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Food plant diversity and associated challenges for farmers on two agrarian reform settlements in Mato Grosso, Brazil

Diploma thesis Diplomarbeit

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“...É nos – das nossas mãos que sai a saúde das pessoas. [...] Para a gente ser colono, a gente tem que ser um pouco agrônomo, um pouco economista, um pouco veterinário. [...] Você tem que ser muitas coisas ao mesmo tempo.”

“...It is us – from our hands emanates the health of people. [...] For being a farmer we have to be a bit of an agronomist, a bit of an economist, a bit of a veterinarian. [...] You have to be many things at the same time.”

Respondent, 05.02.2008

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Abbreviations

FAO	Food and Agriculture Organization of the United Nations
IBAMA	Brazilian Institute for Environment and Renewable Natural Resources (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis)
IBGE	Brazilian Institute for Geography and Statistics (Instituto Brasileiro de Geografia e Estatística)
INCRA	National Institute for Colonization and Agrarian Reform (Instituto Nacional de Colonização e Reforma Agrária)
INPE	National Institute for Space Research (Instituto Nacional de Pesquisas Espaciais)
MDG	Millennium Development Goals
MNC	Multinational Corporation
MST	Landless Rural Workers' Movement (Movimento dos trabalhadores rurais sem terra)
PRONAF	National Program for the Fortification of the Family Agriculture (Programa Nacional de Fortalecimento da Agricultura Familiar)
STRLRV	Rural Workers' Union of Lucas do Rio Verde (Sindicato dos Trabalhadores Rurais de Lucas do Rio Verde)
UN	United Nations
WHO	World Health Organization

1. Introduction

1.1. Personal Approach

My personal approach to the research site in Mato Grosso, originates from a six months stay as a volunteer in Jacobina, a town in the federal state Bahia in Northeastern Brazil (October 2000 – April 2001). I was working in one of the projects that were initiated by the Austrian priest Josef Hehenberger. Besides my regular work in a hospital's kitchen I accompanied padre José on his weekly visits to an MST tent camp named "São Francisco". I got in contact with Rural Land Workers without Land¹ for the first time then. They were occupying a plot of land that belonged to a landlord at the side of a road, waiting for the day when they would officially own this piece of land. They would at least wait 4 years, whilst living in huts built of wood, palm leaves, and tarpaulins, until they would be entitled to move to their plots. During that time, the occupants had to survive a lot of 'challenges', like the threats of the landlord's gun men which included the periodic demolition and torching of their fields and crops. At that time, I was more a silent observer than an active participant.

This first stay and contact with Rural Land Workers without Land in Bahia influenced my personal development. I wanted to get actively involved by working on a settlement, because I was confident that land reform could be an effective strategy to fight poverty and food insecurity.

Six years after that experience, I finally did get the opportunity to conduct fieldwork for this diploma thesis with the farmers at the Ribeirão Grande settlements in Mato Grosso.

1.2. Problem definition

Food plant diversity is a vital part of agrobiodiversity and as such fundamental for food security, livelihood security and food sovereignty of all people (Mulvany, 2001; Pimbert, 1999; Scherr, 2003) as well as for human well-being (Díaz et al., 2006). Although there are 7,000 crop species important in agriculture and human nutrition around the world, less than 150 of them are relevant for the global market (Thrupp, 2000; Wood et al., 2000) and only 1.5 per cent of those 7,000 account for approxiamted 90 per cent of the human calory consumption (Wood et al., 2000).

Agrobiodiversity is the basis for highly nutritious and diverse food (Thrupp, 2000). Globalization of agriculture, disparity in land distribution (chapter 2.3.1.), green revolution technology, and the introduction of High Yielding Varieties² are some of the severe threats leading to the erosion of diversity of agroecosystems (Pimbert, 1999; Shiva, 2004; Thrupp, 2000). Some global players in the agricultural inputs and products business, like Monsanto, Syngenta, Dow and Bayer, aim to control the world's food system by patenting seeds (Shiva, 2004). Pirating and patenting seeds or plants implicates that those

¹ *Os trabalhadores rurais sem terra*. In newspapers and articles concerning agrarian reform and land redistribution one can read the term "The Landless" (*os sem terra*). During my fieldwork one of my respondents said that it would not be very polite to call them "The Landless" because firstly they are often called that even though they already have land, and secondly this expression would often be used in a derogatory way. Therefore I prefer the term "Rural Land Workers without Land".

² High Yielding Varieties (HYVs) or "Modern varieties" are usually characterised by a high level of genetic uniformity. They are produced in formal plant breeding stations. E.g. Long J., E. Cromwell, K. Gold (2000): On-farm management of crop diversity: an introductory bibliography. Overseas Development Institute and ITDG.

Multinational Corporations (MNCs) disregard and impinge upon intellectual property rights of peasants (Pimbert, 1999) who have always taken seeds they retained from the last harvest to sow the following year. Today they are forced to buy seeds every year for MNCs control local markets and the sterility of “terminator” seeds they are selling (Shiva, 2004). Heterogeneous agricultural landscapes formed through diverse farming systems are being transformed into uniform monocultural areas (Thrupp, 2000).

Global agricultural change is threatening small farmers and agrobiodiversity (Boyce, 2004), and consequently food plant diversity. It is mainly small farmers around the world who are the driving force in supplying food to the people (Rosset, 2006; Rosset, 1999). They hold a key function in conserving agrobiodiversity.

In order to defy such threats and to sustain agrobiodiversity and food plant diversity, sustainable use of resources (Cromwell et al., 2001), implementation of agroecological principles (Thrupp 2000; Rosset 2008), empowerment of farmers and indigenous people, strengthening and relying on local knowledge and local conditions, enhancing *in situ* conservation of genetic resources, and policies which support biodiversity issues are crucial (Shiva, 2004; Thrupp, 2000).

In Brazil, agriculture has been increasingly dominated by export-oriented agribusiness with emphasis on monocultures like soybean, cotton, and maize, especially during the last two decades (Fearnside, 2001; de Miranda et al., 2007; Steward, 2007). The heavily subsidised soybean production is on the cost of food production for local consumption because small farmers sell land they have already cleared to soybean producers and push on to other areas for logging (Fearnside, 2001) or migrate to cities (Bickel, 2005). Soybeans are mostly exported and not used for human consumption except for cooking oil (Fearnside, 2001). Rice, beans, manioc and maize are the main staple foods in Brazil (IBGE and Ministério de Planejamento, Orçamento e Gestão, 2006; Salles and Bergamasco, 1995). In Brazil, small farmers are responsible for 87 per cent of the national manioc production, for 70 per cent of beans production, for 46 per cent of maize production, and for 34 per cent of rice production (IBGE and Ministério de Planejamento, Orçamento e Gestão, 2006).

Scientific literature on food plant diversity concentrates mainly on the quantity of species that can be found in one place and the influences for a certain frequency of species being for example market orientation of farmers, remoteness of research areas, and distances to markets (e.g. Coomes and Ban, 2004; Major et al 2005; Perrault-Archambault and Coomes, 2008; Wezel and Ohl, 2005).

This study wants give an insight into food plant diversity and food plant management of farmers on two agrarian reform settlements in Mato Grosso, Brazil. On the one hand, it focuses on sustaining factors for food plant diversity like for example values and motivation, and the power of industrial agriculture being a constraining factor for food plant diversity on the other hand.

1.3. Research questions

Research

In this study, the focus lies on food plant diversity as part of agricultural biodiversity, and the underlying reasons for the cultivation of a variety of food plant species. Thus, the research questions of interest are:

- Why do farmers prefer to plant many different species of food plants instead of just planting one or two cash crops?
- Which factors might influence diversity of food plants on the settlements?

Food plant diversity in the context of this thesis focuses on edible plants species including condiment species being consumed for alimentation. There is no focus on medicinal

plants, although different plants that are named here might also be used for medicinal purposes.

1.4. Research objectives

Within this thesis, the following purposes will be accomplished:

Objective 1: All food plant species including condiment species that are cultivated by the farmers will be documented and classified. The management concerning food plants will be presented. The usage of food plants will be presented.

Objective 1 is concentrating on the number of cultivated food plant species found on the research site, their management, linked agricultural practices, and usage.

Objective 2: Underlying values and motivation for the cultivation of various food plant species will be highlighted.

Objective 3: The challenges farmers face due to the adjacent soy farms will be pointed out.

