	90
Faeg - representative of sugarcane producers	1	Visiting	Formal	Office	Semi-structured	60
Incra - journalist, superintendent and agronomic engineers	5	Visiting (2x)	(In)formal	Office	Non-structured and semi-structured	3600
UFG - Institute of Social and Environmental Studies	2	Incra and visiting	Informal	Class room at UFG	Semi-structured	60
UFG - Faculty of Education, Professor José Paulo Pietresa	1	E-mail and visiting (2x)	Informal	Class room at UFG	Semi-structured	60
Fetaeg - representative of sugarcane employees and producers	1	Visiting and phone	Formal	Office	Semi-structured	20

Agronomic engineer from Comigo	1	Visiting	Informal	Comigo store	Semi-structured	20
Agronomic engineer from Agrodefesa	1	Visiting	(In)formal	Office and car	Non-structured	20
Edison - Rural real estate broker	1	Visiting	(In)formal	Office	Non-structured	15
Decentent from african slave	1	Lindomar Neres da Silva from CPT	Informal	Home of respondent	Non-structured	20
Representative of Fetraf	1	Hotel Palace Avenida and visiting	Informal	Office of Fetraf	Non-structured	20
Lindomar Neres da Silva from CPT	1	Hotel Palace Avenida	Infomral	Car, touristic tour, camps	Non-structured	One day
Family farmers from the local market 'Feira da Terra'	2	Visiting	Informal	Local market 'Feira da Terra'	Non-structured	20
Rural workers from camps	4	Visiting	Informal	Camp	Non-structured	20
Small-scale farmer from settlement	1	Visiting	Informal	Farm	Non-structured	10
Employee cattle store	1	Visiting	Informal	Cattle store	Semi-structured	15
Rafael - grain producer	1	Sindicato Rural and visiting (4x)	Formal	Office	Semi-structured	30
Victor - grain producer	1	Sindicato Rural and phone	Formal	Office	Semi-structured	120
Douglas - grain producer	1	Employee bus station and visiting	Formal	Office	Semi-structured	20
Thiago - grian producer	1	Employee cattle store and visiting	Formal	Office	Semi-structured	20
Anderson - grain producer	1	Agronomic store from Jataí and phone	Informal	Banco do Brasil	Non-structured	15
Leandro - grain producer	1	Ariel Carlos and phone	Informal	Phone	Non-structured	5
William - grain producer	1	Ariel Carlos and phone	Informal	Phone	Non-structured	5
Cattle rancher and secretary of agriculture	1	Lindomar Neres da Silva from CPT	Informal	Office	Semi-structured	15
Agronomic engineers from Seara and Agros	2	Visiting	Informal	Office	Non-structured	20
Marcos - grain producer and cattle rancher	1	Secretary of Agriculture	Formal	Office	Semi-structured	30
Fernando - manager of a grain farm	1	Lindomar Neres da Silva from CPT	Formal	Hotel	Semi-structured	20
Fábio - grain producer and cattle rancher	1	Julio grain producer and visiting	Formal	Office gas station	Semi-structured	20
Henrique - grain producer and cattle rancher	1	Sindicato Rural and phone	Informal	Phone	Non-structured	5
Diego - grain producer	1	Rudimar Palharini and phone	Informal	Phone	Non-structured	5
Julia - cattle rancher that rents her land for soybean production	1	Hotel owner and phone	Informal	Phone	Non-structured	8
<i>Total</i>	<i>74</i>					

Legend			
Respondents from the municipality Jataí		Respondents from the municipality Caiapônia	
Respondents from the capital Goiânia		Respondents from the municipality Piranhas	
* 'Visiting' means that the location of the interview was visited. The number indicates te number of times that the location was visited before the interview could take place. A name of a person or organization indicates that they gave me contact information of the respondent.			
** 'Non-structured and semi-structured' is indicating that the type of interview was different at both locations			
*** '(In)formal' means that at the two localities of the interview the formality was different.			