Smallholder farmers in the sugar industry:

Opportunities for a living income

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MSc-thesis
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Abstract

There are 35 million people living in rural Latin America who cannot meet their basic needs. Since Latin America is one of the largest sugar producing continents, this research focuses on smallholder sugar farmers in Brazil and Paraguay. The research focuses on opportunities for sugar smallholders to earn a living income, an income which is sufficient to sustain both household needs and farm activities. First the structure and market determinants of the current world sugar market are viewed. Then the research narrows down on Brazil and Paraguay and shows how these determinants influence national sugar markets. Special focus is on national policies favouring the position of smallholders. Finally welfare analysis is done which shows how national policies affect domestic smallholders and other actors. It is concluded that the income of sugar smallholders can be increased when access to input markets is provided and when producer prices increase.

Keywords: smallholders, living income, sugar world market, sugar cane, smallholder policy, Brazil, Paraguay

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List of abbreviations

Organisations

EC	European Commission
FAO	Food and Agriculture Organisation
IFAD	International Fund for Agricultural Development
ILO	International Labour Organisation
ISO	International Sugar Organisation
OECD	Organisation for Economic Cooperation and Development
UN	United Nations
USDA	United States Department of Agriculture

Policies

CDAF	Compra Direta da Agricultura Familiar *(direct food procurement)*
CPR Estoque	Formaçao de estoque pela agricultura familiar *(stocks set up by family farmers)*
PAA	Programa de Aquisicao de Alimentos da Agricultura Familiar *(food acquisition programme)*
PGPM	Política de Garantia de Preços Mínimos *(guaranteed minimum price policy)*

Other

EU	European Union
GDP	Gross Domestic Product
GNI	Gross National Income
Ha	Hectare
M tonnes	Million tonnes
NGO	Non-governmental organisation
USA	United States of America

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Exchange rates

All references to currencies are recalculated to euros, based on the exchange rate of February 2015, being as follows (Xe, 2015):

American Dollar (US$)	100 US$	equals 87.59 euros
Brazilian Real (R$)	100 R$	equals 31.00 euros
Paraguayan Guarani (₲)	100 ₲	equals 0.02 euros

1. Introduction

1.1 Background

1.1.1 Background information

The developments in the world sugar market are influenced by main exporting and importing countries, meaning that world supply and demand are steered by their national policies. For example, due to non-supportive sugar policy Indonesia changed from a major exporting country in 1930s to a major importer in the 1970s. In 1930s it was the second largest exporter and in 2012 it was the second largest importer (Aris Toharisman and Triantari, 2014; ISO, 2013). In 2008 the Thai government set a production target for 2012 of 1.9 million litres of ethanol a day, and is in 2012 the second largest exporter of raw sugar (Nguyen et al, 2008; ISO, 2013).

The national trends and policies of major sugar actors influence the development at the world sugar market. This can affect the opportunities for sugar farmers in other countries, as figure 1.1 shows for Brazil. Panel (A) shows that Brazil has an excess supply of 24.7 million tonnes of sugar, panel (B) shows that the sum of excess supply of the rest of the world (RoW) is equal to 33.6 million tonnes. The sum of panel (A) and (B) brings total world sugar supply at 58.3 million tonnes, which equals total excess demand (ED_T) as shown in panel (C). This panel further shows that the excess supply of Brazil is a major share of total supply ($ES_B + ES_R = ES_T$). Therefore it is assumed that a change in excess supply of Brazil affects world market equilibrium.

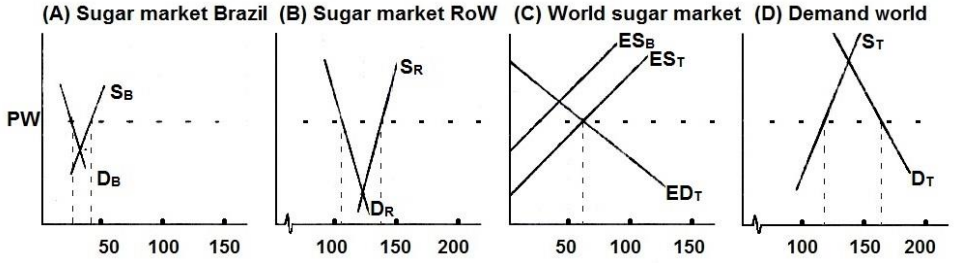


Figure 1.1: World sugar trade model. Panel (A) shows major sugar exporter Brazil, panel (B) shows sugar export of rest of the world, panel (C) shows world market equilibrium and panel (D) total demand excess for sugar.

Figure 1.1 shows that changes at national level can affect the market in other countries, this has as result that changes in the Brazilian sugar market affect sugar farmers in other countries. Compared to Brazil many other Latin American countries produce sugar at a smaller scale. Therefore it is assumed that changes in the Brazilian market affect the sugar markets in these other Latin American countries.

Most Latin American countries are classified as middle income countries with a GNI between $1,046 and $12,745, being between 916.2 euros and 11,163.3 euros per capita (World Bank, 2014a). Nevertheless there are 35 million people living in rural areas which cannot meet their basic needs. A large part are smallholder farmers with family farms which mainly use family labour and might have one or two employees (Berdegué and Fuentealba, 2011). The basic needs of such a farm household include needs to sustain the family such as food, shelter and education. Moreover, it includes investments to sustain the farm, such as seeds, equipment and fertiliser (Anker and Anker, 2013a). These basic needs can be met when a farming family earns a living income. However, for a lot of smallholder farmers in the sugar industry it is difficult to earn a living income.

Figure 1.2 shows the average GNI of Brazil and Paraguay and how this is distributed per quintile. It shows that 60 to 80 percent of the population has an income below the average income of respectively 10,273 and 2,930 euro for Brazil and Paraguay. Further a Gini-coefficient of respectively 52.7 and 48.0 proves that the income distribution in both countries is imbalanced (World Bank, 2014b,c).

Governments can implement policies to improve the income situation of smallholder sugar farmers. This research shows how national policies can influence the opportunities to earn a living income for national and foreign smallholder farmers. It is assumed that policies in Brazil affect both domestic and foreign sugar farmers, since it is a large actor in sugar. Paraguay is taken as foreign and small country, it is a net importer of sugar but nevertheless exported 60 thousand tonnes of sugar in 2012 (ISO, 2013).

Brazil is worldwide the largest production and exporting country in sugar. Between 2003 and 2012 it had an average production of sugar cane of 550 million tonnes which resulted in an average of 35 million tonnes of raw sugar. Paraguay is a small producing country with an annual quantity around 4 to 5 million tonnes of sugar cane, which resulted in an average of 220 thousand tonnes of sugar during the same period (FAO, 2014a).

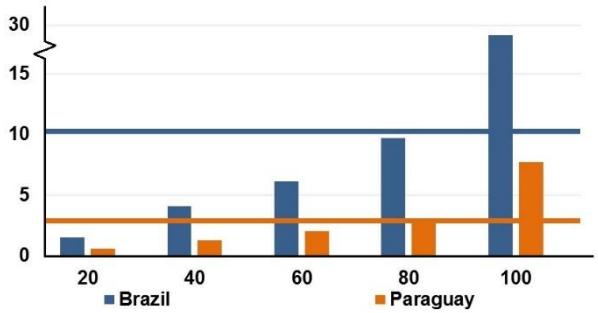


Figure 1.2[1]: GNI of Brazil and Paraguay on average and per quintile (in thousand euros) (World Bank, 2014b).

To analyse the influence of national policies on smallholder income, the research elaborates on the trends and developments at the world sugar market first. Then it narrows down to the national level of Brazil and Paraguay to discuss the opportunities for smallholder farmers to earn a living income. Finally suggestions for policy implementation are presented.

1.1.2 Relevance

Mc Calla and Josling (1981, 1985) wrote in the 1980s two books on interrelatedness of national policy decisions. They state that agricultural policies in one country help to set the market in other countries. This research goes in depth on the consequences of such interrelatedness, it shows how the income situation of smallholders in one country are influenced by policies set by another country. In general, focus on the importance of a living income is increasing, however mostly is looked at farmer level. This research shows that the level of a living income is also determined by factors which are not operating at farm level, but by political implementations at national or foreign level.

1.2 Objective and research questions

1.2.1 Research questions

The main question which arises from the findings above is how the world sugar market interacts with the livelihoods of smallholder farmers, and how this interaction could have a positive effect. Therefore, the main question is as follows:

> "How does the world sugar market interact with policies which provide smallholder farmers a living income?"

To answer this, three sub questions are answered:

[1] Appendix 1 elaborates on the data given in the figures throughout the report. It contains additional information on trend lines, equations etcetera.

1) What is the current structure of the world sugar market and what developments took place from 2003 to 2012?
2) What is the current income situation of smallholder farmers in Brazil and Paraguay?
3) What are potential domestic policies and their welfare effects to improve the income of smallholder farmers in the sugar sector?

The first question elaborates on the current structure of the world sugar market. The focus is on the exporting countries and importing countries, and how they interact. This chapter shortly elaborates on by-products, but further concentrates on sugar crops and the raw product sugar. Two questions are answered, 'how does the market work' and 'why is it developed like this'. Therefore first the structure of the sugar market is explored. Main production and consumption countries are highlighted, as are production methods, consumption patterns, trade relations and price development. When the 'how'-question is answered, the chapter explains why the market is developed like this. The chapter elaborates on weather influences, technological development, emerging countries, and national and regional policies.

The second question focuses on the national levels of Brazil and Paraguay. The chapter firstly elaborates on smallholders in general. It gives a description of smallholder farmers and of a living income. Then it zooms in on smallholders in both countries. At first general information on sugar production and smallholders is given in both countries. Then the chapter elaborates on the developments of the previous chapter in relation to both countries. It explains how both Brazil and Paraguay are affected by trends and developments which are already discussed in the first chapter. For example, how are the countries affected by weather condition and changing demand from emerging countries etcetera. Finally for both Brazil and Paraguay national policy is analysed which affect smallholders.

The third and final question focuses on welfare effects, especially for smallholders. First, the current welfare distribution in the sugar market is analysed. This is done with the information of the previous chapters: how does the world market work and how do the previous introduced national policies interact with it. Based on these findings, the challenges for smallholders are highlighted. Finally, a welfare model explores how these challenges can be addressed and what the effects are for smallholder farmers in both countries and for other stakeholders in the sugar market.

1.2.2 Hypothesis

The hypothesis of this research is that the current income situation of smallholder farmers should be improved. Their income is not enough to meet the needs of the family and to sustain the farm. Income can be improved by policy adjustments on national level. The world sugar market and smallholder farmers in Latin America are linked via national policies. Therefore it should be taken into account that these policies affect more stakeholders in the sugar industry than the targeted group only.

1.2.3 Methodology

To get the main question answered, literature is reviewed and a model with welfare effects is established. Data is used from several sources which provide information on the world sugar market. The ideal sources are independent data registers by the UN, such as the Food and Agriculture Organisation (FAO) and the International Fund for Agricultural Development (IFAD). However, if these sources cannot provide the required information, other data bases are used, for example provided by the International Sugar Organisation (ISO); the European Commission (EC) and the United States Department of Agriculture (USDA). To answer the final sub-question a welfare analysis is done, one separate for policies implemented in Brazil and Paraguay. The analysis shows the effects of these policies on domestic and foreign markets.

2. Structure and developments in the world sugar market

This chapter outlines the structure and developments of the world sugar market. First it elaborates on the structure of the world market. Major actors are introduced, then production and consumption are discussed, followed by an overview of trade relations and price development. When the structure of the market is clear the main market determinants are discussed. The chapter elaborates on climate and weather influences, technological development, the role of emerging markets, biofuels and national policies.

The research focuses on smallholder farmers which grow sugar cane or sugar beet and these crops are processed to raw sugar. When sections have their focus on production, data on both crops and on raw sugar is given. In case of consumption data on raw sugar is presented.

2.1 Structure of the sugar market

In the sugar market there are a few major actors which have strong influence on supply and demand, and the trade flows which result from this. Brazil and Thailand are among the major producers and exporters while China and the EU are among the major consumers and importers.

The last decade, sugar production and consumption were on average respectively 172.4 and 170.7 million tonnes annually. Figure 2.1 gives an overview of the sugar world market during the period of 2003-2012. Total sugar quantity worldwide increased with an average of 2.8 million tonnes per year, being the sum of production and stocks. The increase in consumption was a bit higher, 2.9 million tonnes per year. World trade had an average increase of 1.4 million tonnes per year, meaning that domestic consumption increases on a faster rate than traded sugar.

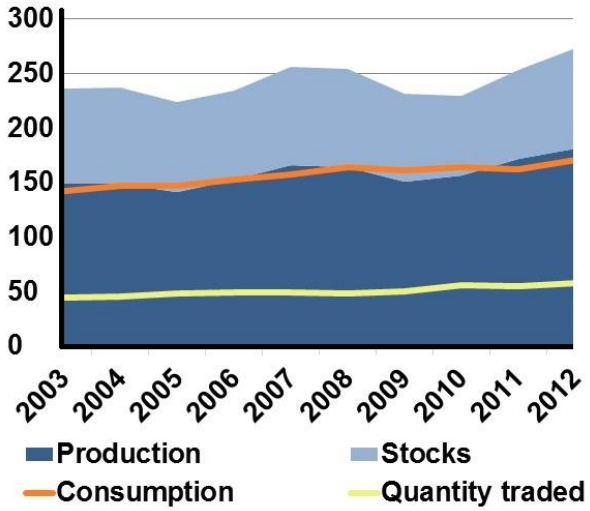


Figure 2.1[2]: World raw sugar supply and demand during 2003-2012 (in million tonnes), (ISO, 2010; ISO, 2013).

2.1.1 Sugar production

Sugar comes from two main crops, being sugar cane and sugar beet. Sugar cane grows best in tropical and sub-tropical climates, while sugar beet grows best in temperate climates. For that reason sugar is one of the few commodities which grows in many places around the world. Figure 2.2 shows in grey the share of sugar production per continent. In blue and orange it shows respectively the share of world beet production and world cane production per continent. It shows that the American continent

[2] Appendix 1 elaborates on the data given in the figures throughout the report. It contains additional information on trend lines, equations etcetera.

grows the majority of sugar cane, more than 50 percent. Further, with 38.7 percent it is the largest producer of raw sugar. This 38.7 percent is mainly Brazilian sugar, about 85.2 percent, while Paraguayan sugar supply is less than 1 percent (FAO, 2014b,c). Sugar crops are mainly cultivated for their high sucrose levels to use it for human consumption and biofuels. For optimal sugar content it is necessary to process the crops quickly after harvesting. The product received from the processed crop is called raw sugar. Raw sugar is not yet ready for human consumption, and is mostly refined near consumption areas. Further, there are several by-products which are molasses, bagasse and filter press cake. Respectively a thick sweet syrup, dry pulp and moistness pulp (Hannah et al, 1997).