The objectives 2 and 3 will approximate the farmers' motivations for planting many different food plant species and how they are handling connected challenges concerning cultivation of food plants.

2. State of research

2.1. Agrobiodiversity and food plant diversity

Agrobiodiversity forms an elementary part of biodiversity. Qualset et al. (1995: 1) state that “...*agrobiodiversity* - includes not only crops, livestock and their wild relatives, but the species that interact with and support them: pollinators, symbionts, competitors, pests, parasites, predators and biological control agents”. It comprises all components that are vital to food and agriculture, and it is bound to human interference: Farmers manage - they interfere with - their soils, animals and crops. This agrobiodiversity management is based on culture and indigenous knowledge.

Genetic resources form the basis for our food systems. There is a strong interdependence between countries concerning alien crop species that were introduced from one country or continent to another. Many economically important crops rely on this alteration: For example *Hevea brasiliensis*, native to Brazil, was brought from South America to South East Asia via England (Cromwell et al., 2001; Long et al., 2000).

Agrobiodiversity is necessary for low external input production systems in order to deal with droughts and pests and to sustain soil fertility. Furthermore it plays an important role for rural development concerning the potential of ecotourism and the economic value of traditional animal breeds and crops (Pimbert, 1999).

In the last decades, a grave decline in traditional food plant varieties, also called folk varieties, local varieties, or landraces³ can be observed. They were replaced by modern varieties. In Sri Lanka, less than 100 rice varieties out of 2000 in the 1950's are left over. In Indonesia more than 70 per cent of the rice plants today originate from a common stock. 75 per cent of the potatoes planted in the United States of America consist of 4 varieties (Thrupp, 2000).

The risk of pests and diseases is augmenting due to this homogenization of crop species and due to the decline of diverse farming systems. Soil biota is heavily suffering in monocultural systems resulting from a high usage of synthetic fertilizers and pesticides (Thrupp, 2000). Landraces often have a higher resistance towards diseases, are able to deal with poor soils, and their seeds can be stored to sow the following year (Long et al. 2000).

Diversity in nutrition and health are interlinked. Health is not only absence of disease: human well - being comprises biological, psychological, social and ecological substructures (Johns, 2001).

2.2. Food security versus food sovereignty

The problems of hunger, malnutrition and poverty in the world have been of persistent concern during the last decades. At the first World Food Conference in Rome in 1974, delegates already proclaimed that until 1984 no child would have to suffer from hunger anymore (Windfuhr and Jonsén, 2005). The Rome Declaration on World Food Security of the World Food Summit in 1996 aimed to reduce by half the people who suffer from

³ Landraces are the counterpart of modern varieties. They are characterized by a high degree of genetic diversity. Unlike modern varieties that are bred with scientific support, farmers breed and select them carefully in their surrounding area. E.g. Long J., E. Cromwell, K. Gold (2000): On-farm management of crop diversity: an introductory bibliography. Overseas Development Institute and ITDG.

hunger throughout the world by 2015 (FAO, 1996). This aim is now part of the first Millennium Development Goal (MDG) “to eradicate extreme poverty and hunger” (UN, 2009). The FAO Report “The State of Food Insecurity in the World 2008” nevertheless makes clear, that the number of hungry people did increase between 2003 and 2007 from estimated 848 million to 923 million people of which 907 live in developing countries. This results mainly from the fact that food prices did advance during the last years (FAO, 2008). Especially in 2007 and 2008, a boost of staple crop prices led to an increasing number of people who were no longer able to afford them (Rosset, 2008). There are many papers on the distinct elaborations of the term ‘food security’ concerning household, regional, national and global level since it came up for the first time in the 1970’s (Lee R., 2007; Maxwell S. and T.R. Frankenberger, 1992). Generally, food security means freedom from hunger. People who are food secure are not in danger to suffer from hunger (Mowbray, 2007). Following the WHO (2008) in a more recent definition

“Food security means that:

- *all people at all times have both physical and economic access to enough food for an active, healthy life;*
- *the ways in which food is produced and distributed are respectful of the natural processes of the earth and thus sustainable;*
- *both the consumption and production of food are governed by social values that are just and equitable as well as moral and ethical;*
- *the ability to acquire food is ensured;*
- *the food itself is nutritionally adequate and personally and culturally acceptable; and*
- *the food is obtained in a manner that upholds human dignity.” (WHO, 2008)*

According to the FAO (2003), in 2003, 44 million Brazilians of 170 millions had less than 1 US-Dollar per day available. Those 44 millions are considered to be food insecure for they do not have the financial means to purchase the amount of food that would meet their nutritional requirements (Meade and Rosen, 2003).

‘Food sovereignty’ is a term that emerged in the mid 1990’s (Windfuhr and Jonsén, 2005; Lee, 2007) and is often implicated in the peasant movement Via Campesina being the originator (Lee, 2007). Windfuhr and Jonsén (2005: 15) state “*While food security is more of technical concept, and the right to food a legal one, food sovereignty is essentially a political concept*”. Food sovereignty is a policy framework that emanates from the question *why* people are starving and living in poverty. In this sense, food sovereignty is based on four pillars: the right to food, access to land and other resources, adequate trade policies, and sustainable production principles. Access to resources like land, water, seeds, and livestock is fundamental for reducing poverty and improving livelihood security (Windfuhr and Jonsén, 2005). A commonly used definition of food sovereignty comes from the People’s Food Sovereignty Network (2002: 1).

“Food sovereignty is the right of peoples to define their own food and agriculture; to protect and regulate domestic agricultural production and trade in order to achieve sustainable development objectives; to determine the extent to which they want to be self reliant; to restrict the dumping of products in their markets, and; to provide local fisheries-based communities the priority in managing the use of and the rights to aquatic resources. Food sovereignty does not negate trade, but rather, it promotes the formulation of trade policies and practices that serve the rights of peoples to safe, healthy and ecologically sustainable production.” (People’s Food Sovereignty Statement 2002).

Food security and food sovereignty are often described and perceived as two opposing approaches (Lee, 2007). I agree with Lee (2007: 12, 13) who in his article “Food Security

and Food Sovereignty” says: “... yet there is nothing fixed or stable about either of these concepts. I argue that in fact they 'co-produce' each other through a shared discourse”.

2.3. The agrarian reform in Brazil: Settlement history, land distribution and family agriculture

2.3.1. Settlement history and land distribution

The settlement periods in Brazil started in the early 1500's and went on until the middle of 20th century, and throughout the Brazilian history they always coincided with specific product export booms when labour was needed on coffee, cotton and rubber plantations. Most of the immigrants during that time came from Portugal, Italy, Spain, Germany and Japan (Groppo, 1996).

According to the last census of agriculture in 2006, Brazil is one of the countries with the most unequal land distributions in the world with a Gini index of 0.872 (IBGE and Ministério de Planejamento, Orçamento e Gestão, 2006). The Gini-coefficient is a means for measuring equality based on the theoretical approach of total equality at 0 and total inequality at 1 (Watt, 2000).

In Brazil, the existing disparity in land distribution emanates from the historical fact of disparity between different social classes (Groppo, 1996) which became worse by establishing the *Lei de Terras*, the Land Law, in 1850. That law disabled the settlers who could not afford to buy land - peasants, freed slaves and European immigrants - to access and gain land through occupancy and forced them to work on large estates (Pereira, 2003; Sauer, 2006). Landlords opposed the free poor because they were afraid of lacking manpower due to their intention of running their own farms. They would have no longer been available as workers for the large estates. Furthermore, the settlers' activities could have motivated landworkers on the big estates to do the same which would have led to a shortage of labour for the landlords (Groppo, 1996).

2.3.2. Agrarian reform

The military regime that assumed power in 1964, repressed the rural workers movements that were mobilized a decade before, and invested exceedingly in green revolution based modern agriculture. During the 20-year lasting period of the military regime, large estate owners were supported, land concentration augmented, and small farmers migrated into cities (Groppo, 1996; Sauer, 2006). In 1985, when democracy returned, rural social movements such as the MST and the National Confederation of Rural Labourers (CONTAG) exerted pressure on president José Sarney (1985-1989) (Pereira, 2003). Addressing the agrarian reform became his priority then: in 1988, it was defined for the first time in the Brazilian Constitution that landed property was bound to a social function (Sauer, 2006). He established the National Agrarian Reform Plan (PNRA) that included settling 1.4 million families in a period of governance. This target failed and in reality only around 83.000 families were settled by 1989 (Pereira, 2003).

