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Faculty of Tropical AgriSciences



MASTER THESIS

**Farming system development in a changing
environment: Experience from resettled households,
southern Brazil**

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Declaration

I hereby declare that I have worked on my diploma thesis titled 'Farming system development in a changing environment: Experience from resettled households, southern Brazil' by myself under a supervision of Vladimír Verner, Ph.D. and that I have used only the sources mentioned at the end of the thesis.

Prague 6 – Suchdol, 23 April 2013

Bc. Petra Brtníková

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Abstract

Barra do Imigrante community is one of new resettlements established upon a construction of Barra Grande hydroelectric dam in central part of Santa Catarina state. Governmental attempts targeted on networking of sustainable energy supplies and infrastructure development nevertheless contradict with wellbeing of small family farms and bring significant socio-economic changes to producers' livelihoods. Using the sustainable livelihoods concept, this study analyzes the ability of households to adapt to the changing environment from both, household assets availability and vulnerability to external structures.

Results of field survey and in-depth interviews indicate that basic needs such as shelter, water and electricity supplies were improved after resettlement. Contrary, production of cash crops is based on principles of contract farming and is highly subsidized. Not appropriate production techniques and vast use of agro-toxins were observed as major causes of harvest losses. Low purchasing price is making the promissory dairy production ineffective. Moreover, farmers' food spending creates significant part of household expenditures. Based on these results we suggest creation of sustainable locally-based agri-business aimed to diversify production, promote agro-tourism in the region and thus strengthen community resilience.

Keywords: market orientation; livelihood strategies; supply-chain; future expectation; sustainability; Santa Catarina; Brazil

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List of Abbreviations

DFID	Department for International Development
EPAGRI	Empresa de Pesquisa Agropecuária e Extensão Rural de Santa Catarina (<i>Center for agriculture research and rural extension in Santa Catarina</i>)
FAO	Food and Agriculture Organization
ha	Hectare
IBGE	Instituto Brasileiro de Geografia e Estatística (<i>Brazilian institute for geography and statistics</i>)
MME	Ministério de Minas e Energia (<i>Ministry of mines and energy</i>)
PRONAF	Programa Nacional de Agricultura Familiar (<i>National program for family agriculture</i>)
R\$	Brazilian Real (<i>currency exchange rate to April 2013 is R\$ 1= CZK 9.86</i>)
SAF	Secretaria da Agricultura Familiar (<i>Secretary of family agriculture</i>)
TLU	Tropical Livestock Unit
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations development Programme
UNOESC	Universidade do Oeste de Santa Catarina (<i>University of the West Santa Catarina</i>)

1. Introduction

Brazilian economy faces challenges of continuing development. Rural areas with dominant role of agriculture still remain centre of high poverty level. With increasing demand for food and rather export oriented production, use of transgenic crops and agro-chemicals became inevitable part of farmer's life.

Country has experienced structural changes in agriculture production. From centrally planned and technology-driven model, incentives are currently directed on family farming support in order to set rural emigration back. Highlands in central part of Santa Catarina is a rural agriculture district with prevalence of family farming model.

Increasing number of governmental programs has been implemented in order to support the livelihood of family farms in rural areas. Not all government-driven programs are focused on farming and rural systems development.

New sustainably-based model is underlined by large investments into renewable energy sources, particularly hydro electric power. Nevertheless, it contributes to planned rural resettlement and often stands in a contradiction with interests of affected small holders.

Newly constructed hydro power plant Barra Grande is one example. It is planned to increase the living standard of local households through increase of energy supplies. However, 191 families had to be resettled to new areas. For this purpose, Baesa consortium was forced to establish seven new villages and to provide people with new livelihood. Such intervention brings significant changes in livelihood strategies of affected families and their farms. How family farms react on forced resettlement and what are the consequences of changing environment in Brazil is a subject of the study.

2. Literature Review

2.1 Brazil as a progressive economy

Despite of being developing country, Brazil is together with Russia, India, China and South Africa anointed as 'BRICS'. Country is identified as a rapidly growing economy with promising potentials in industry and services (Marr and Reynard, 2010). Notably BRICS have made rapid advances in development what United Nations call as 'Rise of South'. Strict objectives of development strategies and social cohesion are having positive impact on situation in Brazil (UNDP, 2013). Brazil occupies important role in the world economy with a special attention to global energy supplies, agriculture and some high-technology products (Brainard and Martinez-Diaz, 2009). Percentage of population living on less than US\$ 1.25 a day went down from 17.2% in 2005 to 6.1%. Being one of the most populous countries in the world, Brazil contributed to poverty elimination achievement (UNDP, 2013). Nevertheless, Brazil experiences extreme regional differences, especially in social indicators such as health, infant mortality and nutrition (World Bank, 2013). The richer South and Southeast regions enjoy much better indicators than the poorer North and Northeast.

2.1.1 Emerging role of energy

Large investments are directed towards projects aimed at increase of economy on national level. The country is one of the largest renewable reserves of freshwater. Together with continued importance of bio fuel industry, Brazil is putting a great attention on use of carbon-efficient energy sources to stabilize the Earth's climate, investments in renewable energy technologies were increased by 8% (UNDP, 2013; Gauder et al, 2011). Many investments are targeted on energy supplies sustainability; noticeably hydroelectric power and infrastructure development

(EnerSolar, 2012; Brazil government, 2011; MME, 2011). Renewable energy in Brazil accounts for almost 46% compared to 12% in the world. Global energy observatory introduces 82 hydro power plants operating in Brazil (2013), mainly situated in southeast regions.

2.1.2 Rural resettlement and economy in the peri-urban zone

On the contrary of economic growth, governmental interventions bring significant changes in rural population and leave behind communities with disrupted structure. Displacement brings risks such as landlessness, joblessness, marginalization, food insecurity and others identified by Cernea (1997). In the past years, rural resettlement schemes caused by dam construction vary throughout the world. Land loss brings significant changes in socio-economic perspective of affected families on regional level. Study result from Sri Lanka indicates positive long-term consequences after resettlement in terms of infrastructure improvement and access to education (Takesada et al., 2008). Opposite was studied in India or China, where negative results far outweigh the positive progress that was achieved. It brought significant impact on environmental resulting in negative economic, social and cultural changes (Newton, 2008; Webber and McDonald, 2004).

2.2 Structural changes of agriculture sector

2.2.1 Food security assessment

Until the 1930s, the Brazilian economy was strongly based on agricultural products destined for foreign markets. Ironically, in spite of the role of agriculture in the Brazilian economy, the country systematically received food aid from

abroad until the 1960s, and even up to the 1980s, Brazil was still a large food importer. Changes in Brazilian agriculture occurred in response to a strong demand, prompted by the government-led industrialization process that took place in Brazil from the 1960s to the early 1980s. In the early 1990s, Brazil slowly began implementing economic reforms designed to reduce or eliminate government controls. It has helped to stabilize the economy and create a more liberal policy regime favourable to agricultural investment, production, and exports ([Schnepf et al., 2001](#)). The sector moved forward rapidly from a traditionally based agricultural system to one based on science. As a result, opportunities for agribusiness¹ exports were identified.

Emerging need to ensure food security by overcoming challenges such as growing population, urbanization, higher levels of income or link between agricultural and bio fuels production brought significant restructuring of Brazilian primary sector. It requires a sustainable promotion of agriculture production through higher productivity and cropping intensity. Country is notable for science-based development of successful tropical agriculture. It was necessary to adopt new technologies and innovations, including improved seeds, fertilizers, and agrochemicals, to change the farming environment into a productive agribusiness ([Pereira et al., 2012](#)).

¹ Agribusiness is a system of agricultural and small enterprises activities based on supply chains and networks. In this system coordination of production, processing and distribution are closely managed and create opportunities for producers, processors, wholesalers, retailers and other supply chain actors ([Silva, 2005](#)).

2.2.2 Implementation of export oriented agribusiness

Brazil has more reserves of farm land than any other country. FAO estimates total arable land to be about 400 million ha where only 50 million ha is being used. Country developed its own savannah region called Cerrado that became one of the top grain and beef-producing regions in the world. It contributed to its position of a leading producer of soybeans and other agriculture products (UNDP, 2013; Pereira et.al, 2012). Cerrado is located across central-west part of Brazil, particularly in Minas Gerais and Goiás states and is predominantly formed by large-scale farms. Brazil supplies a quarter of the world's soybean trade on just 6% of the country's arable land (The Economist, 2010). As country with technology-driven agriculture production, it became an inspiration for other countries such as Mozambique (Cabral et.al, 2012), where successful implication of savannahs-based model was not of such extent. In fact, policies and economic incentives are the determining factors in decision-making process rather than farmers themselves.

2.2.3 Incorporation of Brazil's agriculture into transgenic market

Food security² problematic was predominantly overcome by implementation of science-based technologies. However, the area planted with transgenic seeds has more than tripled, from 9.4 million to 32 million hectares between 2005 and 2011. Use of pesticides in the country doubled, with sales turning for nearly US\$ 8.5 billion. Behind only United States, Brazil became second largest market in the world (Freitas, 2012). Agro-toxins were accepted as inevitable necessity in increase of agriculture productivity. It benefits the crop resilience in a short term and gives

² Food security is defined as the ability of a country or region to assure, on a long-term basis, that its food system provides the total population access to a timely, reliable and nutritionally adequate supply of food (Sachs, 2006).

opportunity to communities to get involved in contract farming. As a contradiction, it violates all principles of health of human and nature. Long-term use of agro-toxins causes significant environmental damage and contributes to climate change. Commercial seeds are tied with expensive use of pesticides, sold in a form of input packages. Farmers become indebted and lose control over their seeds. From microeconomic perspective, such model violates the self-sufficiency of small family farms and makes them trapped in vicious cycles of poverty and in hands of transnational corporations such as Monsanto, Syngenta, BASF, Bayer, Dow, and Dupont, who are, at the same time world leaders in the production of pesticides ([Actionaid, 2005](#); [Robin, 2010](#)).