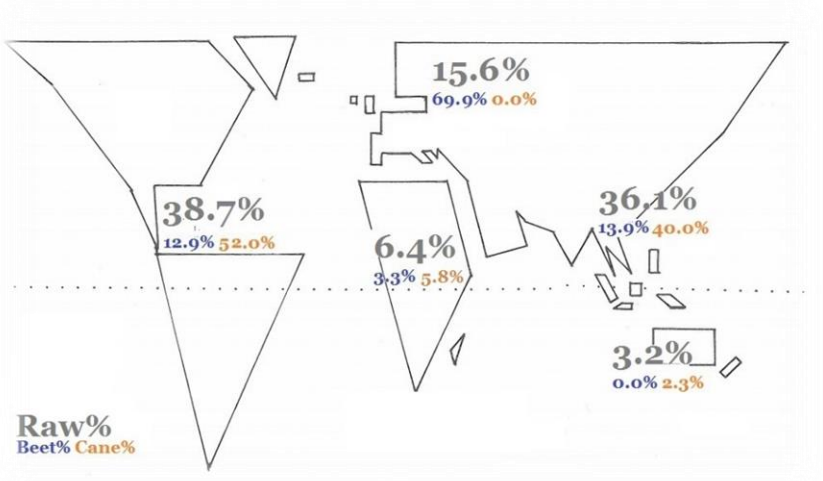
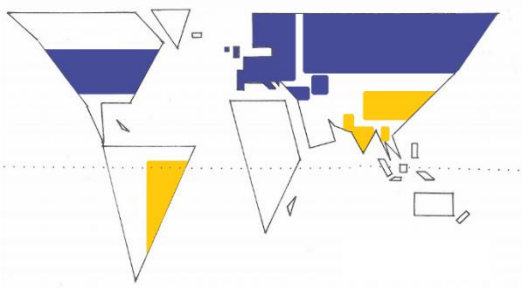


Figure 2.2[3]: Average sugar production per continent during 2003-2012, share of raw sugar (grey), share of sugar beet (blue), share of sugar cane (orange), (FAO, 2014b,c).

In sugar cane the sugar content is approximately 14 percent, further it contains 75 percent water and 10 percent of pulp (Hannah et al, 1997). However, it is not possible to extract all sugar content from the cane, in general the extraction rate for sugar cane is between 30 and 100 percent (FAO and European Bank, 2009). Sugar cane is mainly found in the Americas and Asia, and it is produced in emerging or developing countries mostly, as shown in figure 2.3.

Sugar beet has a sugar content around 16 percent, and consists further for 76 percent of water and around 8 percent of pulp (Hannah et al, 1997). Similarly for sugar beet, it is not possible to extract all sugar content from the beet, on average is the extraction rate between 40 and 80 percent (FAO and European Bank, 2009). Figure 2.3 shows that beet is mainly produced in Europe and in a lesser extend in Asia and the Americas. Further it shows that sugar beet is mainly produced in developed or emerging countries (European Commission, 2014a; FAO, 2014b; FAO, 2014c).



Sugar Beet	**Sugar cane**
1. EU-27	1. Brazil
2. Russia	2. India
3. USA	3. China
4. Ukraine	4. Thailand
5. Turkey	5. Pakistan

Figure 2.3: Top five production countries in 2012, sugar beet in blue and sugar cane in orange (in m tonnes) (European Commission, 2014a; FAO, 2014b; FAO, 2014c).

[3] This is a schematic view of the world map, showing the separate continents, Africa, the Americas, Asia, Europe and Oceania.

Furthermore, table 2.1 gives a short overview of the production of sugar beet versus sugar cane. For sugar cane, Brazil is the country with the largest production. The yield in Brazil is approximately 74.3 tonnes per hectare, which is close to the world average at 70.6. The EU is the largest production region for sugar beet and has average yields of 70.2 tonnes per hectare. This is above the world average which is at 55.0 tonnes per hectare. On average, yields have increased in the last decade, since they were 67.2 and 40.8 tonnes per hectare in 2003 for respectively cane and beet (FAO, 2014b; FAO, 2014c).

	Sugar cane	Sugar beet
World production 2012 (in m tonnes)	1,842.3	269.8
Average yield worldwide in 2012 (tonnes/ha)	70.6	55.0
Production in largest production country (in m tonnes)	721.1 *(Brazil)*	115.6 *(EU)*
Average yield in largest production country (tonnes/ha)	74.3 *(Brazil)*	70.2 *(EU)*
Production in most efficient country (in m tonnes)	10.4 *(Peru)*	1.8 *(Chile)*
Average yield in most efficient country (tonnes/ha)	127.8 *(Peru)*	93.6 *(Chile)*

Table 2.1: Sugar beet versus sugar cane in 2012 (European Commission, 2014a; FAO, 2014b; FAO, 2014c).

In 2012, the total production of raw sugar was 181.3 million tonnes worldwide and the ratio of beet sugar versus cane sugar was 21.3 percent versus 78.7 percent (ISO, 2013). To derive this amount of sugar, 269.8 million tonnes of sugar beet were harvested and 1,842.3 million tonnes of sugar cane (FAO, 2014d).

The level of sugar production of the top five countries over the last decade is shown in figure 2.4. In general, sugar beet production fluctuates, but is quite stable. During the period 2003-2012 production increased with an average of 0.4 million tonnes per year. On the contrary, sugar cane production increased with an average of 14.3 million tonnes per year. This is mainly caused by the strong increases in Brazil and China. Brazil and China are two emerging countries, section 2.2.3 shows that demand in these countries is rapidly increasing, which also explains increase in national production. The other cane producing countries are increasing production too, however less quick than Brazil. Since sugar is dependent of rainfall and other weather circumstances, the fluctuations in production level can be explained by weather circumstances. Section 2.2.1 elaborates on this market determinant.

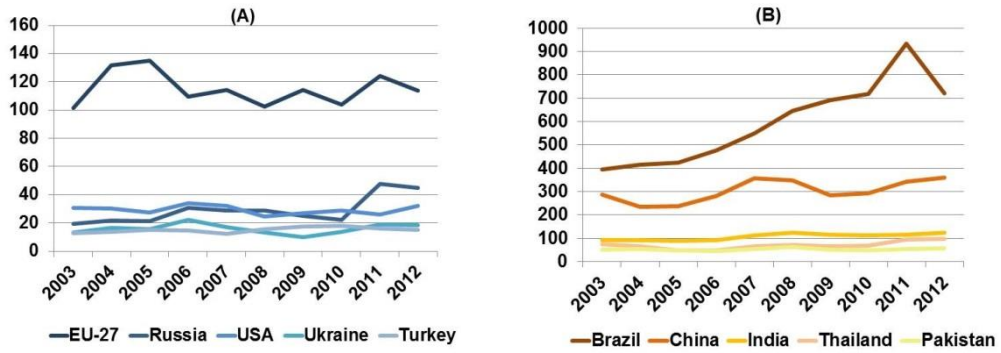


Figure 2.4: Top five production countries during 2003-2012, (A) sugar cane production, (B) sugar beet production (in m tonnes) (European Commission 2014b; FAO, 2014e; FAO, 2014f).

2.1.2 Sugar consumption

The main product from sugar crops are sugar for human consumption and sugar for fuel. By-products of sugar crops are used in other sectors, for example for animal feed, soil conditioner and chemical and pharmaceutical purposes (Paturau, 1989; Yadav and Solomon, 2006; Grandy, 2007). There is an increasing interest to create economic value out of by-products, however this research keeps focus on the main product. The main products from sugar cane are ethanol and sugar. An overview of Neves et al. (2010) shows how Brazilian sugar production is divided over several Brazilian sectors. Table 2.2 gives a rough overview of 2008.

Destination	Percentage	
Total	**100**	
Ethanol	55	
Sugar	45	100
Soft drinks	*9*	*20*
Chocolate and confectionery	*4.5*	*10*
Chemicals	*4.5*	*10*
Milk	*3.2*	*7*
Other	*23.8*	*53*

Table 2.2: Destination of Brazilian domestic sugar use in 2008 (Barros, 2010; Neves et al., 2010)

Global sugar consumption in 2012 was equal to 170.9 million tonnes, which makes world average sugar consumption per capita approximately 24.6 kilograms per year (ISO, 2013). In 2012 the top five countries consist of two developed countries and three emerging countries, being in order of demand: India, the EU, China, Brazil and the USA. Figure 2.5a gives an overview of their consumption pattern over the period of 2003-2012. Consumption was quite stable over time, with an average increase of 0.43 million tonnes per year. Consumption per capita in figure 2.5b shows that in Brazil, China and India consumption is increasing, while it is more stable in the other two countries. An increase in Brazil, China and India is explained by the fact that it are emerging countries, this is further discussed in section 2.2.3 in which emerging countries are described as market determinant.

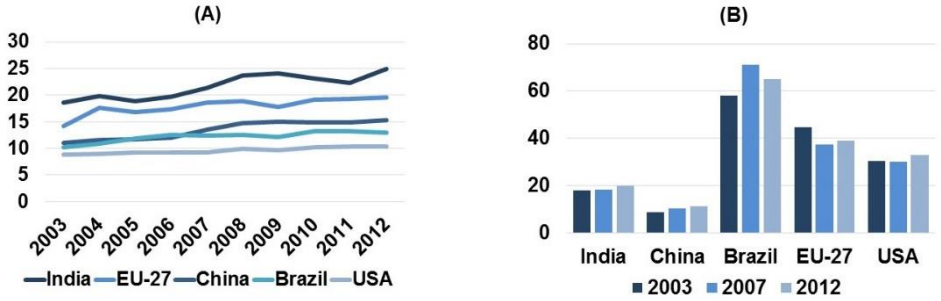


Figure 2.5: Consumption of raw sugar in top five consumption countries, (A) total consumption during 2003-2012 (in m tonnes), (B) consumption per capita per year (in kilogrammes) (ISO, 2010; ISO, 2013)

Besides use for human consumption, sugar is increasingly used as biofuel. Sugar and starch crops are responsible for respectively 40 and 60 percent of total ethanol production (Mussatto et al., 2010). At the moment several countries stimulate consumption with the implementation of national policies, which increases demand for biofuels significant (von Lampe, 2007; OECD and FAO, 2014). The main users are the USA and the EU which implemented several policies on renewable energy. A third big user is Brazil, due to the so-called flex-fuel vehicles (von Lampe, 2007). The increasing role of biofuels as market determinant for sugar is discussed in section 2.2.4.

2.1.3 Sugar trade

Total trade in 2012 was 58.3 million tonnes of raw sugar. Figures 2.6a and 2.6b give an overview of the main exporters, importers and their trade flows. The top five of exporting countries, contribute for 49.0 percent to total trade, while the top five consuming countries are responsible for 22.7 percent of total import (ISO, 2013).

Brazil is largest producer of sugar, and figure 2.6a shows that it is one of the largest exporters. With 42.5[4] percent of world exports Brazil trades with countries all over the world. Cuba mainly exports to former Soviet countries, while other major exporters such as Thailand and Australia export more on regional level to other countries in Asia and Oceania. On the import-side regional preferences are less clear, as figure 2.6b shows. Since the five major exporters provide almost halve of the world sugar export, they also dominate the supply of the five major importing countries. Figures 2.6c and 2.6d show the development during the last decade of the main exporting and importing countries. Increasing trade quantities are explained by increasing demand from emerging countries which is further elaborated in section 2.2.3.

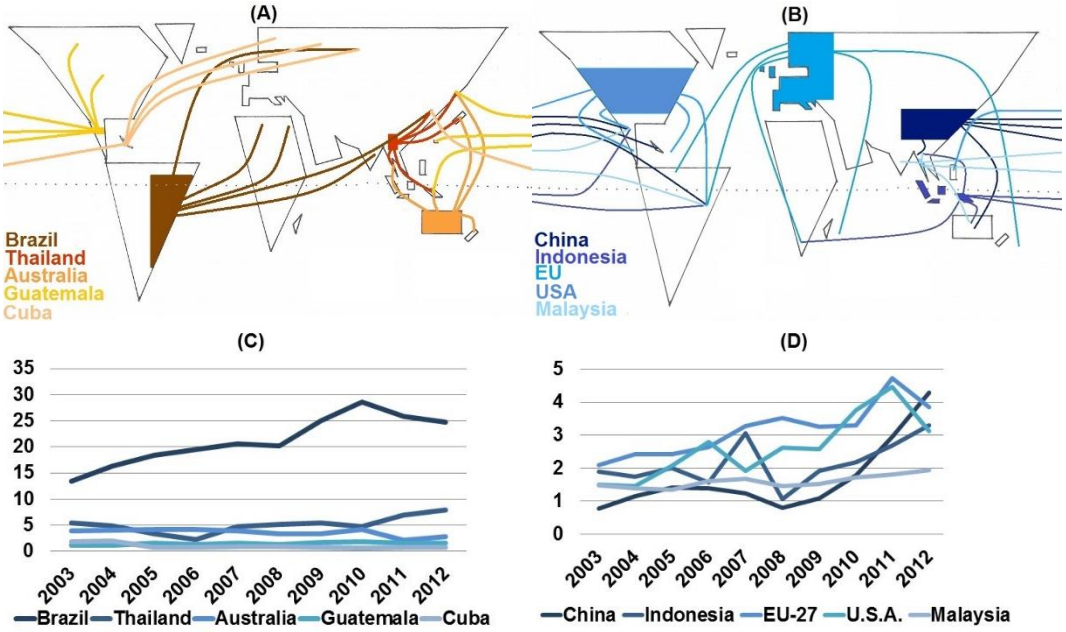


Figure 2.6: Top 5 exporting and importing countries, (A) main exporting trade flows, (B) main importing trade flows, (C) development of exported quantity during 2003-2012 (in m tonnes), (D) development of imported quantity during 2003-2012 (in m tonnes) (ISO, 2010; ISO, 2013).

2.1.4 Prices

Figures 2.7a and 2.7b show respectively the average world sugar prices for producers and consumers. All prices have an upward slope, the price spikes in 2005 and 2011 show that sugar cane prices strongly influence the consumer prices. Sugar cane is the main provider for raw sugar and therefore steers the prices of beet and the consumer prices. Further, the figure shows that cane prices are lower than beet prices. Most cane factories use by-products of the cane to provide energy for the processing, which reduces production costs (Hannah et al, 1997).

[4] Brazil exported 24.8 million tonnes of sugar in 2012. 24.8/58.3 = 42.5 percent.

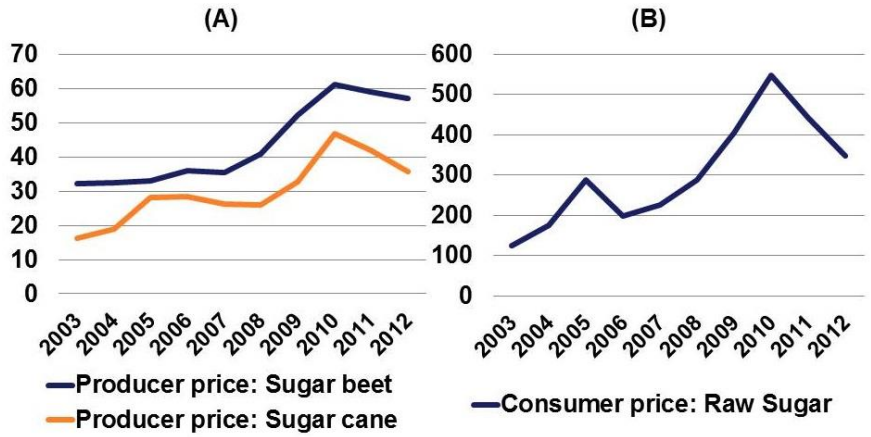


Figure 2.7: World sugar prices in euros per tonne, (A) producer prices are average price of five largest producing countries, (B) world consumption price is based on world prices (OECD and FAO, 2014).

2.2 Market determinants

Section 2.1 referred several times to market determinants, including production growth which is influenced by political decisions and the influence of emerging markets on the development of trade. The following sections elaborate on these market determinants, being climate and weather conditions, technological development, emerging markets, biofuels and national policies. These determinants are chosen since they are related to producer opportunities and challenges. An increasingly relevant topic related to sugar is health, but since this is an issue on the consumption side, it is not discussed in this research. Furthermore, sugar substitutes are also increasingly linked to the sugar debate, but data provided by FAO shows that sugar consumption is not significantly replaced by available substitutes (Galen van et al., 2011). Therefore it is not seen as a challenge for sugar producers and not taken into the discussion. In this section market determinants are introduced shortly, the next chapter elaborates on the issues with regard to Brazil and Paraguay.