According to the INCRA (2006), from 2003 to 2006 during the first period of governance of the current Brazilian president Luiz Inácio Lula da Silva, 252,019 families were given plots of farmland. Between 1979 and 2006, a total number of 913,046 families were settled (INCRA, 2006).

Market-led agrarian reform (MLAR), as opposed to state-led agrarian reform, is a model that was introduced by the World Bank in the 1990's and then adopted and implemented by the Brazilian government under Fernando Henrique Cardoso (1995-2002). This model is clearly not in favour for a substantially redistributive and social just agrarian reform (Borras, 2003; Sauer, 2006). MLAR regards land as an economic good: land is acquired and sold between private parties (Sauer, 2006). Only landlords who are willing to sell their land are affected (Borras, 2003). By contrast, the state-led approach is based on the

expropriation of land, its social function, the social movements and the concern that land has a high political, economical, cultural, and environmental relevance (Sauer, 2006). Sauer (2006: 21) states: “...*struggle for redistributive agrarian reform requires the elimination of the market-model.*” True agrarian reform aims at social reproduction of peasantry by means of redistribution of land and disempowering large property owners. It requires a strong presence of the state that should allocate public goods and services for settled farmers (Sauer, 2006). Especially in Mato Grosso, the increasing area of land that is used for production of soybeans goes hand in hand with land re-concentration. Small farmers are pushed to sell their land and move to cities (Bickel, 2005).

Access to land is a crucial means for livelihood security, especially for people who live and work in rural areas of poor countries (Akram-Lohdi, 2007). In order to respond to food crisis like the last one in 2007/08, governments should expedite agrarian reform programs and redistribution of land in order to bring forward national food production and the ones who grow food for people – peasants and small farmers (Rosset, 2008).

2.3.3. Family agriculture

Agricultura familiar is a term that is widely used when talking about small farmers and settlements in Brazil. Commonly, the respondents on both settlements used this expression. In English literature⁴ one can find the term ‘family agriculture’ that I will also use here. In Brazil, the term was brought up in the beginning of the 1990’s. Before that, public and scientific institutions referred to it as ‘low yield agriculture’, ‘small production’ and ‘subsistence agriculture’ when meaning small-scale agriculture. Abramovay (1997) states as a fact that many of those small farmers would not have means of secure livelihoods due to lacking access to loans, technology and markets. Nevertheless, these circumstances should not be confounded with what family agriculture is at its core. Since 2006, the Brazilian law *Lei nº 11.326* defines *agricultura familiar* (IBGE and Ministério de Planejamento, Orçamento e Gestão, 2006). This law and the definition of Gasson and Errington (1993) on family agriculture are quite similar. There are six characteristics that feature family agriculture:

- the family members live on the productive unit;
- resources and capital belong to the family;
- the people responsible for business are relatives;
- the farm owners manage the farm;
- members of the family carry out farm work;
- property and assets are transferred within family generations.

Of course, not all of these characteristics do apply to all cases of family run farms. Nevertheless they illustrate an ideal type of family agriculture (Gasson and Errington, 1993).

2.4. Current issues in Brazil’s agriculture

Brazil is one of the world’s biggest producers of soybeans, second only to the US. Along with Argentina, Brazil and the US supplied 90 per cent of the world’s soy market in 2003. The European Union and China are the principal costumers of soy (Dros, 2004). Brazil’s advantage in competition concerning agro-industrial products results from the availability of land that makes it easy to expand production at very low costs. This expansion mainly for growing soybeans has led to deforestation, expulsion of animal husbandry to areas of

⁴ E.g. Fearnside P.M. (2001): Soybean cultivation as a threat to the environment in Brazil. *Environmental Conservation* 28, 1, 23-38.

primary vegetation like the Cerrado (central Brazilian scrub savanna) or primary forest, and consequently to a loss of biodiversity, water pollution, erosion of soil, and soil infertility (Fearnside, 2001; Miranda et al., 2007; Steward, 2007).

Pesticide use and synthetic fertilizer input can cause severe environmental damage and health risks for rural workers (Fearnside, 2001) or anyone who is exposed to it. Steward (2007) reports on a family in Santarém in Pará whose personal health and that of their animals are threatened when pesticides are applied on a field close to their house. Land use for soybeans also affects the environment due to the construction of industrial waterways, railways, and highways for transporting harvest and agricultural commodities (Fearnside, 2001). The Cerrado has been severely suffering the last decades, dwindling to one fifth of its former dimension (Myers et al., 2000; chapter 3.1.4.). This loss results from recommendations in the 1970's and 1980's to spare rainforest clearing and to use the Cerrado instead for the production of soybeans (Fearnside, 2001). As export-oriented soybean production relies on intensive investment, it results in extreme income concentration and elitism (Fearnside, 2001; Kaimowitz et al., 1999). During her field research in 2003, Steward (2007) talked to soybean producers who saw themselves in contributing considerably to the rise of the Brazilian economy. They did not really perceive small farmers as being important for economic development.

2.5. Introduction to Environmental Psychology

2.5.1. Values, motivation and attitudes

A functional coherence between inner and outer operations of a person forms the basis of individual actions. Generally, self-esteem is the most fundamental and continuous motivation. The aim of all introversive and extroversive operations and activities of an individual is to ensure and increase self-esteem, and to defend oneself from incidents and experiences that would alleviate it. A person tends to operate in such a way that cognitive, emotional, and behavioural activities will not harm his or her self-esteem (Lantermann, 1999)

Values represent parts of a social concept of reality. In communication within a group, a society, or a culture, values are used as motivation, justification, or basis of valuation for specific events or actions. By personalising social constructions of values, a person builds his or her own value position. Thus, an individual can compare his or her decisions and their underlying values for actions with decisions and actions of others. Values are linked to affective processes and only become motivating or relevant for actions if they threaten or enhance self-esteem. In this regard, they are only relevant for actions if they are present in a given situation (Lantermann and Döring-Seipel, 1990).

Awareness of environmental problems can be perceived as attitude. According to empirical social psychological research, there is a positive but only marginal correlation between verbally expressed attitudes and actual behaviour (Spada, 1990). In other words, people do not always do what they think or say.

2.5.2. Environmental awareness and environmental behaviour

Psychology was one of the first disciplines dealing with environmentalism and environmental awareness. The first studies in the 1970's were examining the coherence between environmental awareness and actual behaviour. Since the 1990's, scientific emphasis is rather put on the theoretical framework and treats of environmental awareness, and on certain determinants of behavioural models (Matthies, 2005). Kollmuss and Agyeman (2002: 258) point out the difference between the English term environmental awareness and its German translation 'Umweltbewusstsein'. The term environmental awareness stresses that people are cognitively aware of environmental problems. The term 'Umweltbewusstsein' has an emotional and ethical connotation hence

a more appropriate English translation for it would be 'environmental caring'. Kollmuss and Agyeman (2002: 253) define environmental awareness as '*knowing of the impact of human behaviour on the environment*'. According to Kollmuss and Agyeman (2002), the following factors might affect environmental awareness and environmental behaviour:

Demographic factors:

As for gender, women tend to have less environmental knowledge but are more emotionally affected by environmental issues than men. Education and knowledge about environmental matters do correspond, but more education does not lead necessarily to enhanced pro-environmental behaviour.

External factors:

Institutional factors such as public transportation enable pro-environmental behaviour. If infrastructure for environmental sound behaviour is badly developed people rather tend to not use them.

Economic factors are usually closely linked with social, infrastructural and psychological factors. They have an effect on people's behaviour, only there is little understanding on how they influence people's decisions: economic incentives such as deposit systems can stimulate pro-environmental behaviour or prevent it when it comes to low fuel prices.

Social and cultural factors of a country like for example the need for stability and security in combination with appreciation of the landscape play an important role in people's decisions.

Internal factors:

Motivation is based upon intensity and direction in order to be able to choose one behaviour out of different possibilities. Larger motives are the reason for a whole set of behaviours whereas selective motives are linked to one specific action.

Environmental knowledge has an influence on pro-environmental behaviour yet its direct influence is rather small or in other words: A high level of environmental knowledge and pro-environmental behaviour are not necessarily correlated.

Values are forming our intrinsic motivation. It is believed that they are shaped to a large extent by their direct social environment like family, neighbours and friends and to a smaller extent by media and political organizations.