2.3 Agriculture production and family farming in Santa Catarina state

Shnepf et al. ([2001](#)) distinguished two major regions engaged in field crop and livestock production, the temperate south and tropical Center-West. Those differ in climate, cropping patterns and other farm characteristics, particularly farm size. Brazil's agriculture development is not only about large-scale agribusinesses in Cerrado savannah region, there is a wide range of policies supporting family farming.

In past decades, agriculture sector in Brazil went through significant development, mainly benefitting large export-oriented farms in the south and south-east. However, smaller agricultural producers have suffered from underinvestment ([EIU, 2007](#)). Agriculture production in Santa Catarina adopted new models of economic cooperation. Macro-cooperatives were replaced by small-scale flexible condominiums that respond social and economic demands of small family farms better ([Anjos et al., 2011](#)). Nowadays, role of condominiums involved particularly in pig production is declining. Phenomenon among farmers is to create

associations for the collective use of machinery and agriculture equipment. Structure is based on smaller family farms. Most of their production is designated for domestic market, but they also contribute to exports. The study of Massi (2000) identified the existence of 348 types of associations in municipalities of the Western Santa Catarina. According to data from agriculture census, there are 186,135 family farms in Santa Catarina comparing to 25,119 non-family based establishments. GINI index in Santa Catarina was 0.39 2006. These are integrated into the agribusiness complexes and in horticulture sector. 170,913 family establishments are owners of their land (IBGE, 2006).

2.3.1 Family farming as a livelihood strategy

Family agriculture is a principle creator of jobs in Brazil's rural agriculture (Medaets, 2003).

FAO (2013) defines family farming as a productive unit that is characterized by a strong link between family and its land that is usually small or medium in size. Farm operates in order to earn a living in an environmentally and socially friendly manner. Therefore, its development has direct positive impacts on the community as a whole. Furthermore, auto-reliance and resilience of family farming concept are emphasized in order to adapt to environmental and economic changes. Hence, family farming represents a strategic sector due to its economic, social, cultural and environmental functions, reflecting the three components of sustainable development.

The Brazilian Agricultural Census (IBGE, 2006) classifies family farming as entity that practices activities in a rural environment and also meets the following requirements:

- Does not have an area greater than four fiscal properties; a fiscal property³ varies between 5 and 110 hectares, depending on the municipality, soil conditions and access;
- Uses predominantly family labour for farm economic activities;
- Family income predominantly originates from economic activities linked to the farm or other enterprise managed by family;
- Businesses that do not meet these requirements are designated as "non-family".

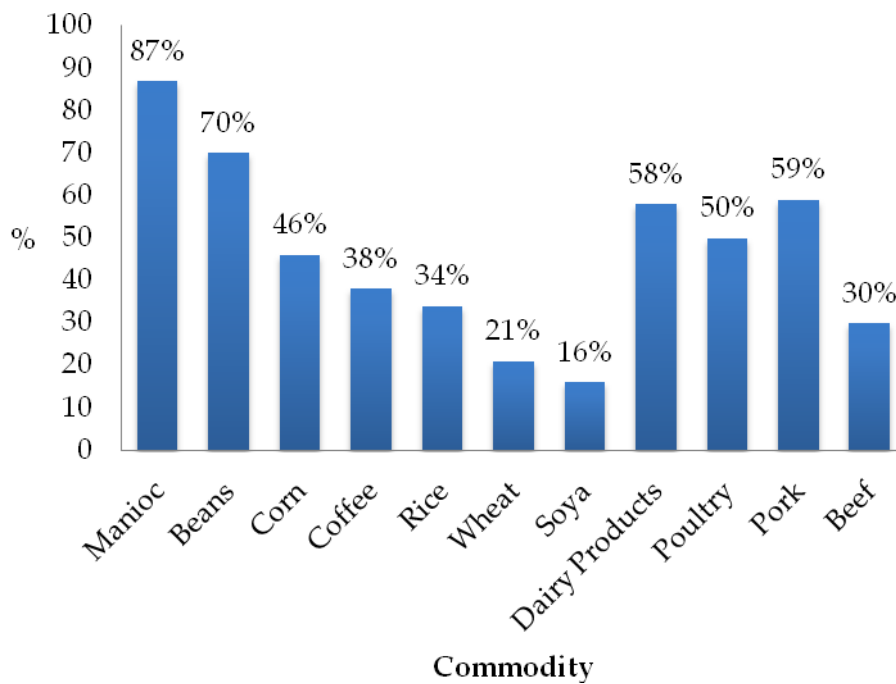


Fig. 1 Food consumed in Brazil originated in family farming

Source: Data based on IBGE, 2006

³ A *módulo* fiscal is the minimum amount of land needed to maintain a family by means of farming. In Brazil, the INCRA produces an average index of agricultural productivity for each municipality, which enables to calculate the prospects of generating enough income to meet the needs of a typical family (Guanziroli and Basco, 2010).

2.3.2 Challenges and opportunities for Family farming

FAO (2012) assessed important challenges that need to be overcome in order to utilize Family farming as a potential solution to ending the problem of hunger and food security in Latin America. As well, through farmers' connection to the land, it could play a significant role in the reduction of environmental impacts caused by climate change. Community development plans are required, allowing access to health care, education, market, inputs and financing. Focus should be applied on territorial rather than sector level to recognize specific features of producers and on empowerment of women headed households. Due to their location, small producers usually experience high transactional costs and low competitiveness. Lack of information and organization structure causes market failures.

2.3.3 Sustainability

Sustainability is an important dimension of livelihoods indicating that progress in development is lasting and provides bases for long-term livelihood improvement.

According to DFID (2001) livelihoods are considered as sustainable when they are:

- Resilient to external shocks and stresses;
- Are not dependent on external unsustainable support;
- In a long-term maintain the use of natural resources;
- Do not undermine livelihoods of others.

Various aspects distinguish several dimensions of sustainability. Environmental sustainability is achieved when use of natural resources is enhanced for use of future generations, economic aspect refers to state in which economic wellbeing and expenditures are sustain over time, social sustainability maximizes social

equity and institutional sustainability is achieved when structures have capacity to keep performing their functions over time (Heinberg, 2010).

2.4 Pragmatic governmental policies

There are multiple ways how to achieve and sustain human development. Innovative programs were launched not only in India or Mexico but as well in Brazil, promoting more equitable distribution of social and economic opportunities (UNDP, 2013). National policies are targeted on development on regional level, such as 'Light for All' electrification program (Gómez and Silveira, 2010). Increasing number of governmental programs has been implemented in order to support the livelihood of family farms in rural areas. These were integrated in the newly launched program *Brasil Sem Miséria* – Brazil's national poverty alleviation plan.

2.4.1 Pronaf

Pronaf is a national program for strengthening of family farming. Through development of Pronaf, Brazilian Ministry of Agrarian Development promotes access to credit and investment in family farming. It is a system of short-term operating credits to cover day-to-day farm expenses, designated for the cost of crop and production inputs or agro-industrial activity, whether for investment in machinery, equipment or infrastructure for production. Under this program, technical assistance and rural extension Sibrater is provided to families.

Pronaf typology has divided farmers into following groups:

- *Pronaf A*: loans of up to R\$ 7,500, with 4% annual interest and a R\$ 3,000 discount on the capital, payable over eight years with a three-year grace period and no amortization;
- *Pronaf B*: for mini-projects with no refundable loans up to R\$ 1,500;
- *Pronaf C*: loans up to R\$ 3,700 with a R\$ 700 rebate on the capital and discounted interest;
- *Pronaf D*: up to R\$ 15,000 with 6% interest, with guarantees, no discount, payable over eight years and with a three-years grace period

In 2000 *Pronaf E* was created, basically eliminating groups C and D and creating a single category called 'Family farming' (Guanziroli and Basco, 2010).

Number and value of loans granted under PRONAF grew rapidly. Annual interest rates for particular credit level are represented in following table.

Table 1 *Current terms of PRONAF loans*

Short-term operating credit		Investment	
Financing	Annual interest rate	Financing	Annual interest rate
Up to R\$ 5,000	1.5%	Up to R\$ 7,000	1%
R\$ 5,000-R\$ 10,000	3%	R\$ 7,000-R\$ 18,000	2%
R\$ 10,000-R\$ 20,000	4.5%	R\$ 18,000-R\$ 28,000	4%
R\$ 20,000-R\$ 30,000	5.5%	R\$ 28,000-R\$ 36,000	5.5%

Source: Data based on SAF, 2009

Furthermore, if their harvest is damaged due to poor weather conditions, family farmers can activate PROAGRO rural insurance that covers 100% of financing and 65% of lost profits.

2.4.2 Food Purchase Program PAA

In addition to short-term operation credit, Food Purchase Program was created in 1995 stimulating family agriculture by distributing products among food insecure people in state sector, such as schools and hospitals. This program is operated by Conab, national food supply agency. Federal institutions are supposed to cover 30% of their food supplies by products generated in family agriculture, premium price is paid for organic products. *'It is a cornerstone in country's Zero Huger strategy'* (FAO, 2012; Guanzioli and Basco, 2010).

2.4.3 Bolsa Familia

To stimulate social progress, Bolsa Familia program was introduced, providing cash transfer under Ministry of Social Development (Brazil government, 2011; Secretaria da Agricultura Familiar, 2012). Transfers are predominantly made to women with children, supporting formation of human capital. It encourages opportunities for a large-scale action in field of education, health and nutrition for the poor. In 2005 Bolsa Familia covered 6.6 million families and was proposed to cover 11.2 million families by the end of 2006, program is supported by World Bank. Bolsa Familia incorporated four programs into a single cash transfer which reduced bureaucratic complexity. However, rural areas with dominant role of agriculture still remain centre of high poverty level. Program identified two target groups, the extreme poor and the moderate poor, depending on households' income and composition (Lindert, 2008).

3. Objective

The aim of this research is to critically examine and analyse the situation of resettled population in Barra do Imigrante community in central rural part of Santa Catarina state, located in South of Brazil.