2.2.1 Climate and weather conditions

Climate and weather conditions are taken into consideration as market determinant, since the production of any agricultural crop can heavily fluctuate depending on good or bad weather influences. For smallholder farmers this is a relevant factor since the production level is one of the determinants for the level of their income.

The growth of sugar depends on both water provision and temperature. Optimum rainfall should be between 1500 and 2500 mm evenly spread during the growing season. Optimum temperature for sugar cane growth is between 22 and 30 degrees Celsius (FAO, 2013). Several researches show that a change in climate with higher temperatures and lower rainfall does not necessarily affect sugar production significantly. This is explained by the higher amount of CO_2 when temperature increases. Since CO_2 has a fertilizing effect on sugar cane, this can outweigh the negative effects of reduced rainfall (Marin et al, 2013; Singels et al, 2014). This is also confirmed by research done by Nelson et al. (2014). It shows that sugar is a crop which is least affected by changing climate conditions if it is compared with coarse grains, oil seed, rice and wheat.

Coumou and Rahmstorf (2012) conclude that an increasing amount of extreme weather events have happened during the first ten years of the twenty-first century. This includes more frequent heatwaves worldwide and more extreme rainfall. World production analyses by the USDA show that weather effects are mostly outweighed, since favourable weather at one place compensates heavy rainfall at another place (USDA, 2014).

2.2.2 Technological development

This research refers to technological development being influenced by two aspects, the production aspect and the management aspects of the farm (Keating and Mc Cown, 2001). In general, the purpose of technological development is to increase efficiency at the farm level. Efficiency can be increased from production perspective by higher yields, or from management perspective by shorten transportation time. Both can lead to a higher quality or quantity, and can affect world prices or world supply. Further it can affect the income level of smallholder farmers. However, it should be recognised that increased technology includes increased costs (Schneider et al., 2011). The final effect on income depends on both increased yields and increased costs.

Regarding the sugar industry, most research on efficiency increase focuses on increasing management structures. Higgins et al. (2007) refer to several researches in a number of countries, these researches show that increased efficiency results in a high-quality product. According to Higgins et al. one of the main challenges in the sugar industry is to increase efficiency in the moment between harvesting and transport. The main challenge is to reduce the time between harvesting and the milling process, to maintain the sugar content in the crop and to deliver a high-quality product.

2.2.3 Emerging markets

Emerging markets play a significant role in the sugar markets, since increased sugar demand affects world trade. Increased demand can influence the choice of smallholder farmers to increase their sugar production instead of switching to alternative crops.

Worldwide there is a growing middle class, which is defined by the OECD as people who contribute to economic growth at a significant level. This growth is measured by rapid increase in GDP and is mainly seen in Asian countries and to a lesser extend in Latin America (Kharas, 2010). According to Hannah and Spence (1997), rapid GDP-growth results in a rapid increase in sugar consumption. They state that income elasticity of sugar is high in countries with a low income, but that this elasticity decreases when income increases. It is expected that sugar consumption will rapidly increase, and that it will stabilise after a certain level of income is reached.

This is confirmed by research by Popkin et al. (2011), which shows that sugar, fat and salt intake around the world is increasing. It is difficult to find specific data on food intake for developing or emerging countries. The research which is done at this level mostly focuses on emerging economies being Brazil, China, India and Mexico. Research in these countries shows a positive relation between growing GDP and increasing level of overweight population.

2.2.4 Biofuels

Sugar crops and starch crops are the main crops which are used for biofuel production, with a ratio of respectively 40 and 60 percent (Mussato et al., 2010). This brings more diversity in the use of sugar, and therefore affects the sugar supply market. Furthermore, it increases market opportunities for smallholder farmers. Worldwide energy production is increasing, in a period of 40 years energy production more than doubled. Nevertheless, the relative share of biofuels and waste did not change and was in both periods around ten percent of total energy supply. One of the sources used for biofuels is sugar cane ethanol. While biofuels are scarcely used at global level, at national level this can be different. In Brazil for example, about 50 percent of the harvested sugar in 2012 was used for ethanol production (Barros, 2013).

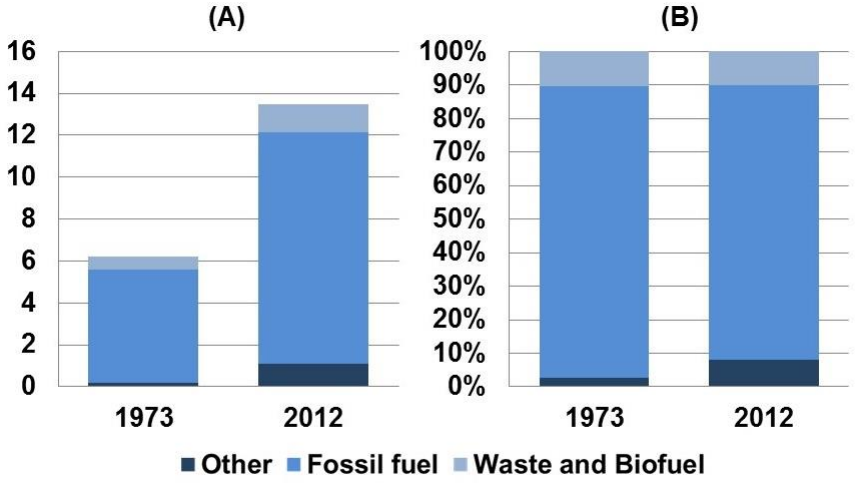


Figure 2.8: Comparison of world energy supply in 1973 and 2012, (A) absolute value (in m tonnes oil equivalent (mtoe)), (B) relative value (International Energy Agency, 2013; Barros, 2013).

Several research is done to explore the link between food prices and fuel prices, including de Gorter et al. (2013). They show that national policies regarding biofuels do affect the prices of food grains. They show that it are mainly OECD-countries which implement such policies, while developing countries are not able to respond to this rapid increase. Sorda et al. (2010) give an overview of these biofuel policies and strategies of the largest actors in biofuel production. They conclude that most common instruments are import tariffs to reduce international competition, and to stimulate different levels of the supply chain with subsidies for example at intermediate input level or consumption level.

2.2.5 National policies

Sugar is one of the many agricultural goods which is protected by governmental policies. In general the goal is to protect domestic production with help of border protection or production support (Mc Calla and Josling, 1985). National policies are taken into the discussion since policies of major players influence the market, and therefore affect opportunities for smallholders in their own and other countries.

At the side of the exporting countries, there are two contrasting developments visible. The biggest exporters have strict agricultural policies to stimulate production or they have largely unsubsidised agricultural sectors. Thailand and Brazil are two countries which have several policies to stimulate sugar production. For example, both countries stimulate ethanol production. In 2008 did Thailand establish a production target for 2012 of 1.9 million litres of ethanol per day, with the goal to produce 9 million litres per day in 2021 (Nguyen et al., 2008; Preechajarn et al, 2012). In Brazil, the ProAlcool programme was established in 1970s to stimulate ethanol production, despite deregulation in the 1990s is roughly halve of Brazilian sugar cane is produced for ethanol use (Neves et al., 2011; Galen van et al., 2011). Australia and Guatemala are examples of countries with largely unsubsidised sectors. To take Australia as example, the country abolished most agricultural policies in the seventies which led to major reconstructions. Least efficient producers made place for more efficient producers. Roughly 90 percent of domestic food consumption is produced in Australia, while still 60 percent of Australian food is exported (Lawrence et al., 2013).

At the side of the importing countries there are both emerging economies and developed countries. At the one hand are the main importers rapid growing economies such as China and Malaysia. At the other hand it are developed countries, being the EU and USA. Malaysia for example has a rapid growth in income and population, while there are limited possibilities for agricultural expansion. The country has minor tariffs on agricultural goods and imports sugar mainly from Australia (Warr et al., 2008). The EU and USA have on the contrary strict trade policies. The USA for example has sugar trade

agreements with 41 countries, and with exception of Mexico is the government able to limit the import from these countries (Galen van et al., 2011).

Chapter three will elaborate on some policies of Brazil and Paraguay which specific focus on the reduction of domestic poverty in general and among smallholder farmers in particular.

3. Smallholder sugar farmers in Brazil and Paraguay

The aim of the chapter is to analyse the interaction between the world sugar market and the domestic sugar markets in Brazil and Paraguay. The chapter starts with defining the concept smallholders and living income in the context of this research. Then sections 3.2 and 3.3 narrow down onto the national sugar industries of respectively Brazil and Paraguay. General information is given on the sugar industry and to what extend smallholders are involved. Then it shows which market determinants influence the national markets, and finally how national policy influences the opportunities for sugar smallholder farmers.

3.1 Introduction to smallholder sugar farmers

Both smallholders and living income are concepts which can be interpreted broadly. A clear definition on both concepts is useful to create common understanding before the research goes in-depth. Section 3.1.1 gives a short overview how the concept smallholder is used in science, in international organisations and by national governments. Based on that review a definition will be given which is used in the succeeding context. Further, a definition on living income will be based on a detailed research done by the UN International Labour Organisation (ILO).

3.1.1 Definition of smallholder farmers

From scientific perspective, Chayanov presented in 1925 a new look at smallholders. He argued that standard economic theory was not suitable for peasant household economics since peasants do not strive for profit maximisation. He stated the relationship between labour and income as follows: *"the values obtained by marginal labour will depend on the extent of its marginal utility for the farm family"* (Durrenberger, 1984: p.9). Despite the year of publication, the work of Chayanov is still actual in discussions. At the one hand it is argued that his ideas are still useful at macroeconomic level, at the other hand in microeconomics they are too simplistic. One of the reasons for this is that Chayanov argues from the perspective of the nuclear family structure, ignoring the many forms a family can have. At macroeconomic level the nuclear family is suitable to work with, but in microeconomics a complete impression of family structures is needed (Hammel, 2005). Ellis (1993) bases his definition on theories set by Chayanov. He focuses especially on the dual character of peasant household, which are producers at the one hand and consumers at the other. He uses the following definition: "*peasants are households which will derive their livelihoods mainly from agriculture, utilise mainly family labour in farm production, and are characterised by partial engagement in input and output markets, which are often imperfect or incomplete*" (Ellis, 1993: p.13).

International organisations have several definitions for smallholders. A prominent and often cited statement is made by the World Bank in 2001 in a rural strategy background paper on poverty. The paper qualifies five categories of poverty including low asset base, described as: *"smallholder farmers with up to two hectares of cropland"* (Okidegbe, 2001). This is based on an analysis on 24 countries and therefore not specific focusing on Latin America. The International Fund for Agricultural Development (IFAD) formulates a definition especially on Latin American smallholders and is more aligned to the context of this research. This definition focuses on the context in which farmers make decisions, rather than focus on acreage. The context is determined by the access to assets and the climatic and economic environment. Further, the paper highlights that the 2-hectare definition used by the World Bank is not suitable for smallholder farmers in Latin America since most families with less than five hectares are not able to make a living from farming. It points out that farms between five and twenty hectares of land still face great difficulties to make a living. IFAD formulates the following definition: '*smallholder agriculture is defined as a social and economic sector, made up of farms that are operated by farm families, using largely their own labour*' (Berdegué and Fuentealba, 2011).

Finally, the Brazilian and Paraguayan governments have established legal definitions. Smallholders in Latin American countries are mostly referred to as family farms and a legal definition is useful to

justify the inclusion and exclusion of participants in several policy programmes. In 2013 Calcaterra made a structured overview of legal definitions of both Brazil and Paraguay. This is based on information via the Latin American trade agreement Mercosur and national governments. In Brazil a landholding is defined as family farm if the family plus maximum two hired labourers work on the farm. Thereby should 70 percent or more of the income be gained via on-farm activities and farm size can be maximum 480 hectares. In Paraguay a family farm is defined as a farm which is managed by the family, hired labour is not defined. At least 50 percent of the income should be derived from on-farm activities and the maximum hectares is set at 50 (Calcaterra , 2013).

The above mentioned definitions have both differences and similarities. The maximum hectares set by governments largely exceeds the definition of IFAD and even more of the World Bank. However, all given definitions agree that the farm depends on family labour, which excludes farms or plantations with hired labour. Further should the majority of the income be derived on-farm. Ideally, the definition for the following report would not include a statement on hectares and only focus on family labour and source of income. Nevertheless, data makes it not possible to find information on this. Therefore based on the finding of Berdegué and Fuentealba, this research will focus on farms with 20 hectares or less. These are farms which often have difficulty with making a living and based on the relative small size it is assumed that farms will rarely hire more than two labourers.

3.1.2 Definition of living income

The earnings of a farmer can be described as a living income if it is sufficient to sustain farm and family (Anker and Anker, 2013a). As basis for the discussion, definitions on living wage are used, which is explained as the salary of a worker which is sufficient to sustain the family. Living income is therefore seen as a living wage plus a sufficient amount to sustain business. ILO created an extensive overview of definitions of a living wage from numerous sources. The report written by Anker (2011) includes institutions varying from NGOs and multinational corporations to governments and the Universal Declaration of Human Rights. Companies do make statements on living wage in their codes of conducts, but in practice is it not implemented (Anker, 2011).

Based on the different analyses, Anker concludes which factors determine a living wage and which costs should be covered. The level of the living wage is determined by the family structure, meaning the size of the household and how many full-time workers are assumed. Further, it depends on the level of costs for a 'basic quality life' per capita in the household (Anker, 2011). In the context of this research, the costs should be extended with costs to sustain and develop the farm. For all above factors, it must be taken into account that these are always time and place specific, therefore it is not possible to make a concrete statement for one certain level of living wage.

Anker argues that in general a family size of four can be taken as basis since this is the population replacement rate. Further, for developing countries he assumes 1.5 full-time working persons in a household with two adults. This is based on the observations that in many developing countries it is difficult to find a year round and full-time job. Further, according the definitions of Anker the costs which needs to be covered by a living wage are more than the costs to cover basic needs of survival. It includes costs for a nutritious diet, decent clothing, decent housing and some other costs, e.g. education. Hammond et al. (2007) estimated the average household expenditures of people living in poverty, the results are shown in table 3.1. It shows that major expenditure goes to food, and 'other', however this pillar is not further specified in the report.

Household expenditures	Percentage
Food	58%
Energy	9%
Housing	7%
Transport	4%
Health	3%
Other	19%

Table 3.1: average household expenditures of consumers in poverty (Hammond et al., 2007).

The overview in table 3.1 is an estimate of 4 billion poor households, it is not specified on rural and urban or per continent. The balance in expenditures of Latin American rural households can differ from this overview. It is assumed that the pillar 'other' has a larger share in farm households, which includes costs to sustain the farm. After all, family size and level of costs are open for discussion since these are time and place specific. Further research by Anker supports the statement of differences in time and place. For Fairtrade International he estimated the living income in Dominican Republic, Malawi and South Africa. For these three countries is research done at household level, costs are measured for house rental and utility costs, markets and shops are visited, etcetera. Outcomes differ per country and region. Table 3.2 shows a short overview for three countries estimated by Anker and Anker (2013a; 2013b; 2014). The estimates assume several on-work benefits such as free transport and free meals at the workplace. The level of living wage per month is based on average number of fulltime workers per year and household size.