Attitudes are lasting, specific feelings about a certain matter, person or thing. Attitudes towards environmental issues hardly influence pro-environmental behaviour (Kollmuss and Agyeman; 2002).

Kollmuss and Agyeman (2002) developed a model to approach the gap between environmental awareness and pro-environmental behaviour. For this model they especially refer to the work of Fliegenschnee and Schelakovsky (1998) whose work was influenced by the model Fietkau and Kessel (1981). The larger arrow in the middle illustrates that the higher the synergy between internal and external factors is the bigger is the positive impact on pro-environmental behaviour. The black boxes denote possible obstacles for positive factors that lead to pro-environmental behaviour.

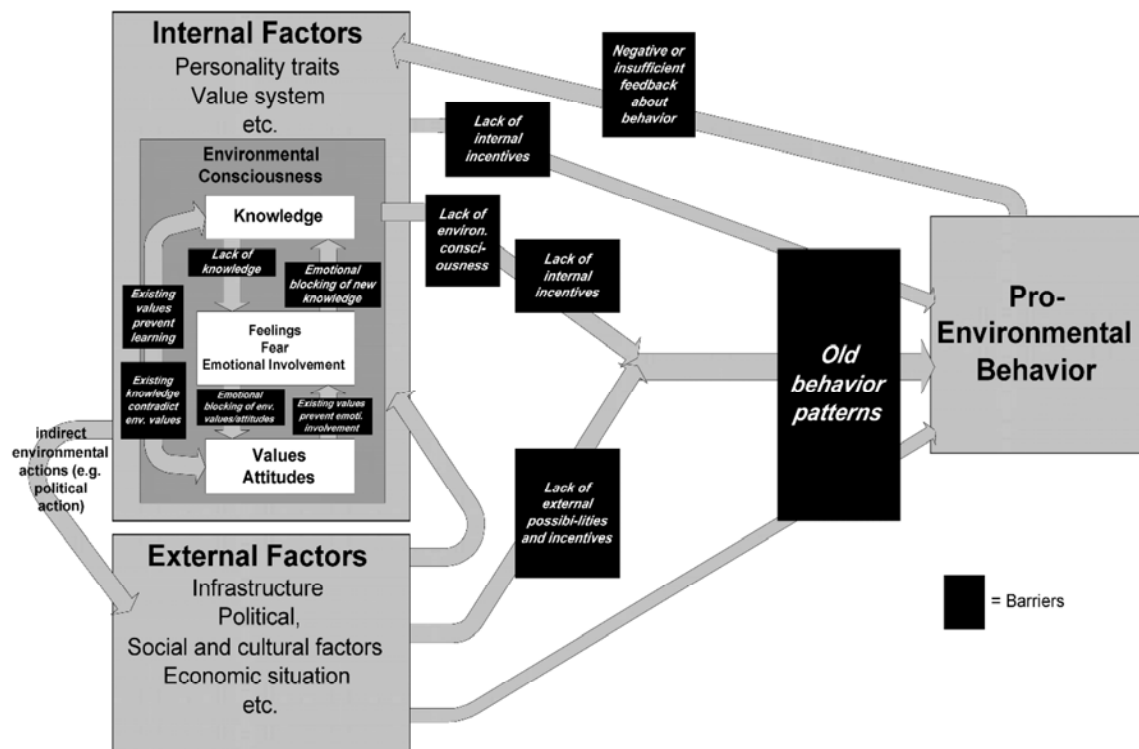


Figure 1: Model of pro-environmental behaviour (Kollmuss and Agyeman, 2002)

2.6. Power and political ecology

Many philosophers, sociologists, political scientists and scholars from other disciplines have defined, described and worked on this concept. I am not going to discuss the theories of power from e.g. Max Weber, Hannah Arendt, Michel Foucault, Gaetano Mosca, Vilfredo Pareto, and Pierre Bourdieu here. This would go beyond the scope of this thesis. For the concept of power plays an important role concerning industrial agriculture and small farmers, I will adumbrate the main features of the term power.

It is important to distinguish between power and domination. Power can be understood as the person- and situation-oriented ability to enforce any purpose against resistance of others. Domination is more institutionalised and bound to the guidance of a collective. Power is essentially comparative, in other words, it is measurable according to the superiority over competitors. Domination on the contrary has nothing to do with superiority over others because it exists only if the power of certain competitors is meaningless already (Pauen, 1998).

Power in German means *Macht*. The term *Macht* comes from the Old High German word *maht* and from the Gothic word *magan*. Both are synonyms for the physical and mental abilities of an individual (Pauen, 1998),

French and Raven (1959) distinguish 6 bases of power.

Reward power refers to the ability of a wielder of power to reward someone if he or she behaves in such a way as the wielder power has desired.

Coercive power can be perceived as amplified reward power. It involves punishment for an “inferior” person who does not obey the “superior” person or tries to resist his or her certain influence.

Referent power refers to someone who is holding the function of a role model, and the ones who identify themselves with personal attributes of this role model in order to get satisfaction or to prevent unease. In the context of referent power, the “superior” individual

does not implicitly have to do something, but rather the referring individual voluntarily accommodates him- or herself to the role model.

By contrast, **legitimate power** is linked to authority and stems from internalized values. It is based on cultural values and social structures, and it is depersonalised which means that it is bound to a profession or an institution. A “superior” individual has the legitimate right to issue orders or instructions and the “inferior” individual is obliged to comply with them.

Informational power or informational influence is a type of legitimate power. Someone who controls access to and availability of information has got informational power.

Expert power means valuable knowledge of a wielder of power who has got extraordinary skills, know-how or experience in a given realm. Expert power is bound to expertise. An individual that is reliant on an expert, assesses his or her knowledge referring to the expertise just as to an absolute extent and is cognitively influenced. Expert power is similar to referent power, the former being more delimited.

Bryant and Bailey (1997) state that power is a key concept for understanding environmental conflicts. Some economic activities such as logging and cash cropping have visible effects on the environment. For example, cleared forests, plantations and monocropping fields are visual “*imprints*” of powerful stakeholders. By observing the environment, one can get an idea of power proportions between different actors (Bryant and Bailey, 1997).

“In dealing with social power [...] we are concerned [...] with the control that one actor, or party, or operating unit exercises [...] over some set of energy forms and flows that constitute part of the meaningful environment of another actor. What is important here [...] is that energy forms and flows have to be relevant to some system of value and meaning, that is to say, be culturally recognized.” (Adams 1975: 12, 13).

Energy forms and energy flows of the environment do not only refer to topography, climate or natural resources; also people, speech, and human behaviour should be perceived as such. In this context, the term ‘control’ means to decide on the use of a certain technology and to implement it. In this definition of control, technology refers to a set of knowledge, abilities and equipment that is required to modify the structure of energy forms (Adams, 1975).

2.7. Studies on food plant diversity

There are different approaches for surveying underlying determinants for plant diversity in scientific literature. I will present four examples here in order to exemplify which parameters have been determined and analysed so far.

Wezel and Ohl (2005: 1) for example ask “*Does remoteness from urban centres influence plant diversity in homegardens and swidden fields?*”. They surveyed plant diversity in swidden fields and homegardens of two indigenous communities in the Amazonian rain forest of Peru. Compared to other studies on plant diversity in Peru, they find a rather low number of species; 71 in 19 homegardens and 25 in 46 fields. They mainly ascribe this fact to the remoteness of this area impeding exchange of plant material with other farmers.

In another study on crop species diversity in the northeastern Peruvian Amazon (Perrault-Archambault and Coomes, 2008) 300 homegardens in 15 communities were surveyed with a total species number of 309 and an average of 26 species per homegarden. Villages with poor species diversity tend to be remote in contrast to villages with higher plant diversity. Villages with the highest species diversity are situated close to stations of oil companies that employ people from different regions. People with diverse sociocultural backgrounds in these villages are socially more involved due to market access and

interaction with other inhabitants. Species diversity and garden size correlate as well as age and gender: generally, species diversity was higher in larger gardens, in gardens tended by women or older caretakers.

Major et al. (2005) focused on food plant and condiment species, and the question whether diversity is influenced by market orientation. They visited 16 households in 8 communities in the Manaus region in Brazil. A total number of 79 species was found in homegardens and other agricultural plots. Dominance of marketable species was higher in homegardens of market-oriented farms but still they retained high species diversity.