Under the initiative of development project: 'LAGOS – Ecological Development in the Lake's Region' result of this study contributes to overall analyses of particular area.

Research is particularly focused on:

- (i) present livelihood strategies of targeted rural family farms affected by dam construction;
- (ii) possibilities for farming systems development in terms of family resources and capacities;
- (iii) structure analysis mapping linkages among community and other stakeholders.

During research, sustainable rural livelihood concept is used as a useful analytical framework.

4. Methodology

4.1 Study area description

Research was conducted in central part of Santa Catarina state, which represents one of the most developed regions of the whole country, both in the terms of human development index (HDI) and according to per capita income as well.

Study area was selected upon primary information provided by project participants. Project LAGOS – Ecological Development in the Lake's Region is coordinated by Sociedade Verde, Brazilian NGO. The most relevant criteria for study area selection were social and economic disparities of households affected by resettlement comparing to the rest of Santa Catarina state. Generally, focused area could be considered as a typical example of poor agricultural district in southern Brazil where governmental programs and policies discussed in literature review are addressed to.

Two municipalities, Campo Belo do Sul and Cerro Negro, were chosen as physical boundary of the study area. Target group was the biggest of the resettlement villages 'Barra do Imigrante', landlocked between Campo Belo do Sul and Cerro Negro municipalities.

Campo Belo do Sul and Cerro Negro municipalities are located in Serrana mesoregion, central part of Santa Catarina state with average elevation of 996 meters above sea level. Area is called Campos de Lages (Lake Region) and is known for high frequency of small ponds and lakes suitable for fishing. Flooding risk is high however, with lack of rain many water sources disappear. Wide areas of pine trees give advantage to timber industry but at the same time cause soil acidity and so obstacle in farm production. The soil in the area is acid with clay-enriched lower horizon and low saturation of bases. The climate is classified as humid sub-tropical with hot summer, mild winter and no dry season. Warmest

month is January with average temperature 25.8°C, July is the coldest with average 6.3°C at night. In winter there are days with night freezes. Generally, climate in the area is colder comparing to the rest of Santa Catarina state, particularly due to higher elevation.

Central part of Santa Catarina state is a poor rural district with agriculture being primary economic activity. The agricultural industry of Santa Catarina differs from that of the rest of Brazil in being small scale and almost entirely owner-operated. In general, field crops are far more important than livestock, with corn as the dominant crop of the state. Wheat, manioc, black beans, and rice are other staples (Noble, 1967).

Brazilian Real is official currency, R\$ 1 is valued on US\$ 0.5 and 9.6 CZK. Towns with the lowest GDP and HDI are situated here. In 2010, median value of monthly per capita income of rural households was R\$ 263 in Campo Belo do Sul and R\$ 275 in Cerro Negro (IBGE, 2013). Campo Belo do Sul is a municipality of 7,483 inhabitants, there are 3,581 inhabitants living in Cerro Negro. Both cities belong to a group whose population was significantly touched by Barra Grande dam construction and households engaged in agriculture production were resettled. Region is significant for production of fruits, beans, corn, onion and soy. The livestock sector is shown in cattle, pigs and sheep. However, there is a significantly long distance in between places of production and food consumptions. Agriculture products in rural areas are imported from 300 km distant producers. Due to presence of subsistent family farms there is a potential for so called food carbon miles to be decreased.

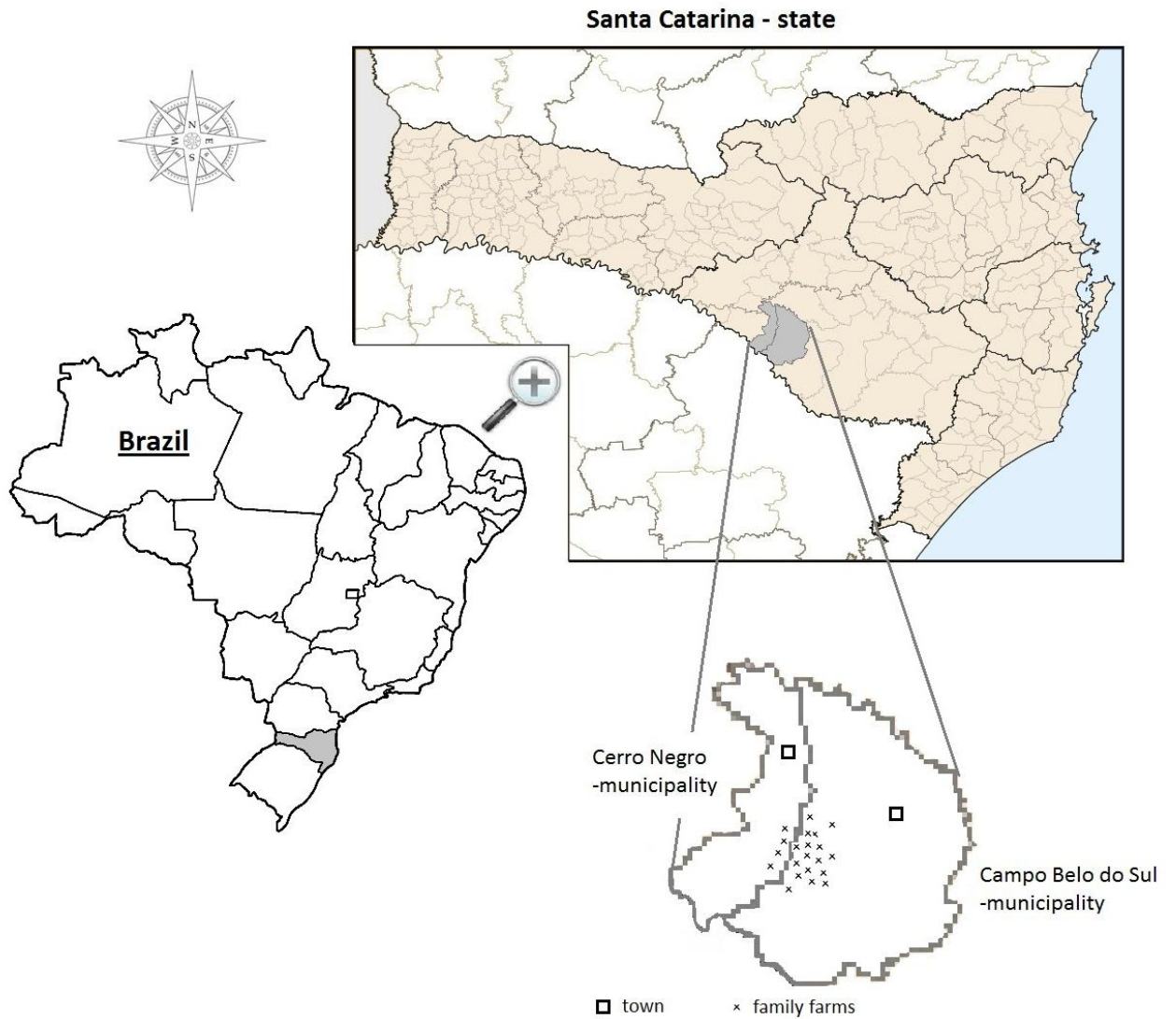


Fig. 2 Study area location

4.2 Background of the study

As stated above, study site was chosen in cooperation with project LAGOS – Ecological Development in the Lake’s Region under supervision of non-profit organisation Sociedade Verde. Project is focused on repatriation of families who were resettled in agricultural area around river Pelotas.

In 2005, hydroelectric power plant 'Barra Grande' was constructed across the river and created a physical boundary between Santa Catarina and Rio Grande do Sul states (UNFCCC, 2006). Dam was financed by 'Baesa' consortium that is responsible for compensation of land loss. Baesa is a group of Brazilian power companies CPFL Energia and DME, Aluminum manufacturers Alcoa and CBA and engineering company Camargo Correa. It is planned to increase the living standard of local households through increase of energy supplies. However, 191 families had to be resettled to new areas. The ability of households to adapt to new resettlement is purpose of this study.

As compensation, Baesa is responsible for providing new livelihood for affected families and technical support in agriculture production. As well, it pays royalties as a percentage from revenue to individual municipalities. With financial support, new houses were built for immigrants' families and farmers gained their own land. Housing facilities were improved according to a prototype in all cases, however composition and number of household members varies.



Fig. 3 Entrance to the community



Fig. 4 Dam Barra Grande built on river Pelotas

Resulting from resettlement, following communities were newly constructed:

Table 2 *Resettled communities*

Name	Number of Families	Municipality
Boa Vista	15	Anita Garibaldi, SC
Santa Catarina	24	Anita Garibaldi, SC
Nossa Senhora de Salete	35	Esmeralda, SC
Sao Francisco de Assis	31	Esmeralda, SC
<i>Barra do Imigrante</i>	37	<i>Campo Belo do Sul, SC</i>
Laranjeira	33	Capao Alto, SC
XV de Fevereiro	16	Anita Garibaldi, SC
Total	191	

Source: UNOESC, 2011

Research was done in one of new resettlements, 'Barra do Imigrante'. Entrance to the community is 10 km far from Campo Belo town hall and houses of families are spread around the road unto 12 km far. In total it counts for 37 families, 121 people.

Resettlement brought significant obstacles in agriculture production that is the major source of income for affected families. In flooded area the soil had a better quality, nutritional value and was naturally irrigated from water stream. There was no need of vast use of chemical fertilizers. Farmers were self-sufficient in food production so the food expenditures on the market were minimal.

4.3 Research design and data collection

Data were collected in June and July 2012 in one of resettlement villages 'Barra do Imigrante', landlocked between Campo Belo do Sul and Cerro Negro municipalities. In total 37 family farms situated in the community were taken as units of analysis. Research was designed as a holistic in-depth case study of Barra do Imigrante community, formulated according to sustainable rural livelihoods concept (DFID, 2001; Chambers and Conway, 1992). Range of cross-sectional data was collected and results were generalized. We assume that the other newly constructed villages will behave in a similar way as our sample.