Country	Living wage	Household size	Fulltime workers
Malawi	66.86	5	1.59
South Africa	181.84	4.5	1.64
Dominican Republic	237.50	4	1.67

Table 3.2: living wage estimate per household, presented in euros per month (Anker and Anker, 2013a; 2013b; 2014)

For Brazil and Paraguay there is no detailed information available yet for a living wage or living income. This research cannot go in sufficient detail to give a proper estimation for smallholders in both countries. The GNI introduced in chapter one however, gives insight in the income distribution in Brazil and Paraguay. It shows that the lowest quintile of Brazil receives an average income of 128.0 euros and the two lowest quintiles of Paraguay receive respectively 48.6 ad 109.4 euros. This is below the estimated living wage for the Dominican Republic, another Latin American country. When a proper living income estimate for smallholders will be made, it is suggested to take crop types in account. This is because profit and investment differ per crop type, a rice producer shall choose to invest in irrigation while a sugar cane producer shall not. When a living income for sugar smallholders in Brazil and Paraguay is established, it should cover costs of respectively 3.3 and 3.9 members, being the average household sizes (IBGE, 2011; Colmán et al., 2009). The number of fulltime workers in both countries is unknown, but as suggested above this can be estimated at the average of 1.5 working adults per household.

When the level of living income is established, it is not yet certain that a farmer and his family shall spend the income as calculated. Research shows that there are cases when non-essential purchases are chosen over necessary purchases, for example investments in weddings or other festivities. This can be preferred above farm-related investments to make a social statement and to cover up the low income situation (Subrahmanyan and Gomez-Arias, 2008). Thus the establishment of a living income has not the direct consequence of poverty reduction.

3.2 Smallholders in the Brazilian sugar industry

In Brazil there were in 2006 in total 190.8 thousand farms which were involved in sugar farming. Of these farms, 116.9 thousand farms had a maximum farm size of 20 hectares. Figure 3.1 shows that the majority of sugar farmers are smallholders, 61.3 percent, the blue part of figure 3.1a represents farms with less than 20 hectares. With an average household size of 3.3, there are about 386.0 thousand people which are affected by the developments in the Brazilian smallholder sugar industry[5]. However, these large number of smallholders produce a relatively small amount of the total Brazilian sugar, as the right figure shows, around 3 percent of total sugar.

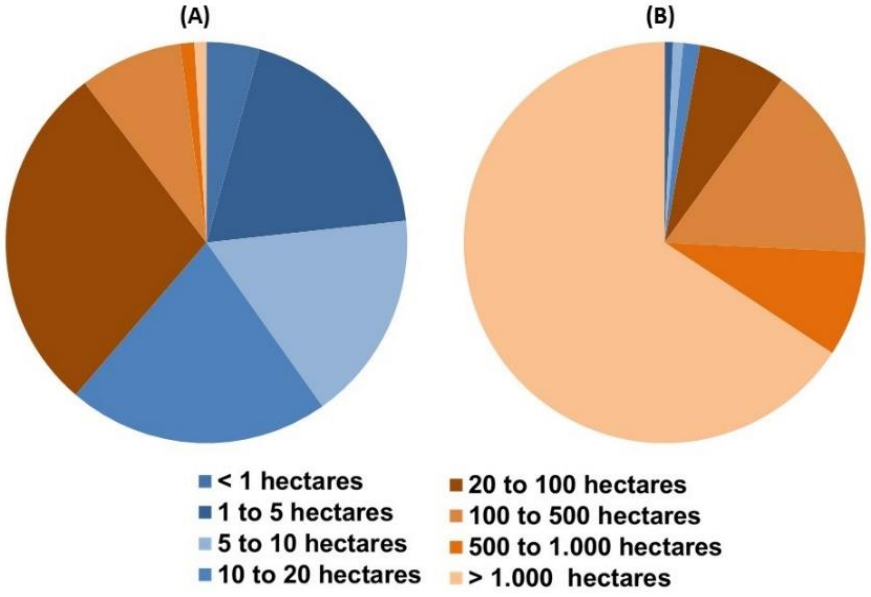


Figure 3.1[6]: Share of smallholders in Brazilian sugar production in blue, (A) share in total number of sugar producing farms in Brazil and (B) share in total sugar production (Ferreira, 2012). Please be aware that the acreage spend on sugar is not inevitably equal to the total acreage of the farms.

3.2.1 Determinants in the Brazilian sugar market

The previous chapter introduced several market determinants which can influence the sugar production in countries. This section shortly discusses how the production in Brazil is determined by climate and weather conditions, technological developments, emerging markets, biofuels and policies. The chapter shows that there is no policy specific for smallholder sugar farmers, but a policy programme which is most directly concentrating on sugar smallholders is discussed in 3.2.2

Climate and weather conditions

The average annual rainfall in Brazil was 1590 mm during the period of 1990-2009, while temperature was around 25.3 degrees of Celsius (World Bank, 2015). Both are within the range of preferred weather conditions for sugar cane growth. Due to these conditions irrigation is minimal needed in Brazilian sugar cane growth (Martinelli et al., 2011). Nevertheless, weather does not only affect crop growth, it can also influence harvesting and transportation. For example, in 2010 bad weather caused delay in transportation. Due to heavy rain the loading in Brazilian harbours was forced to stop since humidity can ruin the product (Chan and Teo, 2010). An overview by the USDA on the world sugar situation shows that rain and humidity more often influence harvesting or processing. During the period of

[5] The average household size is Brazil is equal to 3.3 persons, then 116,971 farms this gives 116,971 * 3.3 = 386,004 people.

[6] Appendix 1 elaborates on the data given in the figures throughout the report. It contains additional information on trend lines, equations etcetera.

2003-2012 there were five reports on delayed shipment or less harvesting days due to weather (USDA, 2014).

The future prospect for sugar cane is positive if climate change is taken in consideration (Nelson et al., 2014). Research compared and harmonised several climate change prediction models and the evaluation included the effect on prices and yields. Compared to four other crops or crop groups grown in Brazil, sugar cane is least affected on these indicators. Sugar prices will not heavily increase and compared to other crops sugar has least yield decrease.

Technological development

From production perspective Brazil is currently leader in agricultural exports due to investments in crop technology. Brazil experiments with biotechnology, and is one of the top ten leaders in the business. With experiments in sugar cane varieties, cane is made insect or pest resistant and therefore yields can be increased (Martinelli et al, 2011; Schwartz et al., 2009). Nevertheless, data from FAO shows that sugar cane yields in Brazil are rather stable, in 2003 it was 73.7 tonnes per hectare and in 2012 74.3 (FAO, 2015).

Another development is a decrease in the ratio worker/hectare, this was 0.06 in 2009. It is observed that in Brazilian sugar production the number of workers is decreasing while sugar cane area is increasing. Compared to other crops, the years of schooling in the sugar cane sector are increasing. With an average of 4.5 years of schooling in sugar cane compared to 4.0 years of schooling in agriculture in general, the researcher concludes that sugar cane is a skill demanded activity (Souza Ferreira Filho, 2012).

Emerging markets

Figure 3.2 shows the share of the top five sugar trading partners of Brazil in 2012, and the share they had in 2003 and 2006 (ISO, 2010; ISO, 2013). China is a relatively new trading partner for Brazil, while export to Russia is decreasing in both relative and absolute amount. Since 2008 China is the main destination of Brazilian agribusiness exports in general, taking the place of the USA (Neves et al, 2011). In total approximately 30 percent of total sugar exports goes to the five major exporters. This has as result that a policy intervention of one of the trade partners shall not significantly affect Brazilian exports.

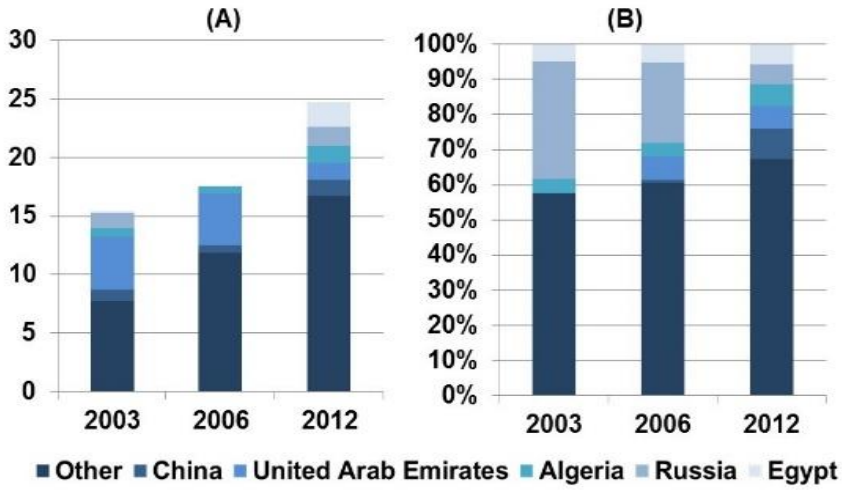


Figure 3.2: Change in Brazilian sugar export partners, panel (A) absolute value (in m tonnes) and panel (B) relative value (ISO, 2010; ISO, 2013).

Biofuels
In Brazil, sugar cane is grown for ethanol since the 1930s, however, the oil crisis in 1973 was an enormous trigger for increase of ethanol production. Around that time national programmes were developed to stimulate sugar cane production and ethanol mills, such as the programme *Pro Alcool*. One of the reasons for increased ethanol demand, was the introduction of the ethanol car in 1979. Nevertheless, a renewed type of car was developed in 2003 with flex-fuel technology. Flex-fuel cars can use both biofuels and fossil fuels, in 2009 92.6 percent of all new sold cars had this technology implemented (Hall et al, 2011; Neves et al, 2011). Besides domestic ethanol demand, there is an increasing demand for ethanol from foreign countries. In 2012 were the USA, Jamaica, South Korea, El Salvador and Japan the main ethanol trading partners (Barros, 2013).

Brazil tries to get smallholder farmers involved in biofuel production with help of several policies, nevertheless it is difficult to get these smallholders involved. Some reasons for this exclusion are poor business knowledge among smallholders and a lack of trust in the industry. An example of this distrust is that smallholders think they shall receive a lower price, compared with other industries (Hall and Matos, 2010).

National policies
In 2003 the Brazilian government implemented a national food programme called Fome Zero (zero hunger). The programme includes adoption of policies that support family farming, with the aim to increase food production and support low-income farmers. To fulfil this aim, both national and local policies are implemented, no policies are especially focusing on smallholder sugar farmers, but there is one big food programme which focuses on smallholder farmers in particular. This is the Food Acquisition Programme, or in Portuguese Programa de aquisicao de alimentos da agricultura familiar (PAA) (Silva Junior da et al., 2012).

In practice this programme results in reference prices for smallholders, these prices exceed the level of the minimum guaranteed price (Santana and Nascimento, 2012). The programme consist of several segments and not all are suitable for smallholder sugar farmers. One of the segments for example aims that the government directly buys products of smallholders to use this for school meals. The programme is called Direct Food Procurement, in Portuguese Compra Direta da Agricultura Familiar (CDAF). For this purpose they focus on products which have less complex processing schemes, e.g. nuts and rice, thus sugar is not included (Silva Junior da et al., 2012). Nevertheless there are also segments in which smallholder sugar farmers are supported. The next section elaborates on this, a programme in which stocks are set up by family farmers.

3.2.2 Analysis of a Brazilian smallholder policy intervention
Stocks set up by family farmers – Formaçao de estoque pela agricultura familiar (CPR Estoque)
To fulfil the aim of PAA and Fome Zero a segment was set up in 2006 to create stocks of family farmer products, CPR Estoque. An assumed result of these stocks are increased local food security and strengthened local networks. Smallholders are supported to create and join farmers organisations and set up stocks. Stocks can then be sold in periods when prices are more rewarding. Examples of commodities which are involved in CPR Estoque are sugar, nuts, flour, meat, fish etcetera (Chmielewska and Souza, 2010; Silva Junior da et al., 2012).

The stocks created by farmer organisations are bought by investment funds and groups. These groups buy the products of farmer organisations with the purpose to sell it later under more favourable conditions. This can be due to more favourable prices in the future or by adding value due to processing (Silva Junior da et al., 2012). The programme is beneficial for sugar cane smallholders since their dependence on middlemen disappears and they receive a guaranteed price for their raw product. The investment funds become responsible for further processing (Chmielewska and Souza, 2010).

In 2009 16 different states in Brazil participated, 192 farmer organisations where involved and roughly 11.1 thousand farms were involved. This is equal to approximately 36.7 thousand people.[7] Investment funds and groups are supported by the government, up to 1.5 million R$ per year (0.5 million euros), depending on the number of smallholders they support. In 2009 there was 46.4 million R$ invested (14.4 million euros), this resulted in a total amount of financed stocks of 52 thousand tonnes (Silva Junior da et al., 2012).

3.3 Smallholders in the Paraguayan sugar industry

In 2008 there were in total in Paraguay 20.5 thousand farms which cultivated sugar cane, and 17.9 thousand of these farms owned a maximum of 20 hectares. Smallholder farms in Paraguay have an average of 3.9 household members, thus approximately 69.8 thousand people are impacted by smallholder sugar farming (Colmán et al., 2009)[8]. Figure 3.2 shows that the majority of Paraguayan sugar farmers are smallholders, and that these smallholders are responsible for 53.2 percent of Paraguayan sugar supply. The biggest producers of Paraguayan sugar are large plantations with more than 1,000 hectares, representing 28.8 percent of the total and the second biggest producers are smallholders with 10 to 20 hectares of land, being 23.1 percent.

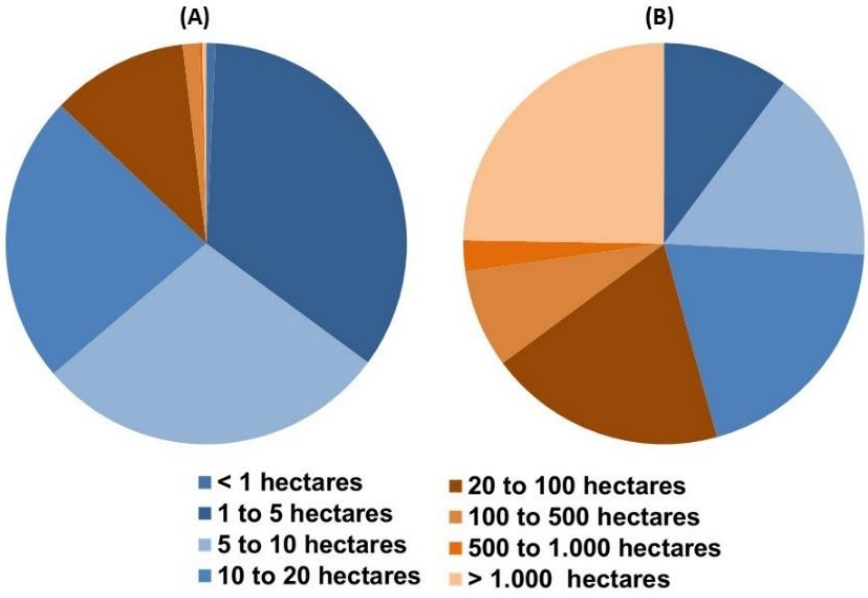


Figure 3.3: Share of smallholders in Paraguayan sugar production in blue, (A) share in total number of sugar producing farms in Paraguay and (B) share in total sugar production (Colmán et al., 2009). Please be aware that the acreage spend on sugar is not inevitably equal to the total acreage of the farms.