Coomes and Ban (2004) surveyed *“Cultivated plant species diversity in home gardens of an Amazonian peasant village in Northeastern Peru”* in 24 households finding a total of 82 species in the homegardens. They concentrated on microeconomic, demographic, social and historical factors for assessing the correlation of those factors and garden crop diversity. According to their findings, crop species diversity was highest in homegardens amongst other agricultural plots. Instead of focusing on selected typical home gardens, that tend to have higher species diversity, they suggested a more extensive sampling in order to get a better understanding of factors that determine species diversity.

3. Methodology

3.1. Research area

Mato Grosso is 903,386 square kilometers large but has comparatively few inhabitants: according to the last census in 2000 Mato Grosso has 2,502,260 inhabitants. With an average of 2.77 inhabitants per square kilometer it is a very sparsely populated state (IBGE, 2005).

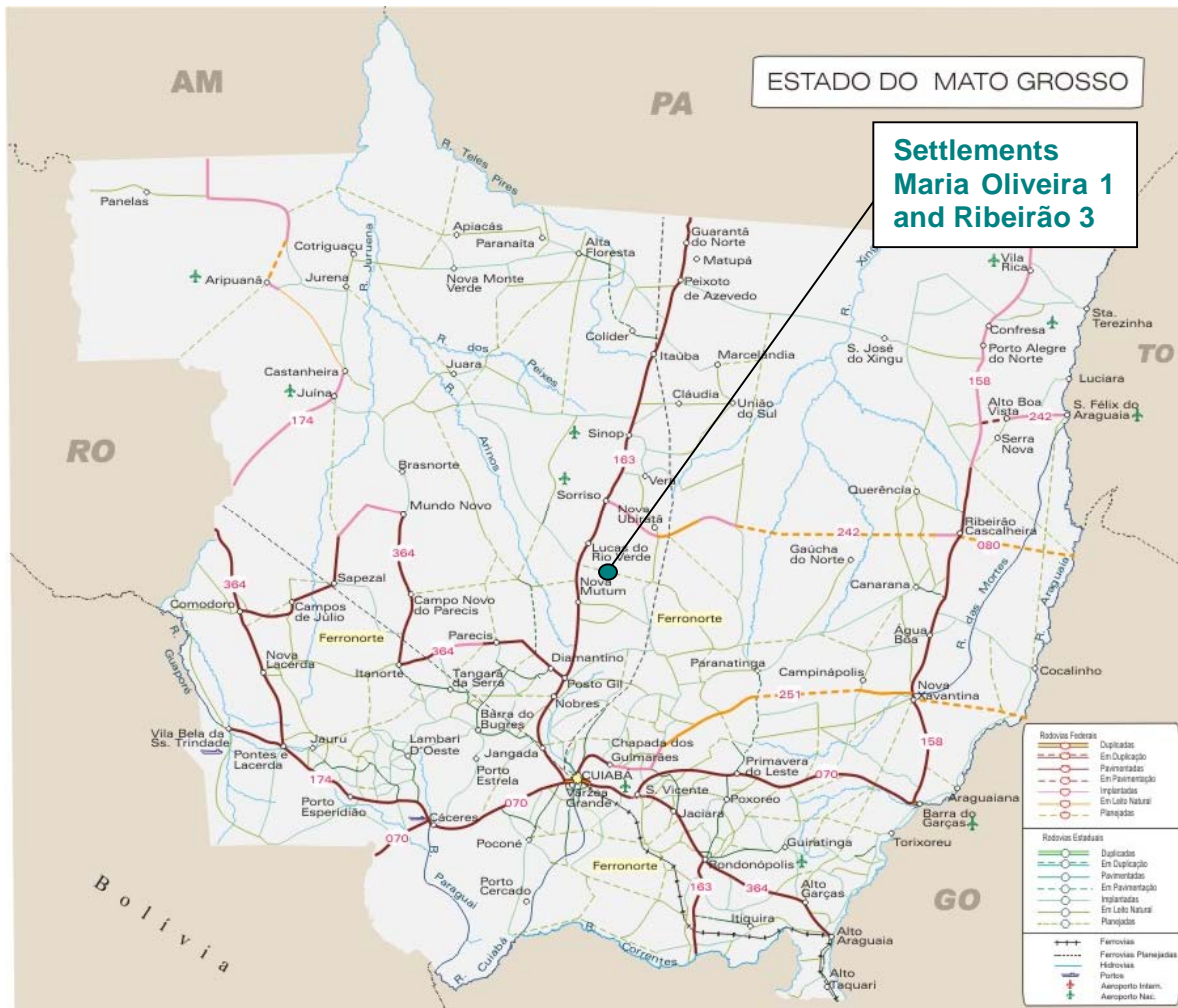


Figure 2: Location of the two settlements where fieldwork took place (modified after Ministério dos Transportes – Governo Federal, Brazil, 2009)

3.1.1. Agricultural production in Mato Grosso

Mato Grosso is the national leader in the production of soybeans. Together with cotton and corn soybeans comprise the most important crops at the federal state level. In 2004, the national production of soy was 49,549,941 tons of which 29.3 per cent were produced in Mato Grosso (IBGE, 2004).

The region is not only famous for its soybean production but also for devastating slash and burn activities: Until August 2000, Mato Grosso was responsible for an extent of gross deforestation of 143,930 square kilometers ranking second after the federal state Pará with 200,118 square kilometers (INPE, 2002).

3.1.2. Vegetation, climate and soil

Ribeirão Grande is situated in the so-called *zona da transição* or transition zone that is the ecotone where the Cerrado vegetation borders the tropical rain forest vegetation. Nevertheless, the climate of this region is determined as savanna climate with a dry season from April until September coinciding with winter. First frequent rain falls start in October with a peak in January (250mm) and end in March. More than 80 per cent of the annual precipitation of 1955 mm occurs during summer. The average annual temperature lies between 20 and 25 degrees (Fearnside, 2003). The Rio Verde flows along the settlements and is an important water supplier during dry season. The region is characterised by little fertile, clayey, red yellow latosols (IBGE, 2003).

3.1.3. Population

Mato Grosso can be seen as a hotspot for migrants who are attracted by the vastness of unsettled area. Migrants come from all over the country: from the South, mostly Rio Grande do Sul, Santa Catarina, São Paulo, and Paraná where the founding of the rural landworkers' organisation MST initially took place. From the bordering states in the North and the Central-West region most people immigrate from Pará, Rondônia, Goiás, and Mato Grosso do Sul due to their proximity. From the Northeast, migrants move in primarily from Maranhão and Bahia, where people want to escape drought. Migrants from southern Brazil often have spent years as land workers in Paraguay, Uruguay or Argentina before they go back to Brazil and then move on to the Central-West region (Ferraz, 2007; Golgher, 2006).

3.1.4. Biodiversity in the research area

Mato Grosso has a share in three biomes: the Cerrado in the South, the transition zone in the center and the tropical rainforest in the North of the state. The Cerrado is one of the world's 25 biodiversity hotspots. Myers (1990) states that biodiversity hotspots are "*areas that (a) feature exceptional concentrations of species with high levels of endemism and (b) face exceptional threats of destruction.*" Of the original extent of the Cerrado only 356,630 square kilometres remain today. 4,400 out of 10,000 plant species that can be found there are endemic (Myers et al. 2000) and make the Cerrado the world's richest savanna concerning its flora and level of native species (Klink and Machado, 2005). Manioc (*Manihot sp.*) for example is a major food crop for millions of people in tropical and subtropical regions and the Cerrado is a hotspot for manioc diversity (Olsen and Schaal, 1999).

Mato Grosso belongs to the states with the highest deforestation rates in Brazil (Fearnside, 2003). In order to slow down deforestation rate and to preserve primary vegetation, federal law requires preserving 80 per cent of the original vegetation on every property in forests, 50 per cent in the transition zone and 35 per cent in the Cerrado (Fearnside, 2003; IBAMA; 2001; Steward, 2007;). Nevertheless, soy producers find ways to undermine those laws, and authorities in many cases overlook those who do not abide by the laws (Steward, 2007).

3.2. Research partners and research site

Field research took place on two settlements out of three settlements on the former estate Ribeirão Grande located about 350 kilometers north of the Capital Cuiabá. Ribeirão Grande was the name of an unproductive estate that was expropriated by the INCRA in 2001. The estate was not a connected area of land but three separated pieces of land. Each of the three pieces of land was transformed into a settlement. The three settlements were situated along an almost straight, unpaved road, 10 kilometers respectively 20 kilometres apart from each other. The former estate belonged to the municipality Nova Mutum. The settlements could be accessed by car only from the Santarém – Cuiabá Highway BR 163 on an unpaved road within a 1.5 hours drive.