During the research both primary and secondary data were collected and analyzed. Fieldwork was carried out in a period of one month. During primary data collection, triangulation of techniques and methods was used in order to improve their validity and reliability (Kumar, 2005). Following data collection techniques were used during the research:

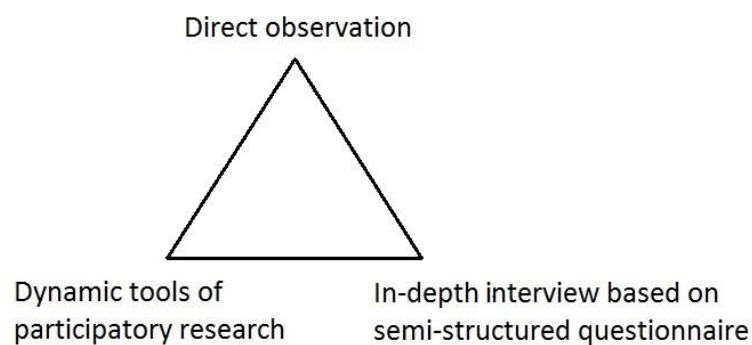


Fig. 5 *Triangulation of research techniques*

In-depth interviews based on semi-structured questionnaire were conducted; firstly with 32 respondents from the community, secondly with key players from agribusiness sector involved in production. Each respondent from the community

was contacted twice, thus more open relationship with farmers was created and appropriate data were collected.

In order to stimulate participation of relevant stakeholders, dynamic tools of participatory research were used. It implies more comprehensive design of research strategy. Those were Guided walk, Stakeholder identification and flow chart, Family resources capacity and use analyses and Family discussion (Boef and Thijssen, 2007).

Finally attitudes and practices of stakeholders and local authorities were directly observed and documented. This technique helps investigator to obtain information that respondents are unwilling or unable to provide. As well GPS coordinates of individual farms were recorded and later could serve as a database for Geographic Information system (GIS).

4.4 Data analysis

Collected data were further cleaned and transmitted into electronic database and statistically analyzed using Microsoft Excel 2007 and Statistica software.

Descriptive statistics were used in order to characterise the researched population sample. The sustainable livelihoods framework was chosen as a suitable tool for analysis of livelihoods in this study because it links the broader socioeconomic components of household' assets, livelihood activities, outcomes of livelihoods activities and factors mediating access activities (Ellis, 2000). The sustainable livelihoods concept identifies vulnerability context, capital assets, processes and livelihood outcomes that are related to poor rural population.

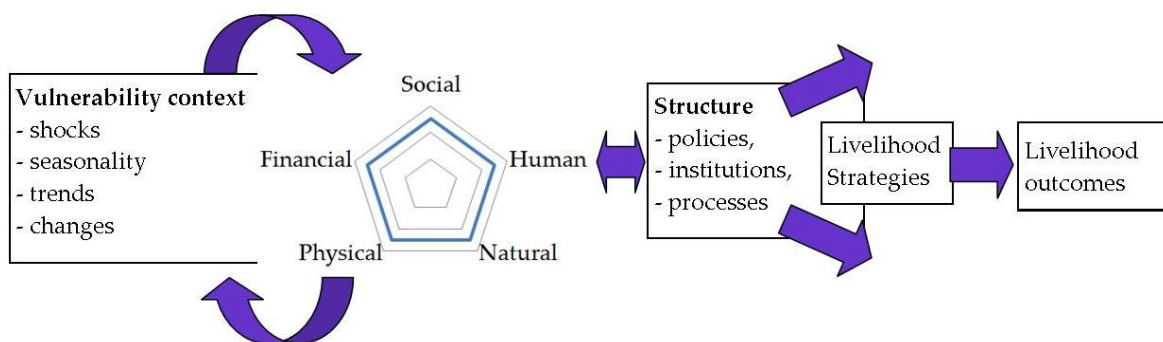


Fig. 6 Sustainable livelihoods framework

Source: Based on DFID, 2001

Following indicators were chosen to assess studied livelihood assets.

Table 3 Indicators regarding individual livelihood assets

Natural capital	Land, water, biodiversity, environment
Physical capital	Shelter, water, energy, transportation, land, livestock, waste management
Financial capital	Financial resources, credit, pension, savings, insurance
Human capital	Skills, knowledge, ability to work
Social capital	Groups and associations membership, access to institutions

5. Results

5.1 Livelihood strategies diversification in new resettlement

Our survey shows that income generating activities vary. Farmers are engaged in subsistent and market oriented system. Centralized model of contract farming involves producers of cash crops, particularly corn, beans and soybeans producers which represent 84.4% of farms that sell their harvest to Copercampos cooperative, 43.8% of families which generate their income through milk production and 34.4% of households contribute to family income by off-farm activities. Among those are particularly sale of young animals, eggs, cutting branches of trees inside or outside of the community, helping on neighbouring fields during harvest or sale of handicrafts produced by women group. 15.6% of families live from other source of income, mainly renting their land to other farmers and profiting by 20% of total harvest price. Some respondents admitted short-term employment migration outside of community. Only 9.4% of households are holders of organic certification, selling their products on market in nearby Campo Belo do Sul. Economic activities are in majority performed in a combination.

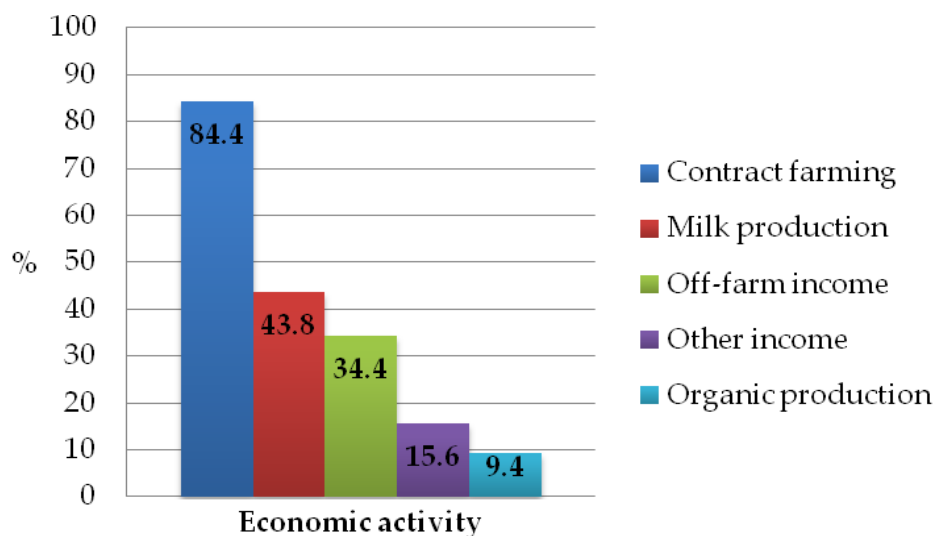


Fig. 7 Percentage of households involved in particular economic activity in Barra do Imigrante community

Land ownership is assigned by legal document that is valid for a minimal period of ten years. Within this time, households are not competent to sell their property. Respondents are mostly willing to stay on land and maintain their agriculture production in the future. However, they require living standards to be improved and more income generating off-farm activities to be available, markedly for their children. During research, most frequent problems seen by farmers were distinguished. They are listed in figure below, starting from the most frequent:

Table 4 *Farmers' evaluation of problems in Barra do Imigrante community*

Particular sector to be supported	Major problems in community
Agriculture	Bad road quality
Milk production	Lack of irrigation
Rural tourism	No regular income
Organic farming	Poor soil quality
Leisure time	Lack of technical assistance
Handicrafts	No drainage system-floods
Cattle breeding	High costs of living
Commercialization	Low price of production sold
Veterinary assistance	Pastures quality
Fisheries	Weak governmental support
Off-farm jobs	Low agriculture production
	Community organization
	Rural emigration
	No greenhouse
	Bad production inputs

Based on research, groups of households were identified according to their main livelihood source.

5.1.1 Farms involved in crop production: commercial channels and supply chain

Survey shows that vast majority of farms are involved in contract farming, particularly corn, beans and soybeans are cultivated and sold to Copercampos cooperative situated in Campo Belo do Sul. Farmers purchase production inputs from Copercampos. Genetically modified seeds are used for harvest. They are grown in a combination with vast use of agro chemicals, particularly Roundup herbicide, lime, nitrate and other fertilizers and pesticides are used by all farmers. Seeds have to be re-purchased every year, only a small portion of original *Creole* seeds is used for plantation.

Farmers are responsible for delivery of their harvest to the cooperative using their own means of transportation. Government provided one tractor to the community association, members pay 25-30 R\$/hour rent fee. Tractor is used for new seedlings plantation, to spray plants with chemicals, during harvest and for transportation of their production to local Copercampos. Local cooperative only buy agriculture products that fulfil standardized quality norms such as given size and shape of grains.

Table 5 Prices for seeds sold by Copercampos' and purchasing prices of products harvested by farmers

Commodity	Price of seeds	Quantity sold	Unit price	Purchasing price	Quantity
Corn	R\$ 180	Saca 20kg	R\$ 9/kg	R\$ 22-27	Saca 60kg
Soybeans	R\$ 120	Saca 40 kg	R\$ 3/kg	R\$ 50-64	Saca 60kg
Beans	R\$ 5	1 kg	R\$ 5/kg	R\$ 150-200	Saca 60kg
Wheat	R\$ 45	Saca 50 kg	R\$ 0.9/kg	R\$ 26-28	Saca 60kg

Grains from farmers are stored, cleaned and dried in local storage units. From here they are either transported to cooperative headquarter where processing occurs, packed and distributed to local supermarkets or distributed into international markets. Further business operations are conducted by sales department through foreign exchange markets, concretely Chicago Board of Trade as swaps, forwards or futures commodities. Following figure represents the supply chain of crops distributed via Copercampos commercial channel.