3.3.1 Determinants in the Paraguayan sugar market

Climate and weather conditions

The average annual rainfall and temperature in Paraguay were respectively 1057.2 mm and 22.3 degrees of Celsius between 1990 and 2009 (World Bank, 2015). Both rainfall and temperature are low compared to the needs of sugar cane, being 1500-2500 mm and 22-30 degrees of Celsius. This national average can explain why Paraguayan sugar production mostly occurs in the eastern part of the country. It borders the region Paraná in the south of Brazil which is a region with high sugar production (Colmán et al., 2009; Ferreira, 2012). Research on climate in Latin American countries shows that both regions are alike, since rainfall and temperature show similar patterns during the year

[7] The average household size is Brazil is equal to 3.3 persons, then 11,135 farms this gives 11,135*3.3 = 36,745.5 people.

[8] The average household size for sugar smallholders in Paraguay is 3.9, then 17,889 farms gives 17,889*3.9 = 69,767.1 people.

(Solman et al, 2013). Changes in climate affecting Brazilian sugar production can therefore be expected to affect Paraguayan production too. These expected changes are discussed in section 3.2.1, the section concludes that sugar cane is a crop which is relatively minor affected by a changing climate.

Technological development
Fletschner and Zepeda did research on smallholder farmers in eastern Paraguay and measured their efficiency (2002). Efficiency was measured as the ratio of inputs transformed to outputs. The researchers conclude that smallholders are highly efficient given their assets. Nevertheless, they further show that smallholders have difficulty to get access to necessary assets, thus this efficiency is highly related to accessibility of assets. The researchers suggest that increased access to input markets increases production among smallholders. Furthermore, they conclude that improvements can be made by increasing scale of production.

Sugar cane yields in Paraguay fluctuated in the period of 2003-2012. In 2003 yield per hectare was 52.4 tonnes, but from 2011 to 2012 a major drop occurred and average yield in 2012 was equal to 36.4 tonnes per hectare (FAO, 2015).

Emerging markets
Figure 3.4 shows the development of Paraguayan sugar export over time. It makes clear that Paraguay has four major export partners, and further exports relatively small amounts to other countries, which is less than one percent of total exports. In 2012 the majority of Paraguayan export went to the USA and the EU, respectively 68.6 percent and 19.3 percent. Over time there have not been major changes in export partners, but the graph makes visible that sugar export increased over time. More than 99 percent of Paraguayan sugar export goes to four countries. This has as result that Paraguayan export is strongly influenced by foreign policies. Approximately 70 percent of Paraguayan export goes to the USA, choices to reduce Paraguayan import have major consequences for Paraguayan sugar export.

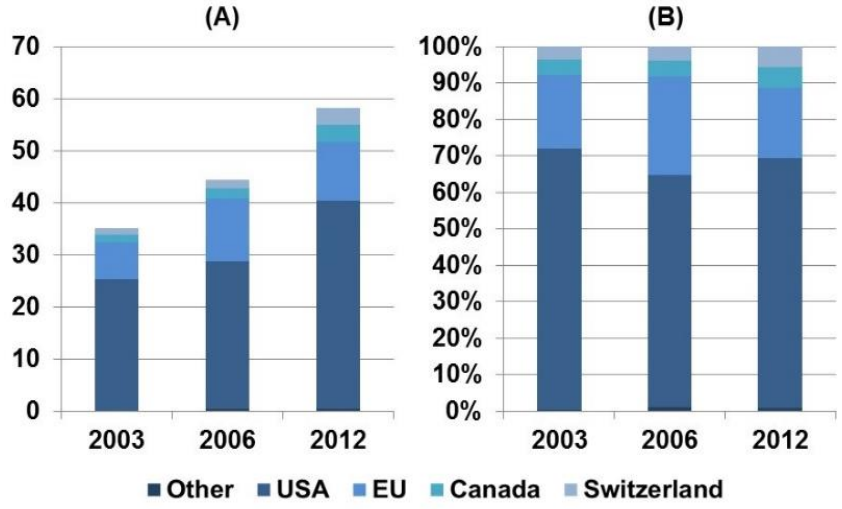


Figure 3.4: Change in Paraguayan sugar export partners, (A) absolute value (in m tonnes) and (B) relative value (ISO, 2010; ISO, 2013).

Biofuels
In general it can be concluded that most Latin American countries get inspired and follow examples of Brazil if it is about biofuel production and expansion (Ludena et al, 2007; Joseph, 2014). In Paraguay is sugar cane the main source for ethanol production but grains are of increasing importance. In 2008 the ratio sugar cane-grain was 95 percent versus 5 percent, while in 2012 it was 80-20. Since 2012 it is allowed in Paraguay to import flex-fuel cars from Brazil and increased demand for ethanol is expected. Before the introduction of the flex-fuel car the diesel-gasoline ratio was about 80-20. With the introduction of the flex-fuel technique this is expected to shift to 65-35 (Joseph, 2012).

National policies
In Paraguay, poverty and social inequality became policy issues in the beginning of the 1990s. One of the major programmes which came forth of this is the public policy for social development: Paraguay for all, or in Spanish Política pública para el desarrollo social 2010-2020: Paraguay para todos y todas. The aim of this programme is to improve the coverage and efficiency of social protection policies in Paraguay. Several aspects of poverty are taken in consideration, the educational system is taken as biggest challenge to support social development. Further existing programmes are made more efficient. Similar to Brazil, there are no programmes especially addressed to sugar producers, but neither on smallholder farmers. An example of a Paraguayan policy programme which affects smallholders is Tekoporã. One of the aims of this programmes is to reduce rural poverty (Lavigne, 2014). The next section shows how this affects smallholder sugar farmers.

3.3.2 Analysis of a Paraguayan policy intervention

Tekoporã – Conditional cash transfer programme
Tekoporã is a conditional cash transfer programme which is part of the larger programme Paraguay for all. The aim of Tekoporã is to break the circle of poverty in rural and urban areas and is set up in 2005 (Lavigne, 2014; Higgins et al., 2013). Households can receive cash transfers and participate in the programme if they fulfil three requirements: they should have children with an age below fifteen or the woman should be pregnant. Secondly is inclusion based on the area people live in, and third based on the position at an index which determines the living condition of the household (Soares et al., 2010).

The programme consists of two parts, the conditional cash transfer and the monthly visit of a social worker. The conditions a household should fulfil are threefold: school attendance, a regular visit to the health centre and the updating of immunisations of children. An impact evaluation by Soares et al. (2010) shows that consumption is not significantly increased neither is labour supply decreased. Agricultural investments increased significantly. Compared with non-participating households, households participating invested about 45 percent more in agricultural production. However, the research does not elaborate on specific investments.

According to Higgins et al. (2013) in 2010 the programme supported approximately 83.5 thousand families, equal to roughly 325.6 thousand people.[9] The budget was approximately 337.2 billion Paraguayan Guarani (₲) (roughly 61.5 million euros). This resulted in a cash transfer of about 180 thousand to 300 thousand ₲ per household per month (32.8 to 54.7 euros).

[9] The average household size for sugar smallholders in Paraguay is 3.9, then 83,500 farms gives 83,500 * 3.9 = 325,650 people.

4. Welfare analyses on policy changes in Brazil and Paraguay

Chapter four concentrates on the potential policy implementations and their effects on smallholder income. Based on the findings of the previous chapters this chapter presents a welfare analysis of the world sugar market, with special focus on the effects for smallholder farmers. Section 4.1 gives an analysis of the welfare distribution in the market, and how this is affected by CPR Estoque and Tekoporã. The section further shows the effects of these policies on the income of smallholders. Section 4.2 highlights several challenges faced by smallholders to earn a living income. Some of these are already introduced in the previous chapters where market determinants are discussed. Finally, suggestions for policy reform are made, the aim of these reforms is to increase the level of income for smallholder sugar farmers.

Both Brazil and Paraguay started in the 1990s with increasing policies for food and nutrition security, poverty reduction and social protection (Silva da et al., 2011; Lavigne, 2014). The emphasis on food and nutrition security is twofold, on the one side smallholders are food producers and can contribute to food and nutrition security. On the other side, they belong to the poorest part of the population and therefore are included in the large share of food insecure people (Silva da et al., 2011). A low level of income contributes to this vicious problem, necessary farm investments cannot be made, which makes smallholders vulnerable to shocks such as bad weather. Low farm investments and high risks make it difficult to earn a living income and this leads to food insecure households (Berdegué and Fuentealba, 2011).

4.1 Welfare distribution in the current sugar market

The current welfare distribution in the sugar market is largely determined by the national policies of the largest importing and exporting countries in the market. These policies are presented in section 2.2.5. The section concludes that exporting countries have favouring production and exporting policies, while importing countries cope with problems of self-sufficiency and a rapid increasing demand (Nguyen, 2008; Isakson, 2014; Neundörfer, 2012; Huang and Rozele, 2010). The effect one country can have on the world market is shown in figure 4.1, it represents the sugar market in 2012. Panel (A) represents the Brazilian sugar market and shows that supply (S_B) exceeds Brazilian demand (D_B), Brazil has an excess supply of 24.7 million tonnes of sugar. Panel (B) represents the sugar supply of the rest of the world. The difference between supply and demand equals an excess supply of 33.6 million tonnes of sugar. The sum of both panels is shown in panel (C), the total world sugar market. It shows that Brazilian excess supply is a major share of total excess supply ($ES_T = ES_B + ES_R$). These together equal total excess demand (ED_T), which is the difference shown in panel (D). Suppose now Brazilian sugar supply changes, for example excess supply increases with 20 percent due to increased production by smallholders. Then, when other things stay equal, the world sugar market increases with 8.5 percent[10].

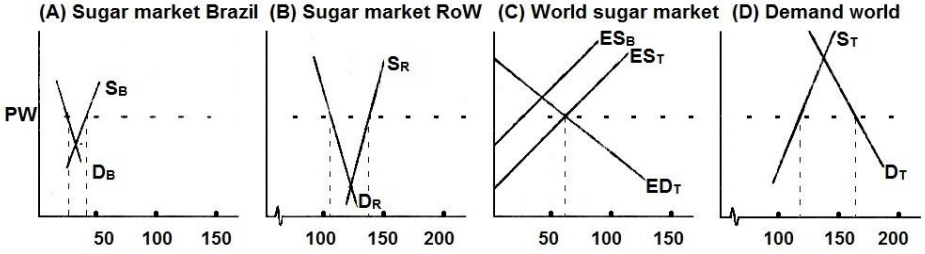


Figure 4.1: Graphical overview of world sugar market (in m tonnes).

[10] Brazilian sugar supply increases with 20 percent: 24.7*1.20=29.6 million tonnes. World sugar market then is: 29.6+33.6=63.2 million tonnes. From 58.3 to 63.2 is an increase of 8.5 percent.

4.1.1 A Brazilian intervention

Stocks set up by family farmers – Formaçao de estoque pela agricultura familiar (CPR Estoque)

CPR Estoque is a programme in which smallholder farmers are supported by investment groups and it results in a guaranteed price for smallholders. In the case of sugar cane smallholders they are not dependent on middlemen anymore and in general, funds provide a higher price for the commodity than middlemen. In figure 4.2 the CPR Estoque is analysed, it shows the effects on the domestic sugar market, the world sugar market and foreign demand market.

Panel (A) represents the Brazilian sugar market, it shows that total Brazilian sugar supply is approximately 40 million tonnes at world market price, and excess supply is 24.7 million tonnes. Supply is split in the share of Brazilian smallholders (S_{BS}) and other Brazilian farmers, the sum is shown by total Brazilian supply (S_{BT}). Figure 3.1 showed that smallholders produce approximately 3 percent of total sugar supply, here this equals 1.2 million tonnes of sugar cane. Panel (B) shows world sugar market with total excess supply (ES_T) which includes total Brazilian excess supply (ES_B). Total excess supply is in equilibrium with total excess demand (ED_T) at world price (PW_1), and the demand market is shown in panel (C).

Now the Brazilian government implements PAA and smallholder sugar farmers receive a guaranteed price for their product ($\overline{P}_{BS}$). This has as result that smallholders produce a fixed amount of sugar up to $\overline{P}_{BS}$, and leads to an outward shift of total Brazilian sugar supply. Since Brazil provides approximately halve of the world sugar supply, the total supply curve shifts out. Due to this increased supply the equilibrium shifts and world price decreases from PW_1 to PW_2.

For sugar smallholders in Brazil this is a favourable change, due to a guaranteed price they are sure of a certain level of income. At the other hand, for foreign sugar producers the world price decreases to PW_2. For smallholder producers in other countries this has as result that they receive a lower price for their sugar, making it more difficult to earn a living income.

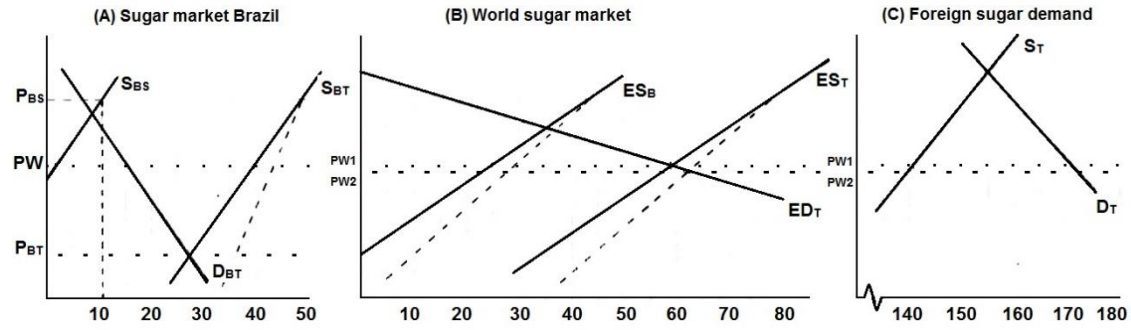


Figure 4.2: Graphical overview of effects of CPR Estoque (in m tonnes).

4.1.2 A Paraguayan intervention

Paraguay is a small producer in sugar, in 2012 it produced 120 thousand tonnes which is less than one percent of total world production (ISO, 2013). Intervention in the Paraguayan market therefore does not affect the world market, thus the world market is not taken into the analysis. The graphical overview contains two panels, one showing the effects in supply and demand and the other showing the trade effects.

Conditional cash transfer programme – Tekoporã

Tekoporã is a conditional cash transfer programme for poor households. The transfers should encourage investments in human and social capital. Section 3.3.2 shows that agricultural investments increase among smallholders which participate in the programme. It also states that consumption under participants does not increase significantly. Taken this in consideration, figure 4.3 gives a graphical overview of the effects of Tekoporã. Paraguay is a net importer regarding sugar, nevertheless

the Tekoporã policy influences opportunities for sugar smallholders. Panel (A) represents the Paraguayan sugar market in 2012, with sugar demand (D) around 135 thousand tonnes, total production (S_{PT1}) around 120 thousand tonnes of which 55 thousand produced by smallholders (S_{PS1}). Paraguayan supply and demand are in equilibrium at domestic price PD. Panel (B) shows that at this equilibrium, there is an excess demand of 20 thousand tonnes of sugar.

Now poor households receive conditional cash transfer, therefore both smallholder producers and consumers observe an increase in their income. Smallholder farmers increase their agricultural investments and total supply shifts outward. However, consumption does not significantly increase, which only causes an outward shift of excess supply to ES_2. The increased excess supply of Paraguay has no significant effect on the world equilibrium price which is established by trade of a total of 58.3 million tonnes. The implementation of Tekoporã is positive for Paraguayan sugar smallholders. As stated in section 3.3.2 smallholder farmers receive approximately 30 to 50 euros per month extra, and it results among other things in increased agricultural investments. The change in production is not sufficient that it will affect the world market, and therefore are foreign smallholder sugar farmers not affected by this Paraguayan policy implementation.