Two of the settlements were chosen as research site due to the support of Professor Carolina Joana da Silva from the *Universidade do Estado de Mato Grosso* in Cáceres. She introduced me to one of her PhD students, Luciana Ferraz, who was working in the *beija-flor* project on the settlements. Luciana Ferraz asked the farmers before my arrival whether they would agree on me visiting the site and conducting interviews, and they accepted. Luciana also suggested interviewing those farmers who actively participated in the *beija-flor* project as they were very cooperative. The STRLRV also welcomed my research activities and provided useful information concerning the origin of the settlements.

The STRLRV has been supporting farmers on the settlements since the start of the land occupation in 2000. The rural workers' union provides technical assistance and acquires projects and funds for the farmers, such as the *beija-flor* project in order to foster a sustainable use of resources. This project enforces the production and use of non-timber-forest-products such as honey or the *copaíba* tree oil. As a part of this project two green houses were built on each settlement in order to grow tree seedlings for reforestation (personal communication STRLRV, 2007).

In 2000, an encampment was built on a small spot of land that has become part of the settlement Maria Oliveira 1. According to my respondents and to the STRLRV, there have been several hundred people occupying the land in order to get land. Many of them gave up during the first months of occupation.

In 2002, 24 families could finally move to their plots or *lotes* on the settlement Maria Oliveira 1. In 2006 another 56 families moved to Ribeirão 3. The two settlements were different in structure. The plots of Ribeirão 3 had partly already been prepared for agricultural activities before the farmers moved to their plots, while Maria Oliveira 1 had to be cleared before that, because it had been fallow for many years. Both settlements were embedded in the soybean landscape that dominated a huge part of Mato Grosso (Figure 3a and 3b).



Figure 3: Soy field in October 2007 (a) and in January 2008 (b) (Source: Hanz K. 2007 and 2008)

3.3. Respondents

From mid January 2008 to mid February 2008 I visited 18 households from a total of 80 on two agrarian reform settlements: 8 households out of 24 on the settlement Maria Oliveira 1 and 10 households out of 56 on the settlement Ribeirão 3. All of those 18 households participated in the *beija-flor* project.

In order to keep the respondents' identity anonymous, I designated them according to the settlement they live in: MO – farmers at Maria Oliveira 1 and Rib – farmers at Ribeirão 3. The individual codes are consecutive numbers.

Only one person was living in five of the households, two persons were living in two households, three persons in four households, four persons in four households, five persons in two households, and seven persons in one household.

In all except for one household I interviewed one person of the family. There was no selection made on sex or age of respondents. I interviewed one person of the household who was available and who was willing to be interviewed at the time. In one household I interviewed two persons because both wanted to be interviewed (Rib8 was the husband of Rib2). Those two interviews were conducted separately. In total, I interviewed 19 persons.

The age of the 19 respondents, 12 women and seven men, ranged from 18 to 76 years. The average age was 44.5 years. Seven respondents were born in Rio Grande do Sul, eight in Paraná, two in Santa Catarina and two in Mato Grosso. All of the respondents had at least four years of formal education. None of them has had any higher education. One respondent could not read nor write.

In 12 households the husbands or fathers of the families worked aperiodically on soy farms. In another two households this duty was taken over by the sons due to the fathers' state of health. Rib2 and the Rib12 worked regularly during schooldays as advisors for the children in the school bus. All of the respondents had an agricultural background, and all of them except for two women considered themselves as farmers.

3.4. Farms

At Maria Oliveira 1 each family living there owned 70 hectares of land, at Ribeirão 3 each family owned 50 hectares. The actual arable plots were only half the size because the farmers were obliged not to clear more than 50 per cent of their land. The other half was kept as community forest. All farmers on the settlement Maria Oliveira 1 have been cultivating their land for 5 years, whereas the farmers on the settlement Ribeirão 3 have been cultivating their land for 2 years.

Among the respondents, the size of cleared land on the agricultural plots was ranging from eight hectares to 25 hectares with an average of 13.4 hectares per farm. Seven out of ten respondents on the settlement Ribeirão 3 leased between one and 11 hectares to soy farmers for reasons of generating income or lack of labour. On the settlement Maria Oliveira 1 none of the respondents leased land to soy farmers.

Five respondents owned a tractor together with five other farmers on the settlement Ribeirão 3. They used it only for preparing the soil. Only one respondent on the settlement Maria Oliveira 1 had a tractor but hardly used it.

18 respondents produced primarily for their self-subsistence. Only one has already been selling melons in Lucas do Rio Verde. The other 18 respondents only sold their products if there was something left over and if they had a transport to Lucas do Rio Verde or Nova Mutum for selling their products there.

All respondents kept chicken, most of them kept cows and bees, some had pigs and sheep. Apiculture was a part of the *beija-flor* project. All respondents kept spineless bees.

Owning less than 100 hectares in this region of Brazil was considered small-scale production. In contrast to that, in the South of Brazil the size of a small-scale farm ranged between 5 and 10 hectares. The respondents considered themselves as small-scale farmers.

3.5. Data collection

On my very first visit on the settlements in October 2007 I spent five days there, most of that time I was on the settlement Maria Oliveira 1. My intention was to get to know my partners in the field and vice versa, and to start to *establish rapport* (Bernard, 2006: 344). All of the farmers I was going to interview started talking to me very easily. They showed me around their land and we had informal conversations. At the end of each day I wrote down everything I had remembered in my field research diary.

During my second stay which lasted four weeks from mid January 2008 to mid February 2008, I established a close relationship to the respondents. Due to the everyday conversations we had and due to the privilege of living with them, I got an idea of their situations, their lives, beliefs, and points of view. Besides the “rough” fieldwork, I enjoyed a lot of cheerful and emotional moments, during the interviews.

3.5.1. Key informants

Key informants can provide necessary and profound information in order to facilitate field research. They know their culture very well (Bernard, 2006: 196). My first ‘key informant’ Luziana Ferraz helped me to get in contact with the farmers on the settlements. She was not a key informant per definition because she was not a farmer on one of the settlements nor was she living there. I call her key informant because she was an ethnobotanist with a sure feeling for people and she has had several years of experience working as a researcher in rural areas with farmers on settlements, indigenous Brazilians and fishermen. She provided me with a lot of useful information about the settlements and the institutions being involved.

My second key informant was one of the respondents. She participated as a delegate of the settlements in meetings of the STRLRV and had undertaken several journeys to some of the other Brazilian states on behalf of the *beija-flor* project. She knew a lot about what was going on “behind the scenes” and was a very committed farmer.

3.5.2. Informal interviews

An informal interview does not follow a fixed set of question, nor a structured schedule. The researcher’s objective is to recall conversations of a fieldwork day (Bernard 2006: 211). The first week of my four weeks stay on the settlements I spent hanging out and talking to the farmers (my future respondents), and participating in meetings in which they were discussing their *beija-flor* project and the founding of an association. Bernard (2006: 211) also states that informal interviews might “...*uncover new topics of interest that might have been overlooked.*” For this research that was the case concerning the soy farmers that were surrounding the two settlements. I had not realized before my second stay on the settlements how important that topic was to the respondents.

3.5.3. Semi-structured interviews

An interview guideline is the basis for conducting semi-structured interviews. (Bernhard 2006: 212). I elaborated the interview guideline (chapter 13.1. and 13.2.) and then discussed it with Luciana Ferraz. She pointed out potential unclarity concerning the questions. I then adapted certain expressions and phrasings following her advice.

3.5.4. Pretesting of interview questions

I conducted pretests for the interview questions and the interview situation in the beginning of January 2008. It was not possible for me at that time to find a similar group of respondents like a group of other family farmers, so I visited five households in the neighbourhood of Luciana Ferraz. She recommended those households for pretesting because the women of those households would know many food plants and would also know a lot about the management of plants. All of them were living in single-family houses with gardens on the outskirts of Cuiabá. I already tried there not to read the questions from the questionnaire but rather to use my memory to create a more informal interview situation. I also recorded the interviews to get familiar with handling the mp3 player.

3.5.5. Participant observation

Listening and observing are very important skills when conducting participatory research: It is of great importance to listen actively to people, and it requires at least the same concentration as speaking (Heslop 2002: 49). Bernard (2006: 337) divides observation into three different roles: *complete participant*, *participant observer* and *complete observer*.