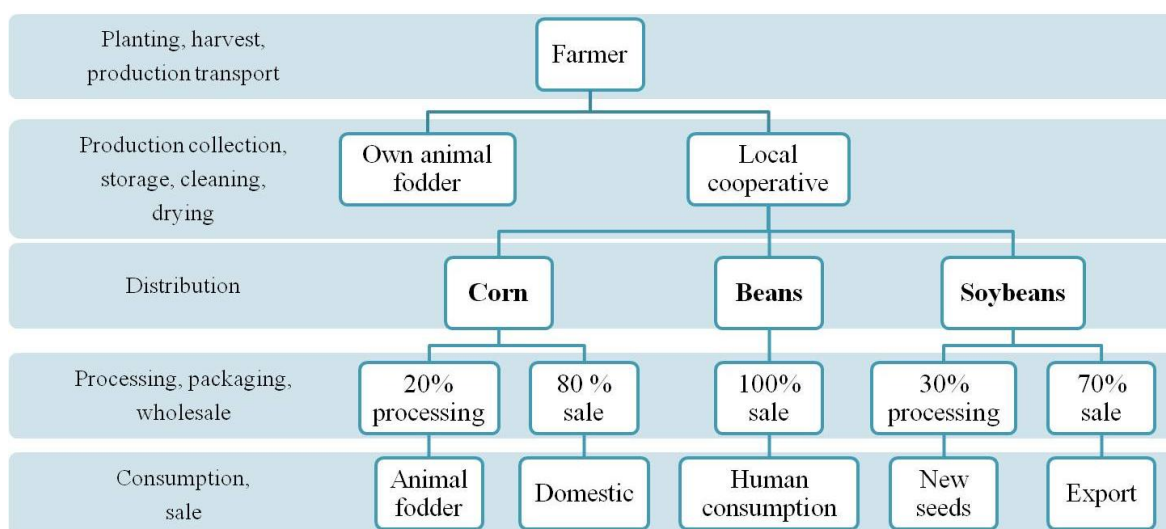


Fig. 8 Supply-chain of cash crops produced in Barra do Imigrante community

Survey shows significant losses of harvest during past seasons. Some farmers noticed up to 80% loss of production in last year. As well, large amount of crops does not reach required quality standards, thus they cannot be sold to cooperative and only are used as a fodder for own animals.

5.1.2 Milk producers: distribution and use

Farmers engaged in milk production established partnership with Bel Pais food industry. Company purchase raw milk that is further processed into variety of dairy products, particularly cheese is sold to final consumers. Once in 11 days Bel Pais dispatches middlemen who come into the community and collect milk from farmers. Price of milk purchased from farmers rose from R\$ 0.50 per litre to R\$ 0.60 per litre in 2012. However, profitability from milk production is volatile due to poor infrastructure in the community. During heavy rains road becomes impassable for traffic and hence middleman cannot come to pick up the collected milk. Farmers lack storage refrigerating capacities, they cannot keep the milk fresh and so it is being wasted. At the same time, with lack of rains and no irrigation system pastures dries out, thus animals do not get proper nutrition and production is dropped, particularly during winter months. Community applied for a sperm bucket that was financed by Baesa consortium. By keeping animals fertile, milk production increases. Average animal expenditures are R\$ 515 per year. Productivity of dairy farms is 740 litres per cow in average, it is below national average. Only three dairy farms reach the average state production of 2432 litres per cow per year.

5.1.3 Potential of organic and locally based production and consumption model

Results show that apart from conventional approach, farmers in Barra do Imigrante community are actively involved in organic farming. Production is concentrated on following commodities: tomatoes, lettuce, beets, kale, carrots, cabbage, broccoli, onion, potatoes, scallions, chives, arugula, radish, chicory, peaches. Farmers obtained permission to create a small farmers market in Campo Belo do Sul. Here the commodities are traded every Tuesday, price is set R\$ 0.10 below current supermarket price. As well there is a demand for cassava manioc, strawberries, peas, beans, sweet potatoes or corn. Profitability of organic production sale differs with season; average profit of farm producing on 0.8 ha of land is R\$ 1,200 per month during summer, R\$ 400 per month during winter. Not sufficient amount and quality of agriculture commodities is offered in local supermarkets. Those are delivered once a week from 300 km remote producers. Demand in the municipalities and profit from local organic production is increasing, comparing to R\$ 200-300 per month in 2000. With current demand, price levels and ideal agriculture conditions, profitability of organic field is estimated to be R\$ 2 per m² per month. Organic farming is labour intensive, labour demand for 0.5 ha is six hours a day. In case of community farmers, 0.3 ha is used for seedlings cultivation, 0.5 ha for harvested products. To sell production with organic label, farmers need to apply for certification, in community case it is provided by Ecovida private initiative under given condition at the cost of R\$ 500. Among other inputs needed for harvest are seeds (R\$ 50), plastic cover for a small size greenhouse (R\$ 80) and bio-fertilizer kit that is diluted in 150l of water (R\$ 50).

5.2 Livelihood assets

Livelihood assets are composed of so called building blocks of livelihoods that have significant effect on peoples' ability to mobilize strategies and convert them into outcomes. The sustainable livelihoods concept identifies five categories of assets upon which livelihoods are built (DFID, 2001; Carney, 1998).

5.2.1 Natural capital

There is a potential for community to derive benefits from the environment. Natural resource base is particularly rich on ponds suitable for fishing however they are not maintained and often dry out. Large reforestation area creates a natural boarder with the community and protects parts of agriculture land from strong winds. Households profit from sale of eucalyptus tree. Profitability from one ha of eucalyptus forest is approximately R\$ 15,000-20,000 every seven years. Community is covered with araucaria trees giving large pignolia nuts that are frequently collected and consumed by local inhabitants. Community lowlands are covered with swamps and face high risk of flooding. There are governmental driven programs for native habitat conservation however farmers are not informed about possibilities of benefitting from original land and thus big parts stay unused and not nurtured.

Table 6 *Land use system in target area*

		Mean	Median	Standard deviation	N*
Land size	Total land size, ha	19.7	18.25	7.8	32
	Annual crops land size, ha	8.5	8	5.6	29

N* indicates total number of households

5.2.2 Physical capital

Resulting from resettlement, housing facilities were built in a newly established community according to a prototype. Shelter was improved and is secure in all cases however family size was not considered during allocation. Thus, regarding size of house, not all families are better off. House and warehouse for tools and equipment were built on each property, which is mostly surrounded by barbed wire fence. In some cases warehouse was turned into a pig sly or additional facility for animals was built. Chicken house was constructed on 78% of properties. As well, there are five apiaries in the community. Contrary, basic irrigation system was modified by three households only and there was no drainage system found in the lower parts of community that would protect fields from flooding.

Average size of acquired land is 19.7ha, however there is no strong correlation between number of people living in a household and exact size of land they received. Therefore there is no visible pattern of land distribution. Majority of families does not have sufficient resources to use the entire area for harvest, thus big part of land stays unused. In three cases only, additional land was rented. In average 40% of total land area is used for cash crop production, remaining area serves as pastures for animals or is overgrown by annual plants, shrub or trees. From those particularly pine trees, eucalyptus and araucaria trees are found in the community.

Table 7 *Distribution of livestock in households*

	Mean	Median	Standard deviation	N*
Livestock Chicken	33	30	20.7	31
Cow	15	12	12.4	30
Pig	5.7	4	3.9	19
Sheep	7	6	2.6	3
Horse	1.2	1	0.6	12

N* indicates total number of farms having particular livestock

Significant differences in livestock counts were observed among individual households. Using unit coefficients for calculation, total livestock units in community and average value for household are represented below ([Chilonda and Otte, 2006](#)).

Table 8 *Tropical livestock unit⁴*

	Chicken	Cow	Pig	Sheep	Horse
TLU	0.01	0.7	0.25	0.1	0.65
Total	10.22	317.1	27.25	1.5	9.75
Mean Household	0.32	10.23	1.43	0.75	0.81
SD Household	0.21	8.63	0.95	0.25	0.39

⁴ TLU is a conventional method quantifying range of livestock types and sizes in a standardized unit. Based on metabolic rates it shows that five sheep of 30kg will consume as much as one cow of 250kg ([FAO, 2013](#)).

Basic sanitation is met in each house. Drinkable water is distributed into houses via pipes from common resource. Several water catchment systems are built throughout the community thus water is relatively accessible. In houses positioned at higher altitude, pressure in water pipes fluctuate thus they are dependent on own water supplies. There is a collective recycling facility built by farmers inside of community. Recyclable trash is further privately sold by ton to Campo Belo do Sul, however insufficient amount of garbage causes difficulties in system.

Significant obstacle in the community's infrastructure is caused by unreliable transportation. Households are situated along community road that is merging into the main road connecting Campo Belo do Sul with surrounding towns. Road in the community is about 15 kilometres long and is finished by dead end. Its structure is muddy and of a very poor quality thus with heavy rains, road becomes impassable. It causes significant difficulties particularly in milk production and school attendance.

5.2.3 Financial capital

According to our results, 84.4% of households involved in contract farming access credit via *Pronaf* which is a national programme of small, low interest loans. They are in most of the cases facilitated by *Epagri*; educational centre for rural extensions and research. There are two types of loans. *Custeio* is commonly used for defrayal, helping farmers to finance production inputs in the beginning of a season, or *investimento* for investment, mostly into machinery, herd size increase or other farm facilities. Both are in majority used in a combination.