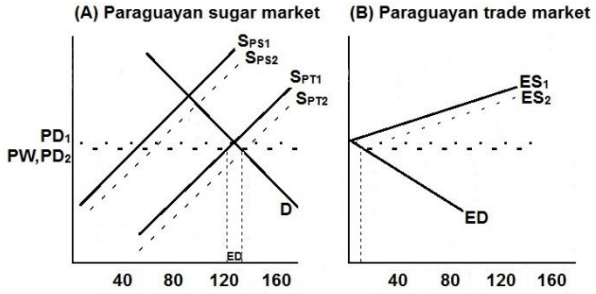


Figure 4.3: Graphical overview of effects of Tekoporã (in thousand tonnes).

4.2 Challenges for smallholders in the sugar market

Smallholder sugar farmers face several challenges to achieve a living income. These challenges are divided in two categories, some are for smallholder farmers in general, some are specific related to the sugar supply chain. These challenges and their possible solutions are discussed here before reforms are suggested in section 4.3.

4.2.1 Smallholder challenges and solutions

General problems faced by smallholder relate to exclusion by legal definitions and inefficient national and foreign policies.

Legal definitions

Both Brazil and Paraguay established legal definitions to describe smallholders. These definitions are established to make clear standards for smallholder related policy. Nevertheless these definitions often result in exclusion of a share of smallholders. Both Brazil and Paraguay have requirements related to the minimum percentage of income gained from on-farm labour, respectively 70 and 50 percent (Calcaterra, 2013). However, for smallholder farmers in Latin America it is often difficult to accomplish this if their farm is smaller than 20 hectares. A large share of their income is gained from non-farm activities. In Brazil for example, approximately 6 percent of income is gained by on-farm activities among smallholders with less than 5 hectares of land. The gross of their income is gained by non-farm activities (Berdegué and Fuentealba, 2011). As result there is a large share of smallholders which are farmers in practice, but not defined according the legal definition. Therefore they are excluded from national smallholder policies and can these policies not benefit the income level of smallholders.

To solve the problem of this limited definition, it is suggested to increase the flexibility of defining smallholders. Currently a household must fulfil three requirements before they are defined as smallholder. It is suggested to increase flexibility and change the request to fulfil all requirements into the request of fulfilment of at least one or two characteristics. This makes the definition more efficient and includes more smallholder farmers in practice. Increased flexibility is also suggested by the OECD-ministers as one of the five characteristics for efficient policy objectives (Moreddu, 2007). These five characteristics are discussed in section 4.3.

National policies
A challenge for smallholder farmers is that national agricultural policies are often general for the whole sector. In such cases it is difficult to be effective for all subgroups such as smallholders. In Brazil this problem was noticed during the implementation of the guaranteed minimum price policy (PGPM). The programme was set up for farmers in general, but since smallholders mostly live in relatively isolated areas and their produce was too small, it was difficult for them to benefit from this programme. Recognising these problems, the Food Acquisition Programme (PAA) is established (Silva da et al., 2011). This is a smallholder programme and it is an interesting example of narrowed down target groups. At the one hand the programme contains the CPR estoque programme, in which all smallholder farmers can benefit, regardless the commodities they produce. On the other hand the programme includes the direct food procurement (CDAF), in which smallholder farmers can only participate if they produce commodities which are suitable for the school meal programme (Silva Junior da et al., 2012). If sugar smallholders would benefit from the CDAF-programme, they shall change their produce and a decrease in sugar cane production will occur. Thus to effectively target the right group, it is necessary to narrow down to spend the investment efficient, but to keep it to a general level to prevent reduced production of non-supported substitutes. Finally, research of Filipski and Covarrubias (2012) shows that most rural households in developing countries are net food buyers. Thus, when policy is implemented to benefit smallholders, it should not result in higher consumer prices. Then the effects of increased income shall not have the opposed effect of increasing purchasing power.

The challenge thus is to get the right size for the target group and to optimise the aimed effect of income increase and poverty reduction. It should be taken in account that the target group is not too broad as in the case of the PGPM, but neither too narrow as in the CDAF-programme. Policies specific for smallholders but general in commodities are suggested, to avoid excessive benefits for large farms and to avoid reduced production of potential excluded goods.

Foreign policies
Income opportunities for sugar smallholders are affected by political decisions as shown in the section above. Policies do not only influence national smallholders, but can also have effect on foreign markets. As section 4.1.1 shows, a Brazilian policy-intervention which favours Brazilian smallholder sugar farmers has as effect that the world sugar price decreases. A decreased world sugar price has as result that smallholders in other countries, including Paraguay, receive a lower price for their product. While a national policy supports domestic smallholders, it can have a disadvantaged effect on foreign smallholders. Thus a policy with positive effects on national level, can have negative side-effects on international level.

It might be beyond the interest of a national government, but also this challenge can be reduced by targeting the right group. This is shown by the example of the Brazilian CPR Estoque, which is introduced in 4.2.2. Targeting results in a smaller increase in world excess supply and a smaller decrease of the world market price. Therefore is it more effective for domestic smallholders and less distractive for foreign smallholders.

4.2.2 Crop-related challenges and solutions

Challenges especially related to the crop include quality and quantity, distance to the processing mill and the monopolist position of local processing mills.

Quantity and quality

A higher income can be gained either by increasing quantity or quality. Since the amount of available hectares is restricted, it is difficult to increase quantity in the short term. Improvements in quality are also difficult since accessibility to input and output markets are often restricted for smallholder farmers. This leads to allocative inefficiency, smallholder farmers cannot make an efficient combination of inputs and outputs (Fletschner and Zepeda, 2002). Other research on smallholders in Latin America shows that it is difficult to make a living out of farming for smallholders with less than 20 hectares (Berdegué and Fuentealba, 2011). Therefore one of the main challenges for smallholder sugar farmers is to increase the quantity and quality of their product, which withholds smallholders the opportunity of increased income.

A solution for increased quality is increased access to input markets. For example, increased access to fertilisers leads to more efficient balance of input versus output. A suggested policy reform to improve accessibility for smallholder farmers to fertiliser markets in the short term, is to implement a targeted input subsidy. The research of Fletschner and Zepeda (2002) shows that a long term solution is to increase bargaining power of smallholders by joining producer organisations. Section 4.3 elaborates on both a short term and long term intervention.

Distance to the processing mill

The quality of sugar cane is further influenced by the post-harvesting process, being the timespan in which sugar cane is delivered to the processing mill. As explained before, sugar cane is a perishable crop which should be processed directly after harvesting. If this does not happen, sugar content decreases and the crop loses value (Hannah and Spence, 1997; Unica, 2014a). Therefore, the longer the distance from farm to mill, the lower the producer price shall be. In Brazil, the majority of smallholder sugar farmers lives in the northern and southern region, with average of 4 to 6 hectares (Bivar et al, 2012). A map with the Brazilian processing mills in appendix 2 shows that the amount of mills is scarce in this region, especially compared to the dense areas in the eastern and central region of Brazil (Unica, 2014b). Therefore for most smallholder sugar farmers distance to the mill is longer than for farmers in more dense areas.

There are several options to come across this challenge. For example, processing mills can be stimulated to locate in these les dense areas. However, with the low productivity of smallholder farmers there is no incentive for sugar processors to start up a mill in these areas. This can be seen as a vicious problem: the sugar production is relatively low compared to other regions in Brazil and therefore it is not attractive to start up sugar processing mills. This causes however that smallholders are not stimulated to grow sugar, since the product they deliver is not of optimal quality. Thus to solve this problem, either sugar quality should increase or processing mills can be established.

Mill as local monopolist

In contrast to many other agricultural goods is sugar cane not an end-product. Before it gets value for consumers it has to be processed, thus sugar farmers always depend on the processing mills regarding their income (Vásquez-León, 2010). In a competitive situation, sugar smallholder farmers should be able to choose to which mill they sell their produce. The mill with the best cost-benefit combination would be their trading partner. This is determined by price received for the product and transportation costs. However, most smallholder sugar farmers live in relatively isolated areas where not many sugar processing mills are established. Combined with the perishable characteristics of harvested sugar cane, smallholders rely mostly on one mill and therefore mills act as local monopolists. As a local monopolist, mills are able to settle the price and this gives a second problem related to the scarce amount of mills and the perishable product. The income of smallholders mostly depends on the prices

of the closest mill. Both timespan and transportation costs make it favourable for a smallholder farmer to choose for the closest mill, therefore can mills be seen as local monopolists in less dense areas. This makes it difficult for smallholders to negotiate about prices.

To reduce the monopolist position of processing mills in the short term, it is suggested to implement a price floor for mills. This results in an artificial higher producer price which increases income of sugar smallholder farmers. To reduce the strong position of the processing mill in the long term, increased bargaining position of smallholders is effective. Both short and long term solutions are discussed in section 4.3.

4.3 Suggestions for policy reform

This section elaborates on two suggestions to come across the challenges addressed above, first access to input markets is increased in the short and long term. Secondly it is suggested to reduce the strong position of the processing mill in the short and long term. The short term solutions are based on policy interventions, being a smallholder subsidy and price floor. As introduced above, agricultural policies are often inefficient and not effective for smallholders. They do not benefit from national policies or face negative side-effects of foreign policies. A working paper presented by the OECD introduces suggestions for effective and efficient agricultural policies, these are taken in account when the two policy reforms are suggested. According the OECD a policy objective should have the following five characteristics (Moreddu, 2007):

- The policy should be *transparent*, thus it should have a clear objective and an overview of costs and benefits must be presented.
- Beneficiaries of the policy must be *targeted*, meaning that it is clear which are the recipients, which people are included and excluded.
- It must be *tailored*, thus the benefits should have a proper size, overcompensation of recipients must be avoided.
- The policy should be *flexible*, it should be adjustable to the diverse agricultural situations and it should be able to respond to external changes.
- Finally, *equitability* is needed, awareness of the effects on other sectors and the region.

To solve the challenges regarding national and foreign policies, these five characteristics are taken in account in the suggested policy reforms below.

4.3.1 Increase access to input markets

To solve the challenge of low quality, it is suggested to increase smallholder access to input markets. To achieve this goal in the short term, an input subsidy for smallholder farmers is suggested. To maintain the goal in the long term smallholders are stimulated to create and participate in producer organisations.

Short-term solution: input subsidy

To increase access to the input market, an input subsidy for smallholders is suggested. The subsidy is targeted at smallholders since smallholders have less access to input markets compared to large scale farmers, as explained in section 4.2.2. The effects of this subsidy are shown in figure 4.4. Panels (A) to (C) show the changes in the Paraguayan market, panels (D), (E) and (F) show the Brazilian market. If smallholder farmers in Paraguay receive an input subsidy, smallholder sugar farmers are able to increase their fertiliser use and increase their production. Panel (A) shows that the original supply function of Paraguayan smallholders (S_{PS_1}) shifts out to S_{PS_2}. This affects total Paraguayan supply (S_{PT_1}) and it shifts out to S_{PT_2}. Panel (B) shows that this results in an outward shift of the excess supply function (ES_2), which decreases Paraguayan excess demand. With this change imports of Paraguay decrease and the domestic price (PD) comes close to the world market price (PW). Furthermore, the input subsidy increases demand of fertilizer and the total Paraguayan demand shift from D_{PT_1} to D_{PT_2}.

A similar development will occur in Brazil. Panel (D) shows that total Brazilian supply (S_{BT}) shifts out as a result of increased supply of Brazilian smallholders (S_{BS}). However, since Brazil is a major sugar exporter, increased Brazilian excess supply (ES_B) results in an outward shift of total world excess supply (ES_T). As a result the world market price decreases. Further, the development in the Brazilian fertilizer market are similar to the Paraguayan fertilizer market, increased demand and increased fertilizer prices.

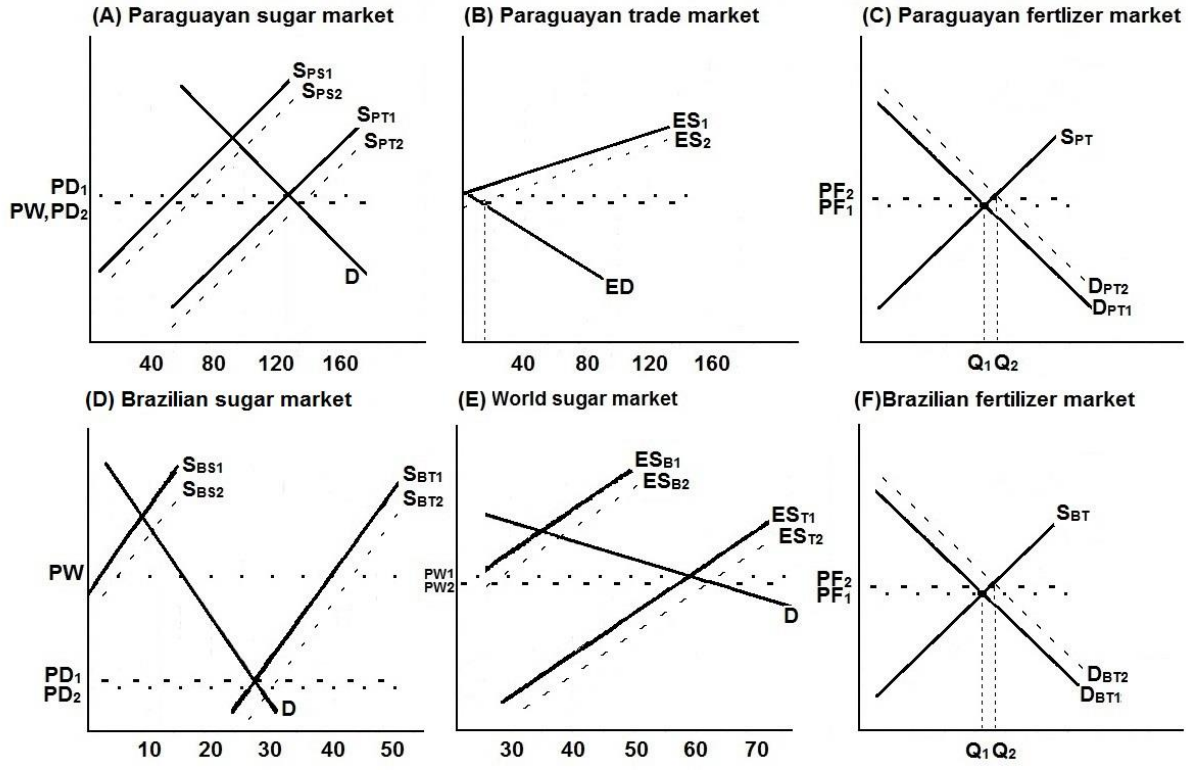


Figure 4.4: Graphical overview of effects on the sugar market in case of an input subsidy, (A) to (C) representing the Paraguayan market (in thousand tonnes), (D) to (F) representing the Brazilian market (in m tonnes).

The advantages of a targeted input subsidy are that only a share of total farmers receive support. This is financially more attractive for governments compared with supporting the whole sector. Further is the policy tailored to smallholders which lack access to inputs and is the support not applied to non-farm related expenditures. However, a disadvantage of a targeted subsidy is that exclusion still can occur. As long as the current legal definitions of Paraguay and Brazil are in use, there will be smallholder farmers excluded from the benefits of the policy reform. This problem can be solved if definitions become more flexible, as suggested by the OECD (Moreddu, 2007).

Thus the main effect of the policy implementation is increased access to fertilizer for smallholder farmers. Access to fertilizer has as effect that a higher quality product is delivered to sugar processing mills, and therefore smallholders can receive a higher price for their product. Since the fertilizer is subsidised, input costs stay equal and while sugar cane prices increase, a higher income is gained by smallholders. Further there are side-effects. First of all, figure 4.4 shows that total sugar supply increases and that it causes a price decrease of sugar and a price increase in fertilizer. Increased sugar cane supply of smallholders can have another effect. As suggested in section 4.2.2 might the number of sugar processing mills increase if the sugar supply in a certain region increases as well. Then the challenge of long distance to the processing mill diminishes as well.