During my 4 weeks stay on the two settlements I lived most of the time with three different families of respondents, two other families of respondents invited me to stay over for a night. I was treated as a family member: I helped in the gardens or on the fields if my help was needed, we watched TV together, we went to church on Sundays, and I helped preparing meals and shared meals with the families. I experienced that for Brazilians lunch is the most important meal of the day and usually it is very rich: It always consisted of the basics rice, beans and meat (mostly chicken or beef, sometimes pork) and a large variety of legumes. Before each meal, juice made of fruits like passionfruit, guava or pineapple was freshly prepared because fresh juice, too, is very important for Brazilians.

At least two thirds of the food plant species I found on the settlements I also consumed as food or beverage during my field stay. I gained around 3 kilos during that month because my respondents made sure to provide me with enough food.

3.5.6. Farm walk

Transect walks let one to explore what is of local importance and to learn more about the surrounding area (Pretty 1995, Heslop 2002).

I asked all respondents to show me around their lands. During farm walks I observed and collected food plants and asked questions concerning plant management. Usually I did one farm walk together with each respondent after I had conducted the interview. Sometimes I made another walk by myself in order to collect plants I had not collected before, to take pictures, and take down notes.

Food plants were observed in homegardens (*quintal*, *pomar*, *horta*) and on agricultural plots (*roça*). On the two settlements *quintal*, *horta* and *pomar* were defined as homegardens or as a part of it but they have different attributes. A *quintal* usually was identified as the surrounding area of a dwelling. It had no fence or any other boundary. Mainly fruit trees were grown there but also other species like beans for example. The expressions *quintal* and *pomar* were used synonymously by three of the respondents. *Pomar* in English means fruit orchard. The *horta* was a piece of land with fence around it. Condiment species, strawberries and vegetables like salad and tomatoes were grown there. *Roça* denominated a field where crops like maize, manioc, pumpkin and watermelon were grown.

3.5.7. Herbarium

In order to document the food plants that the respondents planted, I collected plants on plots of 16 respondents. One respondent did not want me to show around the farm neither did she want me to walk around by myself. Another respondent's family was not living on their own plot but in the former school of the settlement as interim solution before they would get their own land. They were planting only a few vegetables because they did not want to invest money and energy before owning their plot.

I collected each of the mentioned plants only once. I did not collect condiment species and vegetable species, due to the fact that the farmers usually bought those seeds. They had kept the packages and showed them to me, so I could note the names of the species.

I hung up *Capsicum sp.* varieties on a cord in order to air-dry the fruits (Figure 4a).

I dried the plants (leaves and stems, and if available also flowers) I had collected in a rather old-fashioned way by pressing them with papers between wooden grills (Figure 4b). I carefully changed papers everyday for it was rainy season and the air was very humid. This method worked out very well. None of the collected plant parts became mouldy or rotten. I could take everything with me perfectly dried to classify the plants in the herbarium of the *Universidade federal de Mato Grosso* in Cuiabá.



Figure 4: Air-drying of *Capsicum sp.* (a) and wooden grills (b) (Source: Hanz K. 2008)

3.6. Storage of data

Keeping a field research diary was crucial for several reasons like documenting my work during field research and afterwards, writing down new ideas and for taking down notes during informal conversations, observation and interviews with respondents. Bernard (2006: 395) recommends keeping a written backup because technical equipment can fail. I recorded all interviews, except for one, with an mp3 player. The recordings were transferred to a laptop and a USB memory stick on the end of the same day. One respondent did not feel comfortable with being recorded, so I wrote down the answers into my field research diary. I had the impression that all the other respondents did not mind at all that they were recorded, and even forgot about it while we were talking.

3.7. Data analysis

After transcribing the audiofiles and field notes, I coded them by hand. I chose this method over using software. I had an excellent overview over data material and I also got to know it very well, even though, I have to admit that this method would not work so well anymore if there were thousands of pages of transcripts. I developed the codes through *in vivo* coding based on the grounded theory approach (Bernard 2006: 493).

Due to the size of the sample, exclusively qualitative data analysis was implemented.

3.8. Material and equipment

The most important equipment during my field research was an mp3 player, a laptop, a digital camera, a field research diary, pencils and a USB memory stick. I recorded the interviews with an mp3 player (Cowon iAudio). The voice recordings had a remarkable quality, an external microphone was not necessary at all. The mp3 player has a storage capacity of 20 Gigabytes and therefore also served as an external hard disc. The voice recordings were directly saved as mp3 files. For taking pictures I used a digital camera (Lumix DMC-TZ 2). The USB memory stick and the mp3 player served as data back up. For data processing and transcribing I used the programmes of Microsoft Office and iMote.

Necessary equipment for the herbarium consisted of two wooden grills, secateurs to cut small branches, papers and cords. Besides these external tools, my memory, my capability of listening and watching carefully, my language and social skills also facilitated this study.

3.9. Ethical considerations

Luciana Ferraz informed the respondents previous to my arrival about my intention to conduct fieldwork and asked them if they would agree on my presence for several weeks on the settlements which they approved of. On site, I told each respondent that the interviews and conversations were confidential and that they would have the option of quitting the process at any time if they would not feel comfortable for any reason. I asked each respondent if I could record the interview and if I would be allowed to take pictures. I respected any negation. I fed back results and pictures of the fieldwork to the respondents.

4. Results

4.1. Food plant diversity and food plant management

The following chapters address the number of food plant species found on the farms and the farm management concerning food plants. Farm management includes purchasing of seeds and seedlings, reproduction, plant knowledge, labour, machinery and tools, water supply, soil management, pests and diseases, and coping strategies.

4.1.1. Food plants

A total number of 107 food plant and condiment species belonging to 41 families was observed and documented on farms of 16 respondents (chapter 13.4.). The families Cucurbitaceae and Myrtaceae comprised the highest number of plant species, followed by Arecaceae and Solanaceae. The five most frequent food plants were pumpkin (*Cucurbita* sp., frequency (f) = 15), manioc (*Manihot esculenta*, f = 15), banana (*Musa X paradisiaca* L., f = 13), cashew (*Anarcadium occidentale* L., f = 13), and sugarcane (*Saccharum officinarum* L., f = 13). The highest number of food plant species found on a farm was 64, the lowest 14. The average species diversity per farm was 36. Of all observed species manioc (*Manihot esculenta*), watermelon (*Citrullus lanatus*) and maize (*Zea mays* L.) were exclusively grown on the fields and never in homegardens.

Table 1: Number of plant species (107) for the 41 families

Plant family	Species number	Plant family	Species number
Cucurbitaceae	9	Bixaceae	1
Myrtaceae	9	Caricaceae	1
Arecaceae	7	Caryocaraceae	1
Solanaceae	7	Clusiaceae	1
Annonaceae	6	Convolvulaceae	1
Cruciferae	6	Dioscoreaceae	1
Anarcadiaceae	5	Ebenaceae	1
Rutaceae	5	Euphorbiaceae	1
Fabaceae	4	Lauraceae	1
Araceae	3	Mimosaceae	1
Caesalpiniaceae	3	Moringaceae	1
Lamiaceae	3	Musaceae	1
Liliaceae	3	Oxalidaceae	1
Malvaceae	3	Pedaliaceae	1
Passifloraceae	3	Punicaceae	1
Apiaceae	2	Quenopodiaceae	1
Asteraceae	2	Rhamnaceae	1
Malpighiaceae	2	Rubiaceae	1
Moraceae	2	Sterculiaceae	1
Poaceae	2	Vitaceae	1
		Zingiberaceae	1

Some respondents also added *milheto* (*P. claucum*) and *napiê* or *napier* (*Pennisetum purpureum* Schum.) to food plants. I did not include them in the list because they were not used for human alimentation but for feeding cattle only.

Varieties within species were not surveyed, though one respondent (Rib6) mentioned five different banana varieties growing in her homegarden and another respondent (MO19)

mentioned eight different sugarcane varieties growing in her homegarden and on her fields.

Species dominance was not taken into account.