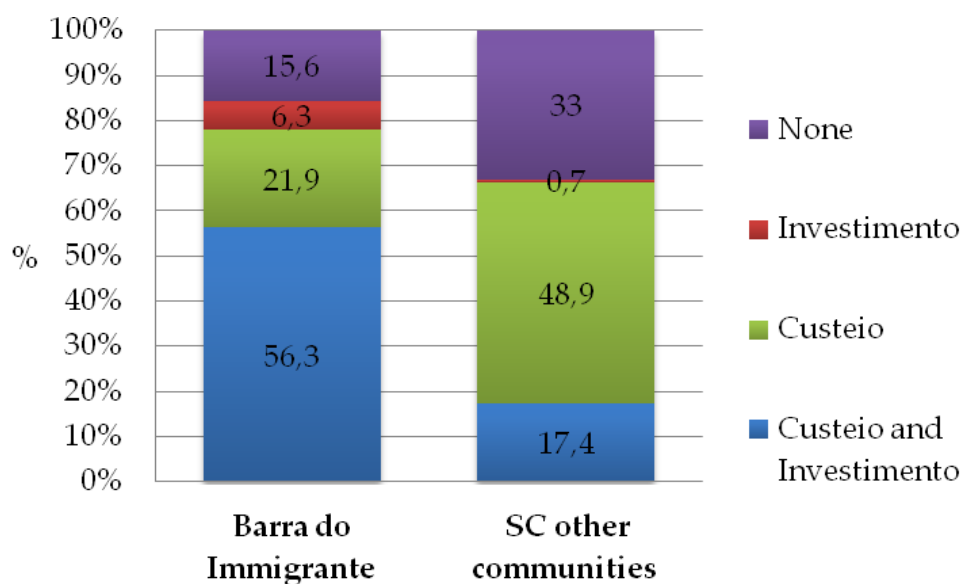


Fig. 9 Percentage of families accessing credit according to credit type, comparison of Barra do Imigrante community with other resettlements in Santa Catarina

Source: Data based on own research and UNOESC 2011

Farmers experience difficulties with loan repayment. They are forced to sell part of their assets or ask for *proagro*, it is an alternative to agriculture insurance. After poor harvest, appropriate documents confirming that all necessary inputs and chemicals for transgenic seeds cultivation were purchased. Subsequently, up to 50% discount on debt is given to farmers using pronaf custeio loan. 62.5% of families access *Bolsa Familia*; income support provided by the national government that supports families with children attending school. 21.9% of families receive retirement.

Table 9 Value of particular government driven incentive drawn by community households expressed in R\$

		Mean	Median	Standard deviation	N
Pronaf, R\$	Custeio	7,615.4	7,000	2,838.8	25
	Investimento	26,845	17,000	27,703.7	20
Bolsa Familia, R\$		122.6	109	34.7	20
Retirement, R\$		1042.9	1,200	248.5	7

Many respondents complain about increasing costs of living and low purchasing price of their products. Results show that significant part of income is spent on food, particularly in households engaged in conventional farming. Food expenditures of organic producers vary between R\$ 30-60 per one household member per month comparing to other farmers whose expenditure vary between R\$ 50-150 per member per month.

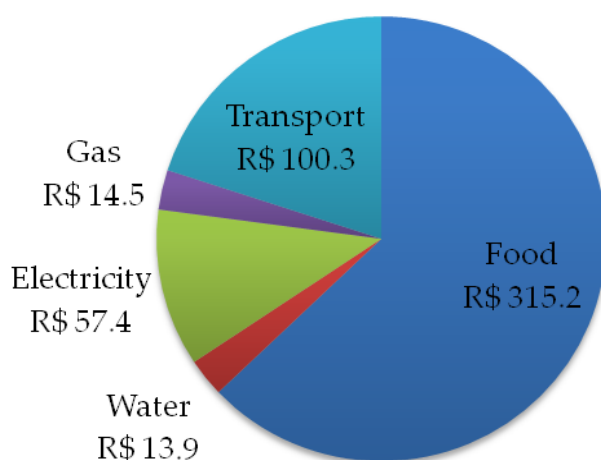


Fig. 10 Average monthly expenses of Barra do Imigrante households

In addition to expenses represented above, households pay about R\$ 50-150 per month for health care and medicine and in average R\$ 150 for education. Median value of total monthly household expenditures is R\$ 612.

Considerably higher are farm expenses, inputs needed for contract farming include seeds, fertilizers, pesticides, lime and nitrate. Total average cost of inputs used for one ha of land is R\$ 628, standard deviation R\$ 424 is significantly high, which indicates that amount of inputs is not used adequately by all farmers.

5.2.4 Human capital

Results from our research show that 69% of community population is in the working age (14-60 years). Dependency ratio of members that are not in a working age is 0.44. Respondents expressed seasonal demand for hired labour particularly during harvest. In remaining season, families with lower dependency ratio mentioned labour surplus.

Table 10 *Households composition in Barra do Imigrante community*

		Mean	Median	Standard deviation	N
Household composition	Household members	3.8	3	1.6	121
	Economically active members	2.5	2	1.25	80
		<15	15-40	41-60	>60
Age composition %		24.8	44.6	24.8	5.8
Male %		46.7	48.1	63.3	71.4
Female %		53.3	51.9	36.7	28.6

Level of education and years of farming experience determine the labour quality. Elementary education accessibility improvement was proved during survey. 7.6% of adults living in the community are completely illiterate. Majority finished only primary level of education. Contrary, all children from the community attend primary or secondary school. Government provided school bus and fixed salary to driver who is at the same time a community member. He is responsible for transportation of kids to elementary school. However, two high schools that are accessible in the region are quiet remote. Thus, acquisition of higher education level is linked with temporary rural emigration.

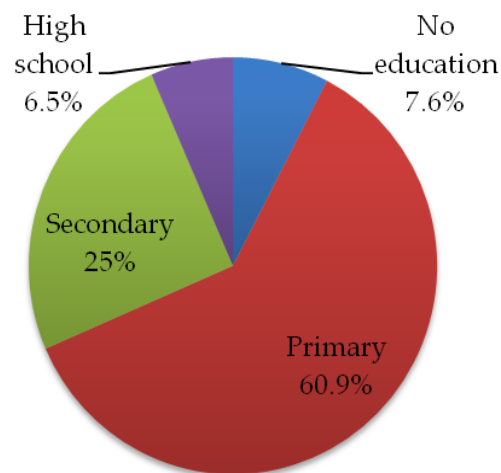


Fig. 11 Adults equivalent with particular finished education level⁵

Majority of respondents have long-life experience with farming. Contrary, specialized education among community members is lacking. Baesa was responsible for provision of technical assistance to farmers. Results show that only 18.7% of producers were reached and the level of assistance was not appropriate according to farmers' needs. More valuable access to information is via educational centre Epagri, extension services provider.

⁵ System of educational in Brazil is split into levels. PRE level consists of primary (four years duration) and secondary (four years) education and is followed by high school (three years).

5.2.5 Social capital

All community inhabitants confess Roman Catholicism. Church service is realized every Sunday and thus church became an important centre of events happening and meeting point for community discussions. Our results show presence of several formalized groups and associations created within the community.

Arcasul association is a base for all producers involved in contract farming. Community association is officially registered as a juristic person and share common controlled budget and concrete farm machineries. *Arcasul* council consists of eight members who are voted for a period of two years. Positions are following: president, vice-president, treasurer, secretary and four fiscal committee members who coordinate associative operations.

Association is vertically integrated with several state and private bodies that are significantly involved in the structure. It is represented in following diagram.

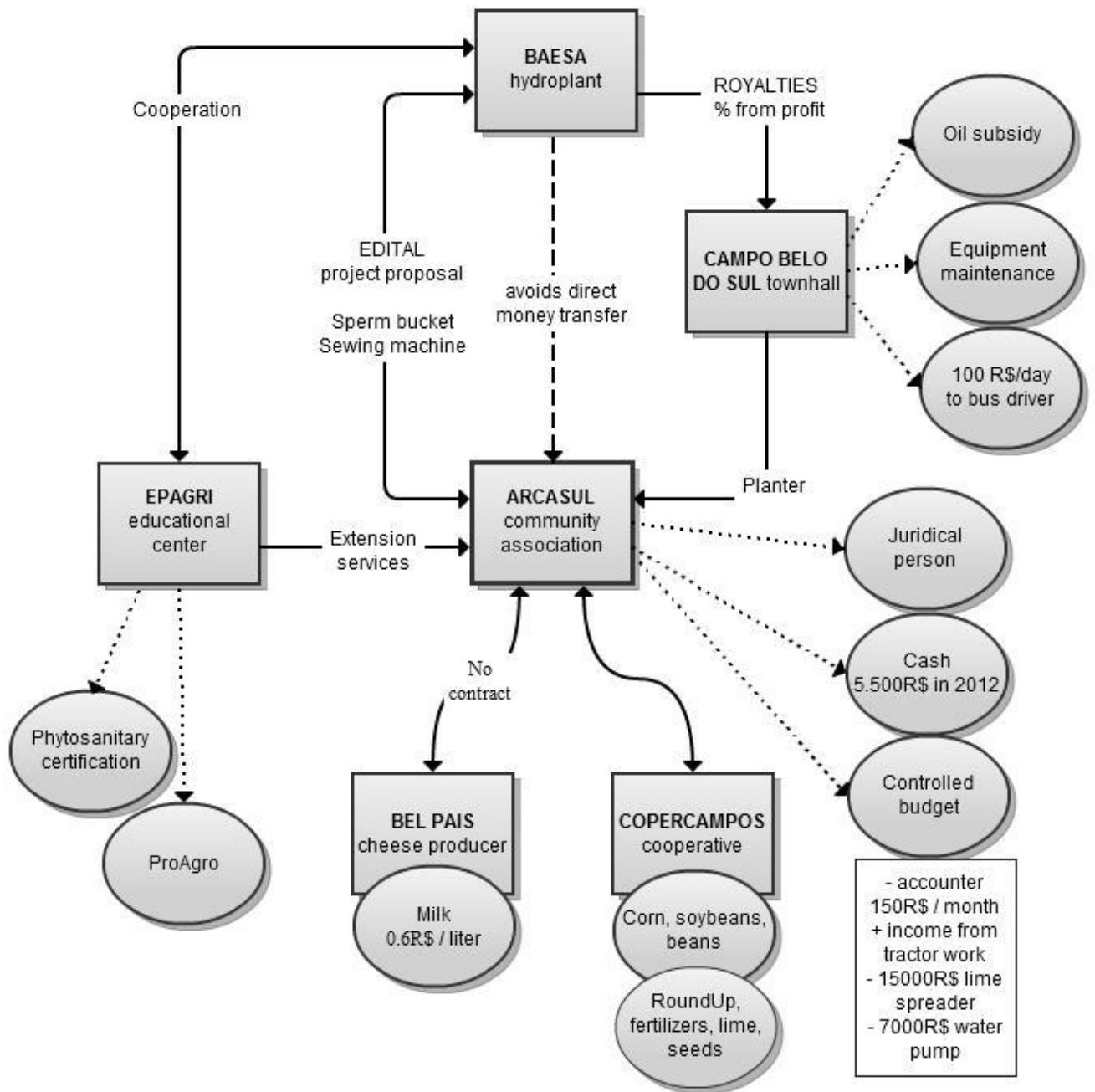


Fig. 12 Map of linkages between Arcasul community association and stakeholders involved in contract farming system

Association is directly supported by Baesa. All communities affected by resettlement have opportunity to participate in project proposal system *Editat* that is opened every year. Farmers can officially request machineries needed for their activities through this approach.