Long-term solution: producer organisations
As introduced in section 4.2.2 are producer organisations beneficial to increase bargaining power of smallholder farmers. Compared to large farms and plantations are smallholders not interesting clients for input providers, due to their small amount of land and product. For this reason do Fletschner and Zepeda (2002) suggest smallholder farmers to organise. Research of Hellin et al. (2009) confirms that access to input markets increases if smallholders cooperate. The advantage of joining a farmer organisation is that the bargaining position of smallholders is strengthened. The research of Hellin et al. (2009) shows an Mexican example where smallholder maize farmers buy seeds at reduced prices due to a contract to one distributor and the large volume they purchase.

4.3.2 Increase producer price
To solve the challenge of the monopoly position of local mills, it is suggested to increase producer prices. In the short term this is achieved with floor prices for processing mills and in the long term the bargaining power of smallholder sugar farmers can be increased by joining farmer organisations.

Short-term solution: price floor
To increase smallholder income, a second suggestion is to increase the price received by producers. As explained in section 4.2.2 processing mills have a local monopolist position and they have strong influence on the prices received by sugar smallholders. Thus to increase the producer price of sugar cane, implementation of a price floor for local processing mills is suggested. Figure 4.5 shows the effects of such an implementation for smallholder sugar farmers in both Brazil and Paraguay. Panel (A) shows the equilibrium of processed sugar supply from mills (SM) and domestic demand (DD), at domestic price (PD). Equilibrium is at Q. Panel (B) then, shifts to the equilibrium at which the mill decides to deliver. Since there are a lot of sugar consumers, it is assumed that sugar processing mills sell their good at a price which equals marginal revenue (MR). Thus quantity supplied (SM) equals marginal revenue (MR). Panel (B) also shows the perspective of the costs for the miller. In a competitive situation, MR would equal marginal costs (MC), which means that MC would be equal to PD. Since mills are the only trade partner for smallholders in the region, they can minimise marginal costs by offering a lower price to sugar smallholders. This is shown in panel (C) by the inelastic part of demand of mills (DM) at Q. Demand equals supply at PF_1. At this price the profit of the processing mill is equal to the coloured area in panel (C). Now a minimum price for millers is introduced at PF_2 as shown in panel (C). Demand is still inelastic and supply shifts to SF_2. In panel (B) there is an increase from MC_1 to MC_2, and profit for millers decreases, as shown by the marked area. There is no change in panel (A), consumer prices are not affected since MC_2 is still below PD.

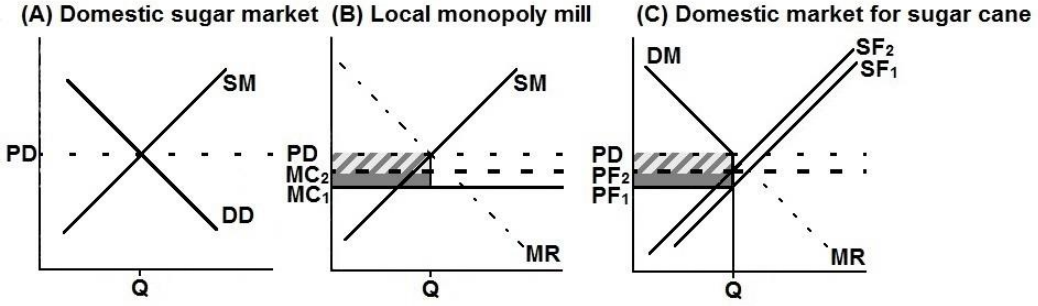


Figure 4.5: Graphical overview of effects on the domestic market in case of a price floor for mills.

The advantage of a price floor is that producer prices increase, but consumer prices are not influenced as long as PF_2 does not exceed PD. Since smallholders are mostly net-buyers of food and not net-producers, this is a large advantage since the purchasing power of smallholders is not negatively influenced. Nevertheless, for sugar processing mills there is a decrease in profit either way, which is a disadvantage for this segment of the chain.

Thus, the main effect is that sugar smallholders receive a higher price and produce the same quantity. This higher producer price directly leads to an increased income. A potential side effect is that smallholders of other crops shift to subsidised sugar and that supply of several local commodities decreases.

Long-term solution: producer organisations
Establishment and participation in producer organisations is already suggested in section 4.3.1. Also to increase producer prices it is a helpful mechanism. Producer organisations can strengthen the bargaining power of smallholders since they take collective action for the common interest of higher prices. However, this is suggested as a long term solution, since creating a viable organisation takes time and struggles must be overcome. A few examples are mentioned by Hellin et al. (2009), including getting collective agreement on rules and being able to monitor agreements. Nevertheless, when such struggles are kept in mind effective farmer organisations can be created. Research done in Paraguay by Vásquez-León (2010) shows that smallholders get empowered if they create and join cooperatives. The research shows that the opportunities increase for individual members, since it brings together assets which are difficult to gain as individual.

5. Conclusions and discussion

Three sub questions are stated to answer the objective how the world sugar market interacts with smallholder policies to provide a living income. The first sub question focuses on the current structure of the world market, followed by the second which narrows down to the level of Brazil and Paraguay. Finally suggestions for national policy reform are introduced to improve the income situation of smallholder sugar farmers in both countries.

The following section gives a conclusion per sub question to answer the objective. These conclusions are followed by a short discussion with limitations of the research, suggestions for improvement and recommendations for further research.

5.1 Conclusions

Before the research questions are introduced, chapter one gives a short introduction to Latin America and in particular to Brazil and Paraguay. The chapter makes clear that most Latin American countries are classified as middle income countries, but there are roughly 35 million people living in rural areas who cannot meet their basic needs. Correspondingly, the income distribution in both Brazil and Paraguay is imbalanced. Approximately 80 percent of the population has an income below average and the Gini-coefficients of Brazil and Paraguay are respectively 52.7 and 48.0. Since Latin America is a continent with major sugar production this research focuses on smallholder sugar farmers, therefore does the chapter shortly introduce the sugar markets of both Brazil and Paraguay. Brazil produces approximately 35 million tonnes of raw sugar per year and therefore is Brazil a major actor in the world sugar market. Paraguay produces about 220 thousand tonnes of raw sugar and is a small actor in the world sugar market. To analyse the influence of sugar policies the research focuses on these two countries as a major and minor actor in the world market. Thus, chapter one concludes that Latin America is a continent with major sugar production, and a large share of the rural population cannot meet its basic needs. Therefore it is concluded that the income situation of sugar smallholder farmers need to be increased to reduce national poverty in both countries. The following chapters show how this is possible with policy implementation.

Chapter two elaborates on the sugar world market to make clear how interactions occur at this level. The American continent is the largest producer of raw sugar with 38.5 percent of world production, and more than 50 percent of world sugar cane is grown there. Most sugar comes from sugar cane, with a cane-beet ratio of 78.7 versus 21.3 percent in 2012. Production and consumption both increased during the last ten years, an increase is seen in both consumption of sugar for food use and sugar for ethanol. The sugar export market is dominated by the five major exporters, Brazil by itself is responsible for 42.5 percent of world trade. Further, the chapter shows that world sugar prices increased on average up to 2010, but since then are decreasing. Then five market determinants are highlighted. These are expected to influence the world sugar market, but in particular to influence opportunities for smallholders to earn a living income. From this chapter can be concluded that Brazil is a major actor in the current world sugar market. Further, developments in the world sugar market provide several challenges and opportunities for smallholder sugar farmers. Challenges are found in unexpected weather events and the effects of foreign national policies. Opportunities are found in increasing technological efficiency and growing economies. Especially the growing Brazilian economy is an opportunity for local smallholders. Smallholders are main food providers for local communities and with increasing GDP is sugar consumption also increasing. Further, on global scale is ethanol not yet an significant contributor to sugar demand.

Chapter three narrows down to the level of smallholder sugar farmers in Brazil and Paraguay. A definition of smallholders is based on scientific literature, definitions used by international organisations and by the legal definitions of the Brazilian and Paraguayan governments. This research defines smallholders as farms with 20 hectares or less. The definition is rather simplistic, but it can be

covered by available data, further it assumes that farms with this size do not exceed two external labourers. Also living income is defined in this chapter. It should cover the costs for decent household expenditures and farm investments. A detailed proposal is not made, but the countries are compared with another Latin American country, the Dominican Republic. This shows that income should increase for respectively 20 and 40 percent of the Brazilian and Paraguayan population. A living income should be able to be earned by 1.5 full-time workers per year and it should cover the costs of respectively 3.3 and 3.9 people per household in Brazil and Paraguay. Then the research focuses on Brazil and Paraguay separately. In Brazil more than 50 percent of sugar farmers is smallholder while 3 percent of total production comes from these farms. In contrast, in Paraguay approximately 46 percent is smallholder sugar farmer and they produce more than 75 percent of Paraguayan sugar. Then for both countries are market determinants analysed. Both countries are not significantly affected by weather events between 2003 and 2012. Brazil is not strongly determined by the policy-choices of its exporting partners, while Paraguay is. Brazil and Paraguay both have one strong programme which benefits smallholders. Respectively 36,700 and 325,600 people from smallholder farms are involved and have the opportunity to increase their income. Data on the share of smallholder sugar farmers is not found. Thus, a rough estimate gives that 20 and 40 percent of the Brazilian and Paraguayan population should have an increase in income. Characteristics of these farm households are that they own 20 hectares or less, and that they have respectively 3.3 and 3.9 household members in Brazil and Paraguay. Further, opportunities for Brazilian sugar smallholders can be found in education, in increasing domestic demand and in biofuels. Opportunities for Paraguayan smallholders are in increasing technological efficiency and in emerging domestic market for biofuels. Besides the two existing programmes, policy reform specific for smallholders or even sugar smallholders are suggested in the next chapter.

Then the final chapter synthesises the findings abovementioned. The chapter shows that Brazilian policies have a strong influence on Paraguay, but not vice versa. This is illustrated by two examples. If all Brazilian sugar smallholders would benefit from the stock programme CPR Estoque, then their income would increase due to a minimum sugar price. However, it would also increase Brazilian excess supply and therefore world excess supply, this results in a lower world price. Foreign sugar markets and their smallholders are then disadvantaged by the Brazilian policy. On the contrary, if all Paraguayan sugar smallholders would benefit from the conditional cash transfer Tekoporã, there would be no effects in foreign markets. Research shows that smallholders increase farm investments. This results in increased sugar production, but since Paraguay is a minor producer at global level, there are no significant effects at the world market. Further, these examples and other findings of the research, show that there are several challenges for smallholder sugar farmers. There are general smallholder challenges related to defining and including the targeted beneficiaries. Further there are crop related challenges, related to the perishable characteristics of sugar cane and the position of smallholders in the supply chain. To encounter these challenges two suggestions for policy reform are made. Both reforms take the characteristics of efficient and effective policy making in account and this leads to an input subsidy for smallholders and a price floor for processing mills. The achievability of the input subsidy is closely related to the formulation of national legal definitions. An input subsidy can be targeted to all smallholders which fulfil the smallholder characteristics, however, not all smallholders in practice are included within the legal definition. A price floor has a stronger achievability regarding its effectiveness, since it is not related to smallholder definitions. The price floor is implemented among all isolated processing mills to reduce the local monopoly position of these mills. Both challenges are further addressed with the long term solution of implementing producer organisations. When a viable organisation is established, this increases the bargaining power of smallholders and they can increase access to inputs and they are enabled to increase producer prices.

Thus, to answer the main question and to get back to the hypothesis, a rough estimation shows that the current income situation of at least 20 and 40 percent of Brazilian and Paraguayan population should increase. The research shows several challenges and opportunities related to the income situation, and several challenges can be addressed by implementation of domestic policies. For efficient and effective

smallholder policies, it is suggested to have a clear target group and tailor the recipients. This is to optimise effectiveness and minimise side-effects. In both Brazil and Paraguay it is suggested to implement an input subsidy for smallholders and a price floor for processing mills. Thus besides linkages with the world sugar market are smallholder sugar farmers also closely linked to other actors in the local sugar supply chain. When these policies are implemented in Paraguay it will affect sugar smallholders and local processing mills. Further it might affect the production choices of other food producers in the region, which choose to switch to subsidised sugar and stop or decrease production of their current crop. When these policies are implemented in Brazil, it will have similar effects on smallholder sugar producers, local processing mills and local food producers. Additional, policy implementation in Brazil shall affect the sugar world market since Brazilian sugar supply increases and therefore total world sugar production increases significantly. Thus if national governments want to increase the level of income for their sugar smallholders they should take in account that income opportunities are both determined on national and global level. In Brazil it should be recognised that smallholder policy does not only affect domestic households, but also foreign households. In the Paraguayan case it should be taken in account that income is not only determined by national choices, but also steered by the world market.

5.2 Discussion

This research gives insight in the world sugar market and the influences it has on income opportunities of smallholders. Nevertheless the research has several limitations. First of all, as introduced in section 1.2.3, data is used from several resources. When data of several sources is compared, there is not a consistent outcome. This is explained due to different estimations by several organisations. To keep consistency, data of FAO is always used as first choice. Nevertheless, detailed data on trade and consumption is not provided via FAO, therefore is data used which is provided by ISO. Further, FAO splits all EU countries separately, thus data from the European Commission is used to provide EU sugar data. This research perceives the EU as one sugar region since the EU has one sugar policy for all member states.

Another struggle during the research was the limited availability of literature regarding living income. One definition is found which is given by Anker and Anker (2013a), but further there is not much written about this fairly new concept. Living wage is more familiar concept, at least among international organisations such as ILO, Fairtrade, etcetera. Nevertheless, estimations for a living wage or living income needed more research than was possible for this research. Local habits and prices of a decent meal should be investigated, as well local standards and prices for housing. Further, minimal farm investments must be defined and calculated. It was not possible to do this extensive research on living income. The research underlines the minimal requirements of a living income, but a concrete estimate is not given.

Finally, the effects of a smallholder policy are given for both for Brazil and Paraguay. Unfortunately is it not possible to distinguish the effects of these policies specific for sugar smallholders. Therefore no concrete conclusions on the effects of CPR Estoque and Tekoporã could be given. This can be improved if both national governments take the five characteristics of the OECD in consideration. If the policies are more targeted and tailored, the effects on several subgroups would become clear.

Further research on living income is suggested, this will solve the former two limitations. The level of living income can be made concrete by doing research at local level on household costs and expenditures and farm investments. This includes local needs and prices of food commodities, housing and other necessities. Further, farm investments and also farm benefits should be made concrete. In such a research also the effects of national policies such as CPR Estoque and Tekoporã shall become concrete. When the minimal living income of smallholder sugar farmers is clear, it will also become visible to what extend investment is needed to decrease the gap between current income and living income.

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Appendix 1: additional information to figures

Figure 1.2
GNI of Brazil and Paraguay on average and per quintile, compared to average GNI (in euros) (World Bank, 2014b).

GNI Brazil	Relative	Absolute
Total	-	2,034,623,597,572.72
Average	-	10,234.20
Lowest quintile	3	1,536.29
Second quintile	8	4,096.78
Third quintile	12	6,145.17
Fourth quintile	19	9,729.85
Highest quintile	57	29,189.54

GNI Paraguay	Relative	Absolute
Total	-	19,513,840,715.60
Average	-	2,921.60
Lowest quintile	4	583.60
Second quintile	9	1,313.11
Third quintile	14	2,042.61
Fourth quintile	21	3,063.92
Highest quintile	53	7,732.75

Figure 2.1
World raw sugar supply and demand, in million tonnes during 2003-2012, including trend lines and equations (ISO, 2013)

Production and stocks : y=227.67 + 2.79x
Consumption : y=140.76 + 2.93x
Trade : y=43.00 + 1.36x

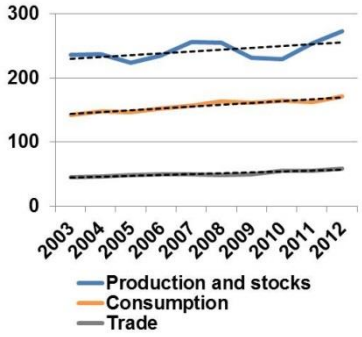

Figure 2.2
Share of raw sugar production per continent, plus share of beet and cane production per continent, annual average in kilograms of 2003-2012 (FAO, 2014b,c).

	Raw sugar	Sugar cane	Sugar beet
World	157,283,999.0	1,584,014,182.8	554,261,443.9
Africa	10,083,212.4	91,490,992.1	8,101,967.7
Americas	60,883,796.0	823,261,313.8	31,818,094.6
Asia	56,803,433.8	633,404,390.6	34,195,085,3
Europe	24,533,980.1	0.0	172,390,528.6
Oceania	4,979,576.7	35,857,486.3	0.0

Figure 2.3
Top five production countries, beet and cane, production in kilograms in 2012 (European Commission, 2014a; FAO, 2014b; FAO, 2014c).

Sugar beet	Relative	Absolute
World	100	269,825,230.0
EU	42.2	113,910,300.0
Russia	16.7	45,057,000.0
USA	11.8	31,954,713.0
Ukraine	6.8	18,438,900.0
Turkey	5.6	15,000,000.0

Sugar cane	Relative	Absolute
World	100	1,842,266,284.0
Brazil	39.1	721,077,287.0
India	19.6	361,037,000.0
China	6.7	124,038,017.0
Thailand	5.3	98,400,000.0
Pakistan	3.2	58,397,000.0

Figure 2.4a
Top five sugar beet production countries, production in million tonnes during 2003-2012, including trend lines (European Commission 2014b; FAO, 2014e; FAO, 2014f).

EU : y=118.15-0.57x
Russia : y=15.81+2.42x
USA : y=30.48-0.22x
Ukraine: y=15.56+0.07x
Turkey : y=12.29+0.54x

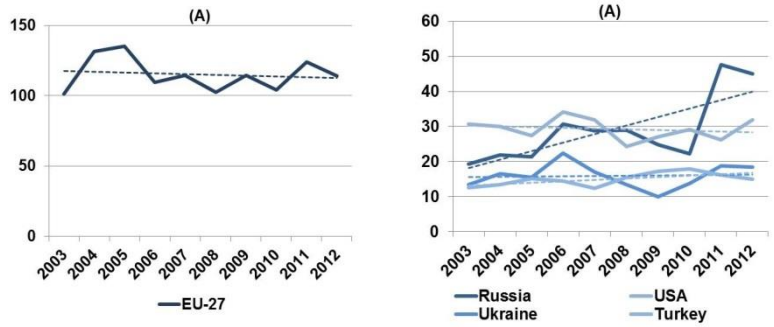

Figure 2.4b
Top five sugar cane production countries during 2003-2012, production in million tonnes, including trend lines (European Commission 2014b; FAO, 2014e; FAO, 2014f).

Brazil : y=304.81+53.14x
China : y=245.63+10.32x
India : y= 85.08+3.98
Thailand: y=50.39+3.61x
Pakistan: y=49.51+0.63x

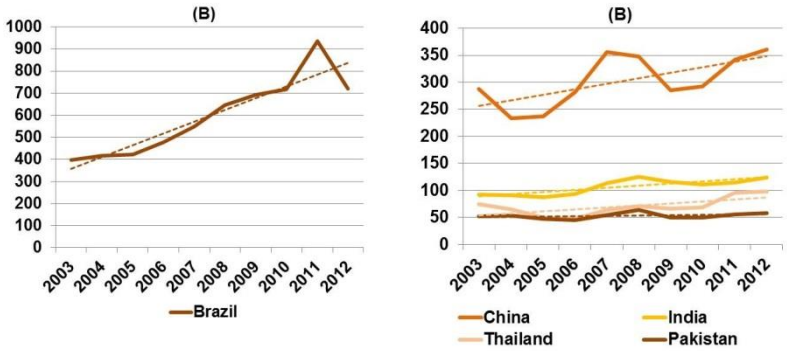

Figure 2.5a
Total consumption of raw sugar in top five consumption countries in million tonnes, including trend lines (ISO, 2010; ISO, 2013).

India : y=17.99+0.67x
EU : y=15.48+0.44x
China : y=10.58+0.53x
Brazil : y=10.65+0.29x
USA : y=8.61+0.18x

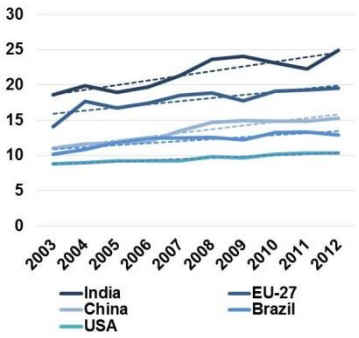

Figure 2.5b
Consumption per capita of raw sugar in kilograms in top five consumption countries (ISO, 2010; ISO, 2013).

	Change 03-12	2003	2007	2012
China	32.6%	8.6	10.2	11.4
Brazil	14.8%	58.0	65.7	66.6
India	13.3%	18.1	18.8	20.5
USA	8.6%	30.3	30.6	32.9
EU-27	0.25%	38.5	39	38.6

Figure 2.6a, 2.6b
Top 5 exporting and importing countries, main trade flows in 2012, relative in percentages and absolute in kilograms (ISO, 2013).

Export		
Brazil to	Relative	Absolute
China	8.7	2,152,529
United Arab.	6.4	1,586,715
Algeria	6.1	1,512,647
Russia	5.8	1,427,569
Egypt	5.7	1,409,835
Rest of world	67.3	16,676,733

Import		
China from	Relative	Absolute
Brazil	45.5	1,989,364
Thailand	22.1	943,970
Cuba	10.0	426,000
Korea rep.	5.5	233,897
Guatemala	1.6	69,422
Rest of world	14.3	612,657

Thailand to	Relative	Absolute
Indonesia	24.4	1,911,025
China	12.7	922,878
Japan	11.0	864,395
Cambodia	8.2	640,548
Korea Rep.	6.4	502,003
Rest of world	37.3	2,925,009

Indonesia from	Relative	Absolute
Thailand	52.9	1,737,769
Brazil	35.8	1,176,753
Australia	7.0	231,109
S. Africa	1.6	54,000
Philippines	0.4	12,853
Rest of world	2.3	74,179

Australia to	Relative	Absolute
Korea Rep.	37.1	1,027,704
Japan	17.2	476,392
Indonesia	12.9	357,851
Malaysia	9.3	257,576
New Zealand	6.8	189,707

EU from	Relative	Absolute
Brazil	27.7	1,066,304
Mauritius	8.9	340,891
Swaziland	7.8	298,734
Mozambique	6.1	234,324
Cuba	5.5	210,483

Rest of world	16.7	462,400

Rest of world	44.0	1,692,752

Guatemala to	Relative	Absolute
USA	17.4	282,097
Chile	10.0	161,699
Ghana	9.6	155,721
Canada	7.6	122,493
Korea Rep.	5.0	81,335
Rest of world	50.4	816,187

USA from	Relative	Absolute
Mexico	32.9	1,026,807
Brazil	10.3	321,006
Guatemala	9.7	302,419
El Salvador	8.8	275,519
Dominican Rep.	6.5	201,645
Rest of world	31.9	995,249

Cuba to	Relative	Absolute
China	53.4	426,000
EU	26.4	210,483
Belarus	12.5	99,630
Russia	7.7	61,459
Rest of world	0.1	526

Malaysia from	Relative	Absolute
Brazil	47.5	920,937
Thailand	26.2	508,411
India	13.6	263,016
Australia	12.5	242,364
EU	0.1	1,991
Rest of world	0.1	2,094

Figure 2.6c
Top 5 exporting countries development of exported quantity during 2003-2012, including trend lines, quantity in m tonnes (ISO, 2010; ISO, 2013).

Brazil : y=13.38+1.43
Thailand : y=3.32+0.32x
Australia : y=4.49-0.16x
Guatemala : y=1.13+0.06x
Cuba : y=1.59-0.11x

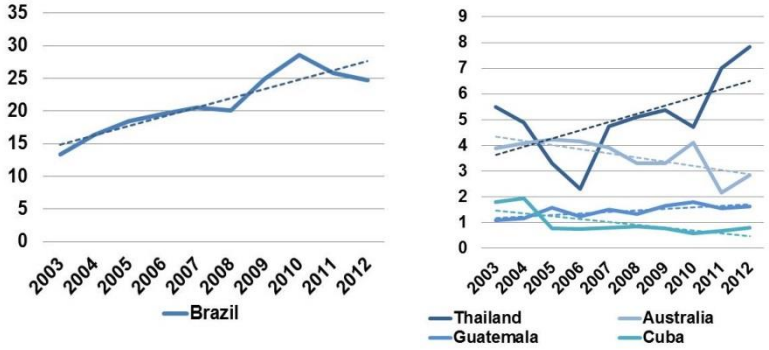

Figure 2.6d
Top 5 importing countries development of imported quantity during 2003-2012, including trend lines, quantity in m tonnes (ISO, 2010; ISO, 2013).

China : y=0.20+0.27x
Indonesia : y=1.51+0.12x
EU : y=1.88+0.23x
USA : y=1.15+0.27x
Malaysia : y=1.31+0.05x

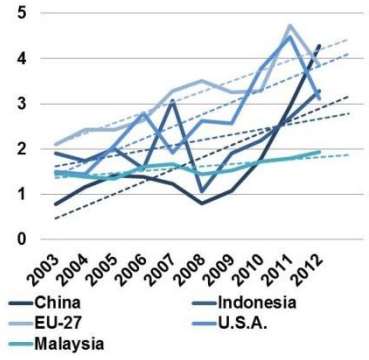

Figure 2.7a, 2.7b
World sugar prices in euros per tonne, (A) producer prices are average price of five largest producing countries, (B) world consumption price is based on world prices, including trend lines (OECD and FAO, 2014).

Sugar beet : y=23.82+3.66x
Sugar cane : y=15.39+2.67x
Consumer price : y=109.17+35.53x

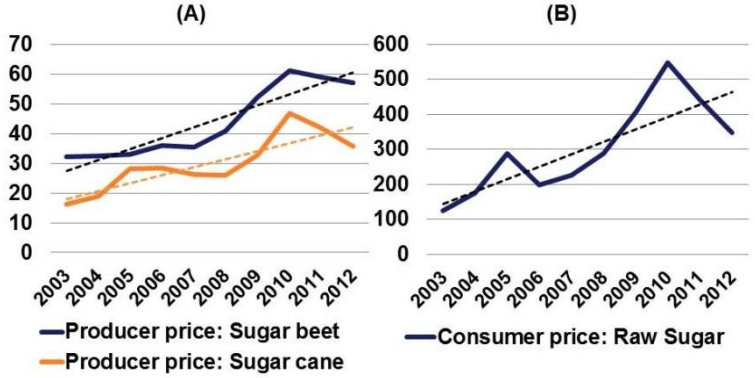

Figure 2.8a, 2.8b
Comparison of world energy supply in 1973 and 2012, absolute value measured in million tonnes oil equivalent (mtoe), relative in percentages (International Energy Agency, 2013; Barros, 2013).

	1973		2012	
	Absolute	Relative	Absolute	Relative
Biofuels and waste	640.06	10.3	1,340.71	10.0
Fossil	5,410.36	87.0	11,019.65	81.9
Coal	1,478.93		3,966.59	
Crude oil	2,938.38		4,205.11	
Natural gas	993.05		2,847.95	
Other	169.49	2.7	1,100.78	8.2
Nuclear	53.05		642.12	
Hydro	110.31		315.81	
Other	6.13		142.85	
TOTAL	6,219.91	100	13,461.14	100

Figure 3.1a, 3.1b
Share of smallholders in total number of sugar producing farms in Brazil (A) and share of sugar production from smallholder farms in total Brazilian sugar production (B) (Ferreira, 2012).

	A. Number of farms		B. Production (in tonnes)	
	Absolute	Relative	Absolute	Relative
< 1 hectares	8,128	4.3	126,968	0.0
1 to 5 hectares	36,267	19.0	2,617,835	0.6
5 to 10 hectares	32,325	16.9	3,298,427	0.8
10 to 20 hectares	40,251	21.1	5,550,304	1.4
20 to 100 hectares	54,087	28.3	28,841,531	7.1
100 to 500 hectares	15,750	8.3	64,486,031	15.8
500 to 1.000 hectares	2,196	1.2	34,760,831	8.5
> 1.000 hectares	1,838	1.0	267,721,388	65.7

Total 2006	190,842	100.0	407,403,315	100.0
Total ≤20 hectares	116,971	61.3	11,593,534	2.9

Figure 3.2
Change in Brazilian sugar export partners, absolute in million tonnes and relative change in percentage (ISO, 2010; ISO, 2013).

	2003		2006		2012	
	Absolute	Relative	Absolute	Relative	Absolute	Relative
China	2,179	0.0	194,084	1.0	2,152,529	8.7
United Arab.	0	0.0	1,274,144	6.5	1,586,715	6.4
Algeria	527,878	3.9	748,441	3.8	1,512,647	6.1
Russia	4,498,743	33.6	4,498,224	23.0	1,427,569	5.8
Egypt	646,635	4.8	1,002,090	5.1	1,409,835	5.7
Other	7,710,646	57.6	11,813,605	60.5	16,676,733	67.3
TOTAL	13,386,081	100	19,530,588	100	24,766,028	100

Figure 3.3a, 3.3b
Share of smallholders in total number of sugar producing farms in Paraguay (A) and share of sugar production from smallholder farms in total Paraguayan sugar production (B) (Colmán et al., 2009).

	A. Number of farms		B. Production (in tonnes)	
	Absolute	Relative	Absolute	Relative
< 1 hectares	153	0.7	2,871	0.1
1 to 5 hectares	7,056	34.3	454,488	11.8
5 to 10 hectares	5,894	28.7	699,176	18.2
10 to 20 hectares	4,786	23.3	888,113	23.1
20 to 100 hectares	2,268	11.0	228,018	5.9
100 to 500 hectares	272	1.3	354,028	9.2
500 to 1.000 hectares	51	0.2	111,488	2.9
> 1.000 hectares	65	0.3	1,106,081	28.8
Total 2008	20,545		3,844,263	100,0
Total ≤20 hectares	*17,889*	*87.1*	*2,044,648*	*53.2*

Figure 3.4
Change in Paraguayan sugar export partners, absolute in million tonnes and relative change in percentage (ISO, 2010; ISO, 2013).

	2003		2006		2012	
	Absolute	Relative	Absolute	Relative	Absolute	Relative
USA	25,250	71.7	28,297	63.6	39,930	68.6
EU	7,106	20.2	12,065	27.1	11,220	19.3
Canada	1,454	4.1	1,942	4.4	3,347	5.8
Switzerland	1,267	3.6	1,711	3.8	3,209	5.5
Other	145	0.4	462	1.0	487	0.8
TOTAL	35,222	100.0	44,477	100.0	58,193	100.0

Appendix 2: Schematic map, spread of processing mills in Brazil and spread smallholder farmers in Brazil and Paraguay