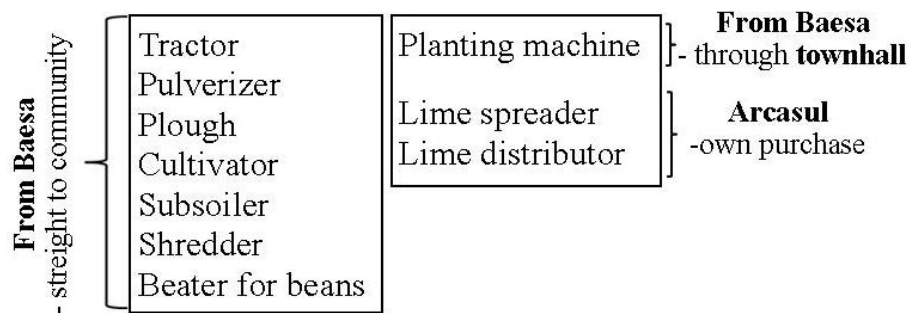


Fig. 13 Machinery according to type of acquisition

Money transfers going through Compo Belo do Sul town hall are not transparent, thus Baesa prefer to pay directly to supplier who delivers machinery to the community.

Farmers participating in organic production are members of *Gerbics* group. They are certified by *Moquitiocata* participatory certification that works on a collective level. Each producer is dependent on each other in terms of not violating certification rules and principles. The entire group loose certification as a consequence of one farm no more being able to keep up with organic production rules. *Gerbics* farmers are members of *Ecoserra* cooperative that is further registered under *Conab* governmental institution. Products are delivered to *Conab* where they are substituted for redeemable record. This paper works as a confirmation of delivery applied in *Ecoserra* where money is repaid to farmers with charge 30-40% of production value. *Conab* only cooperates with organisation so farmers need to be members of *Ecoserra* to access it. It creates a bridge between organic producers and consumers.

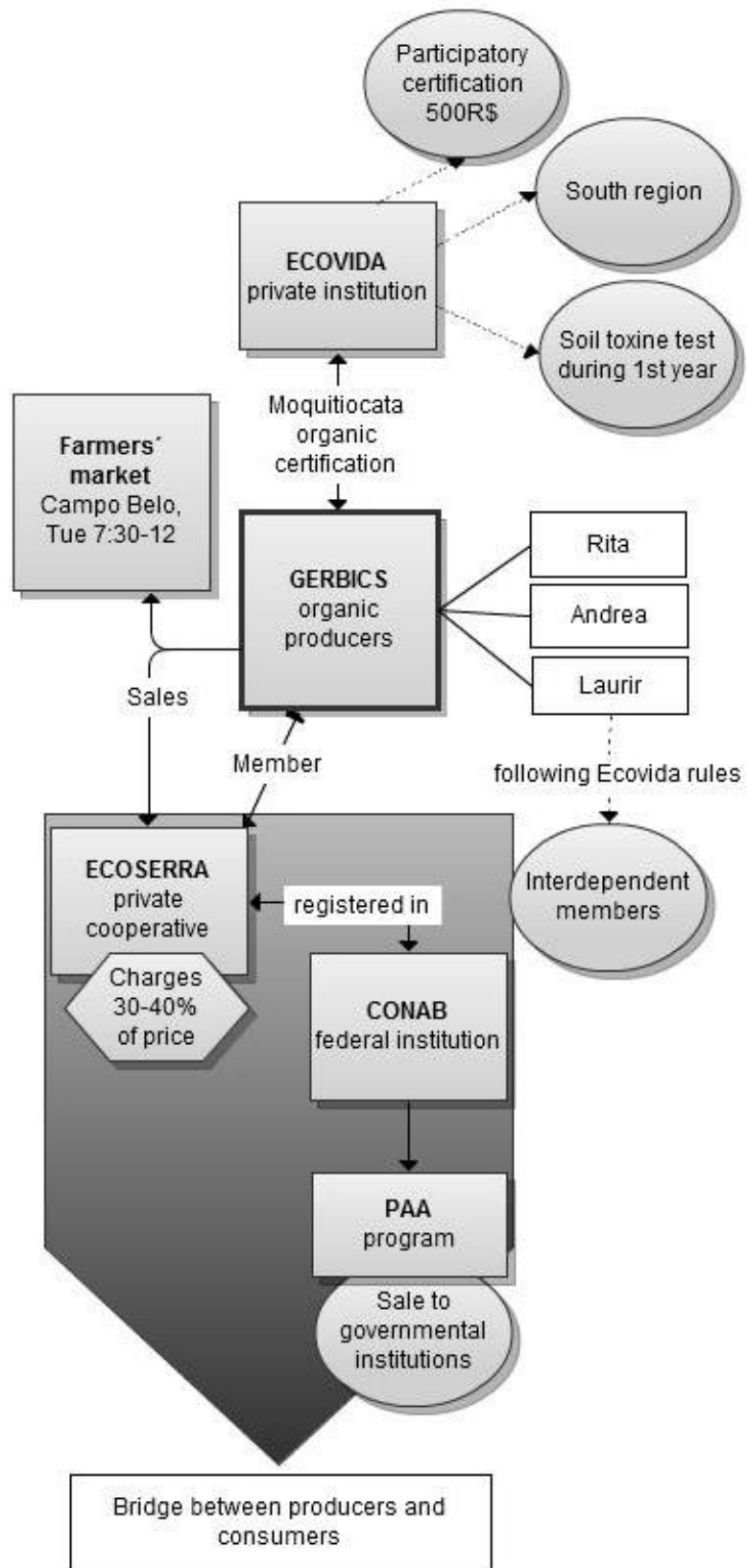


Fig. 14 Map of linkages between Gerbics group of producers and stakeholders involved in organic farming

Together with formalized cash generating groups there is a non-formalized *Women group* where 63% of community women participate. Members gather every Wednesday from 8.30 a.m. to 4.30 p.m. and create handicraft products, particularly blankets, pillows, table pads, bathroom cloths, knitted products or woven baskets that are further sold privately for negotiated price. Group is supported by *Sebrae* institution that provides courses in field of food processing, particularly cheese production and other milk processing or pastry baking. Courses are accessible through edital, however only few women have gone through it. Baesa provided the group with five sewing machines, members are willing to expand and are available to work more.

6. Discussion

The sustainable livelihoods framework indicates physical, social, natural, financial and human assets as inputs for community wellbeing and vulnerability to shocks from external environment (Ellis, 2000; DFID, 2001).

In case of Barra do Imigrante, community resilience was strengthened through physical capital acquisition. Housing and sanitary facilities were improved in all cases. Private land ownership was assigned for a minimal period of ten years giving households advantage comparing to study from China where resettlement is bound with landlessness and tenancy (Webber and McDonald, 2004). It built stable bases for living standards improvement.

However, results indicate wide gaps in overall livelihood approaches. Not sufficient resources for harvest cause underutilization of land resources. Lack of appropriate technologies, technical expertise or changing weather conditions were discovered as main factors causing the promissory cash crop intensification ineffective. Problem rises especially due to low diversification of production and species variety within the community. Such model makes farmers dependent on external food supplies and thus is not self-sufficient.

Our study shows that food expenditures of households engaged in contract farming are almost two folds of households engaged in organic production. It puts them in a position of net buyers and increases the external food dependency. Moreover, inadequate nutrition in terms of food quality was observed among farmers that in a long-term leads to malnutrition as explained by Young (1992).

Value of production is low from both point of quality and quantity. Long-term use of agro chemicals contributed to degradation of soil in the community which contradicts with principles of sustainability. Results show that high price of material inputs such as seeds, fertilisers and pesticides appear to be a great

constraint to production success. The same was discussed in study from Cerrado region (Rada, 2013).

Farmers are not fully benefitting from natural resources. Study from Sri Lanka (Takesada et.al, 2008) shows that irrigation system in the community was built prior to resettlement however none was introduced in Barra do Imigrante community. Significant harvest losses are in contradiction with production and profit maximization. At the same time purchasing prices remain very low.

Labour productivity could be increased through enhanced technical assistance and specialized education. Promises of technical expertise provision were attractive to farmers as well in Development Village in Laos (High, 2008). However, in Barra do Imigrante community trainings were not appropriate. Lack of assistance for transitional residents was as well proved by Newton (2008). Therefore there is a need to develop their knowledge and skills and motivate them towards a change of production systems.

6.1 Further policy implications and resettlement decision-making

Bottom-up approach in decision making process is lacking, thus development tendencies in the region result in limitation of smallholders' choices. In case of Sri Lanka resettlement scheme (Takesada et.al, 2008), even with limited alternative, families had a choice of acquired land. Government and policy-makers should provide rational alternatives of resettlement programmes. Participation of resettled families on planning process is important in their integration and interest in particular economic activities. Moreover, after resettlement more adequate and long-lasting trainings and extension services need to be provided as it was already suggested in Kenya (Syagga and Olima, 1996).

Pereira et.al (2012) claims that public policies have been correctly targeted to stimulate income growth in family farms, both for their benefit and for that of the domestic food market. However, results show that farmers are highly dependent on governmental incentives and many of them have difficulties with repayments and they are falling more into debt. Thus they are trapped in hands of big companies and local authorities.

Our results slightly remind situation in Vietnam studied by Bui et al (2013). Family farming model in Brazil is highly subsidised by range of governmental incentives, thus there is a need to set up proper indicators monitoring how effective and efficient the system is in a long run.

6.2 Suggestions and recommendations

There is a need for structural change of current family farming model. Transition towards more environmentally-friendly production with a special emphasis on sustainable techniques aiming to strengthen local economy, food security and community resilience are suggested to be implemented.

Demand for agriculture commodities in surrounding towns is not met. Quantity of products imported from remote places is not sufficient. It creates opportunity for community farmers to build a locally based system of production and consumption and thus limit vulnerability and dependency on external environment.

Increased diversity of production and species variety within the community is tool to not only minimize food expenditures on the market but at the same time to eliminate inadequate nutrition practices among farmers. Special focus is to be paid on organic production. To support diversification, local collaborative green house should be constructed from which seedlings are distributed to farmers.

We recommend agro reforestation to be conducted, resulting in preservation and recovery of regional environment. Moreover, forest creates a natural windbreak protecting soil from erosion and droughts. With technical support, natural base in Barra do Imigrante gives potential to boost fisheries in region.

With implementation of different agriculture methods contributing to biodiversity enrichment, there is a potential for agro-tourism development. In peri-urban areas it offers feasible solutions bound with urbanization and market-driven economy as previously studied by Yang et al. (2010). Mbaiwa and Stronza (2010) and Arntzen et.al (2007) proved that socio-economic benefits such as employment opportunities, income generation or social services provision were improved after tourism development in communities in Botswana. However, we suggest that construction of paved road leading to the community will encourage tourism involvement and at the same time improve market accessibility.

With acquisition of phytosanitary certification, milk and other raw materials could be processed. Thus, we suggest incorporation of locally-based agri-business in community activities. By processing raw materials, aggregate value added to products would reflect in off-farm income rather than sale of milk at very low price. In further research, marketing plan needs to be elaborated.

Creation of own brand, labelling of women s' groups handicrafts and establishment of locally based store could contribute to agro-tourism development. Creation of sustainable self-sufficient system based on local production is suggested as a successful tool in Brazilian rural development.

6.3 Limitations of the study

Our results have to be understood with certain limitations. First of all, there were not enough capacities to contact all 191 families that were affected by forced resettlement. Only 37 households that are situated within the same physical boundary were selected and thus the research was feasible however this limitation is reflected in overall results' generalization. Secondly, no comparison with historical time series could have been done as there was only a short-time contact with respondents hence only cross-sectional data were collected. Thirdly, on certain days farmers were occupied with field work and thus were not willing to be interviewed. Furthermore, the willingness of representatives of local government to cooperate during our research was very low. This could be explained via complicated social, cultural and political factors, such as low transparency between farmers and local administration or high level of corruption in rural areas of Latin American countries. The last but not least, some misinterpretations were caused by language barrier.

7. Conclusion

Aim of this study was to assess livelihood strategies of small family farms that were, as a consequence of hydro power plant construction forcedly resettled. Particular attention was paid to livelihood assets analysis determining the ability of households to adapt to the changing environment while keeping principles of sustainable development. Research was undertaken in order to address the networking of vertical and horizontal linkages among entities involved in transforming agriculture sector.

Specific objectives were analyzed and are concluded as follows:

(i) Family farming model with mixed cereal and livestock production system was adapted as present livelihood strategy of targeted rural households. As cash crops particularly corn, beans and soybeans are cultivated to be further processed in animal fodder and sold by Copercampos cooperative. Milk is sold at very low price, other animal products are mainly used for own consumption. Only those 9.4% of respondents engaged in organic production are more or less self-sufficient and food secure. Significant harvest losses are addressed to improper irrigation and lack of technologies in transgenic production. Farmers are not able to switch between multiple strategies to secure their livelihoods.

(ii) Regarding work ability, dependency ration and family assets, households have human capacities and as well physical resources for farming system development, however knowledge and technical expertise in the community are lacking in both, contracting and organic production. Results show farmers' interest in organic production and agro-tourism development. Given its physical situation, with increasing demand from surrounding municipalities, there is a potential for locally-based production model to be implemented.

(iii) Results show that targeted farmers are incorporated in more or less formalized networks of economic and social relationships determined particularly upon individual economic activity. Farmers are vertically linked with regional agri-businesses however they do not have decision-making power in the structure. Current governmental policies are targeted predominantly on communities of such a kind, nevertheless subsidies and incentives increase households' dependency on external support and vulnerability to shocks thus are not competent with principles of sustainability.

Transformation of current family farming model and implementation of sustainable techniques aimed to diversify species variety within community are recommended in order to strengthen and build on locally-based economy and community resilience.

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ANNEX

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Annex 1 Questionnaire: Free listing

1. How many people live in the household?
2. Who is owner, what relatives live here?
 - A. One resident
 - B. More the one resident
3. How many family members can read and write?
4. Do you have some off-farm job? If yes is it official?
5. What you want to achieve for your children's future?
6. What you want to achieve for yourself and your family?
7. Is your family a member of some association or cooperative? Which one?
8. Do you have any livestock on your farm? If yes, what kind and how many?

TYPE

QUANTITY

- A. chicken
 - B. pigs
 - C. cows
 - D. horse
 - E. sheep
9. How big is your property and how you utilize it?

PROPERTY TYPE

AREA

- A. annual crops
 - B. perennial crops
 - C. forest/reforestation
10. Do you have any map or plan of your property?
11. What surrounds your property? Do you have close neighbors, forest or river around you?

12. What kind of soil do you have on your property?
13. What buildings do you have on your property?
- A. pond B. apiary C. aviary
- D. house E. fence F. pig sly
- G. paddock H. stable I. chicken house
- J. drainage system K. irrigation system L. Storage building
- Others?
14. What do you do with trash you produce?
- A. collected directly by cleaning service B. place in large trash containers
- C. burn D. burry in the ground
- E. spread in a vacant lot or street F. throw into river, lake
- G. have another destination
15. What was your total production during last year?
16. What inputs you use for your production?
17. Do you receive any technical assistance?
18. If yes, who provides you the assistance?
19. Have your past harvest been affected by droughts?
20. What kind of methods you use in order to decrease the crop loss?
21. Do you somehow profit from animal production sale?
22. Do you participate in some off-farm activity in order to increase your income?
23. What kind of commercial channels do you use to sell your products?
24. Do you have any other form of income?
25. Do you hire some external labor during the year?
26. How many hours per month do you or your hired labor spends on farm work?
27. What financing do you use?

28. Can you evaluate your living standards?

	Very good	Good	Average	Bad
Food				
Access to public services				
Consumption, demand availability				
Education				
Infrastructure				
Community integration				
Environment				
Livelihood				
Business opportunity				
Living standards quality				

29. What are the biggest problems that you would like to improve?

30. What economy sectors should be developed in the community?

31. Do you confess some religion?

32. Do you participate on some collective activities in the community?

33. What do you think is the most important in family farming development?

Annex 2 *Questionnaire: Income distribution*

1. How much money you spend monthly/yearly on:
 - Food (what is your dietary composition)
 - Water (well construction costs)
 - Electricity
 - Gas
 - School (equipment)
 - Health care (do you have a chance to see a doctor, insurance)
 - House equipment
 - Farm accessories
 - Transportation
 - Seeds (R\$/Saca, how many sacas needed)
 - Animals
 - Fertilizers (lime, pesticides, nitrate...R\$/saca)
 - External labor
 - Other
2. Are there certain months during the year when you feel lack of money more? If yes do you know why?
3. If you had some extra money in what you would invest?
4. Have you ever applied for PRONAF? If yes what kind and how much you received?
5. What did you use the money for?
6. Are you able to pay it back? How much do you owe?
7. Do you receive any governmental support? (Bolsa Familia, pension... how much)

Annex 3 *Questionnaire: Human resources and capacities*

Family member	Age	Sex	School Years	Farm Experience	Jan 1.	Feb 2.	Mar 3.	Apr 4.	May 5.	Jun 6.	...
BARBOSA, MARTINS											
Sebastiao											
Nair											
Claudiomero											
Marcele											
Maria Vitora											
SANTOS											
...											

Annex 4 *Questionnaire: Copercampos cooperative*

1. Selling price of chemical fertilizers/quantity: how much is needed per ha and how often?
 - a. Pesticides
 - b. Lime
 - c. Fertilizers
 - d. Nitrate
2. Selling price of bioactive fertilizers/quantity: how much is needed per ha and how often?
3. Selling price of seeds/quantity?
 - a. How much seeds are needed per Ha?
 - b. Corn
 - c. Soybeans
 - d. Beans
 - e. wheat
4. How much you pay to farmers for saca 60 kg of:
 - a. Corn
 - b. Beans
 - c. Soybeans
 - d. Wheat
5. How much you sell it for (corn/beans/soybeans/wheat)?
 - a. On exchange market for market price?
 - b. Where else do you sell and what is the price?
6. How many percent of corn, beans and soybeans production you sell on:
 - a. Global exchange market?
 - b. Domestic market as animal fodder?
 - c. Domestic market for food processing?
 - d. Do you process products yourself or only sell?

Annex 5 Redeemable record of organic production sale (Source: authors' archive, 2012)

Produção Familiar Agroecológica

REDE DE AGROECOLOGIA
ECOVIDA

PRODUTO ORGÂNICO
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Annex 6 Organic garden (Source: authors' archive, 2012)



Annex 7 *Livestock on pastures (Source: authors' archive, 2012)*



Annex 8 *Corn field (Source: authors' archive, 2012)*



Annex 9 *Community landscape (Source: authors' archive, 2012)*



Annex 10 *Maria Rita and Joao Marinho Barbosa (Source: authors' archive, 2012)*