4.1.2. Sources for plants and reproduction

The respondents used different ways for getting plants. They used the following six sources for getting seeds and seedlings:

- One greenhouse on the settlement Maria Oliveira 1 and one greenhouse on the settlement Ribeirão 3;
- The forest on the settlement Maria Oliveira 1;
- Exchange with neighbours;
- Visitors (family, friends, relatives) from town who bring seeds and/or plants to the settlements;
- Journeys to other federal States in Brazil;
- Markets and stores in Lucas do Rio Verde and Nova Mutum;

4.1.2.1. The greenhouse

One greenhouse was built on the farm of respondent MO19 on the settlement Maria Oliveira 1 and another one on the farm of the respondents Rib2 and Rib8. Primarily they were built for growing tree seedlings, but also vegetable species were grown there. The farmers of the *beija-flor* project (chapter 4.2.), where all of the respondents were part of, could go to the greenhouses and get seedlings for planting. “O Viveiro ajudou muito. Muita semente, muitas mudas que você não tinha você consegue.” (“The greenhouse helped a lot. Many seeds, many seedlings that you didn’t have, you got there.” Rib6, 24.01.2008).

4.1.2.2. Forest

Farmer MO1 mentioned that she went to the forest in order to climb up a palm tree to get the seeds for reproduction in the greenhouse: “Essa palmeira aí é pupunha, é muda que eu trouxe de lá. Eu queria semente, eu queria plantar mais, fomos lá [na mata], eu e a I., sofremos muito alto. A gente conseguiu de chegar nos cachos e conseguimos uns quinhentos sementes de pupunha de uma amarela e mais 400 de um outro tipo de pupunha mas desse não nasceu nada. E daí colocamos no viveiro e colocamos na sementeira e quando começaram a nascer colocamos aqui. Eu já tenho umas aqui.” (“This palm tree here is a peach palm, it’s a seedling that I brought with me from there. I wanted to get the seeds, I wanted to plant more, so we went there [into the forest], I. and I, and had to suffer a lot for climbing up the palmtree... We reached the *cacho* and collected about 500 seeds of yellow peach tree and about 400 of another type but this type didn’t grow at all. We put it in the seed bed and when they started to grow we put them here. I already have some here. I will get more.” MO1, 18.01.2008).

4.1.2.3. Exchange with neighbours

The respondents exchanged seeds and seedlings either during their day-to-day activities with their neighbours or when they had a reunions of the *beija-flor* project (Figure 5a and 5b). Exchange of seeds and seedlings happened more frequently after the farmers moved to their plots and started working there than in the following years. Seedlings that could be reproduced by cutting, like manioc for example, were hardly exchanged anymore: “No início a gente trocava muito, agora hoje a gente já tem aqui, a gente não preciso mais. Quando começamos aqui, quem saiu para fora sempre trazia duas ou três mudas de mandioca e a gente partia para começar. Hoje a gente já tem bastante ramo.” (“In the beginning we exchanged a lot, now we have it all here, we don’t need to [exchange] anymore. When we began here, anyone who went to town or elsewhere brought two or three manioc cuttings and we could start with it. Today we have enough branches.” MO1, 18.01.2008).

Farmer MO15 specified which seeds and seedlings he had mainly exchanged or still exchanged with other farmers: “*Sementes e mudas de abacaxi, mandioca, batata, abóbora, milho, mudas de frutíferas á base de troca.*” (“I exchange seeds and seedlings of pineapple, manioc, sweet potatoe, pumpkin, maize and seedlings of fruit trees.” MO15, 04.02.2008).



Figure 5: Respondents changing seeds (a, b) (Source: Hanz K. 2008)

4.1.2.4. Visitors and visits

Friends and relatives of eight respondents (MO1, Rib2, Rib6, Rib7, Rib12, MO14, MO15, MO19) who lived in town brought seeds and seedlings with them when visiting the settlements. Also respondents who visited their relatives and friends in town often brought back seeds or seedlings with them to the settlements. The greenhouse was then used for small seedlings to grow in a protected surrounding or for letting seeds germinate there: “*A E. sempre traz sementes para a gente plantar no viveiro. E sempre quando vou para a minha sogra eu trago.*” (“E. always brings seeds for us to plant in the greenhouse. Whenever I visit my mother-in-law, I bring plants with me back home.” Rib2, 21.01.2008).

4.1.2.5. Journeys

Six respondents (Rib2, Rib6, Rib12, MO14, MO15, MO19) travelled to other federal states in Brazil and brought seeds back with them. The journeys were either private or took place in the context of the *beija-flor* project. Federal states that were mentioned during the interviews concerning such journeys were Amazônia, Bahia, Goiás, Pará, Rio Grande do Sul and Rondônia. Farmer MO15 brought back seeds when visiting relatives in different parts of the country: “*Cupuaçu vem de Amazônia, o jambu de Rondônia, pitanga da região do Sul.*” (“Cupuaçu is from Amazônia, jambu from Rondônia, pitanga from the Southern region.” MO15, 04.02.2008).

When travelling on behalf of the *beija-flor* project, farmer MO19 always brought some seeds back home: “*De Rondônia eu trouxe jambu, semente de pupunha, cupuaçu. Tenho mangarito, tipo batatinha, que eu trouxe do Recife. Goiaba-pêra e assaí também vieram de lá. De Santarém trouxe pimenta, babaçu veio do Pará. A gueroba veio de Goiânia, a ovaia veio de C. perto de Sinop.*” (“From Rondônia I brought jambu, peach palm seed, cupuaçu. I have mangarito, which is kind of a potatoe, that I brought from Recife. Goiaba-pêra and assaí are also from there. From Santarém I brought pepper, babaçu is from Pará. Gueroba is from Goiânia, ovaia is from C. close to Sinop.” MO19, 06.02.2008).

4.1.2.6. Stores in Lucas do Rio Verde and Nova Mutum

Vegetable seeds were the only seeds that were not brought back home when travelling, gained by others, exchanged and/or reproduced by the respondents. All respondents bought vegetable seeds in stores in Lucas do Rio Verde and Nova Mutum. “*Semente das legumes [...] e as hortaliças é comprada.*” (“We buy vegetable seeds [...] and all vegetable plants.” MO15, 04.02.2008).

Farmer MO1 mentioned, that the reason for buying vegetable seeds would be the difficulty of collecting the seeds: *“Os sementes de verdura eu compro, é difícil a gente colher o semente dela.”* (I buy vegetable seeds, it's difficult to collect them.” MO1, 18.01.2008).

4.1.3. Plant knowledge

Farmer MO1 mentioned that it would have been much easier for her to go to the bush or into the woods and collect plants if she would be native of Mato Grosso. She identified two other respondents as farmers who know a lot about plants and also addressed the difficulty of knowledge dissemination: *“É ela [MO19] que sai, traz plantas, então passa para mim. E a L. [MO18], ela entende bastante também, ela é muito inteligente mas não se mistura muito com a gente. Seria uma pessoa ideal para passar coisas para a gente. Agora fica difícil o conhecimento. O quando vem alguém do herbário de Cuiabá, pessoal de lá o do instituto daqui que passa conhecimento de árvore, de remédios para a gente.”* (“It is her [MO19] who is travelling other placee and brings plants here and gives me some. And L. [MO18], she knows a lot, she's very intelligent but she doesn't look so much for our company. She would be the ideal person to teach us something. That's why it's difficult with the knowledge. When someone comes from the herbarium in Cuiabá, employees from there, they teach us something about trees and medicine.” MO1, 18.01.2008).

4.1.4. In situ reproduction of maize

Five respondents (MO1, Rib5, Rib8, Rib12, MO14) mentioned that they would plant a traditional kind of maize. Farmer Rib5 and Farmer Rib8 stated that only hybrid varieties of maize were sold in the warehouses in Lucas do Rio Verde and Nova Mutum. Farmer Rib5 also mentioned that the soy farmers around the two settlements would only plant hybrid varieties. Respondents used the expressions *milho dos índios*, *milho comum*, *milho caiano* and *milho crioulo* when referring to traditional maize that could be reproduced.

Exchange was important for the respondents in order to get traditional maize for planting: *“O milho daqui é ‘milho dos índios’. Ele produz cada ano dos sementes que você guardou no ano anterior. Aqui só vende híbridos. Tenho ele do Seu D., do assentamento MO I. Fui lá e peguei a semente. Ele só tinha quatro espigas. Aqui quase todo mundo tem esse milho. Ele também é chamado ‘semente crioula’. São as sementes antigas.”* (“The maize here is “maize from the Indians”. Each year it produces from the seeds that you stored last year. Here they only sell hybrids. I have got it from Seu D., from the MO I settlement. I went there to get the seeds. He only had four maize cobs. Here almost everybody has this maize. He is also called ‘semente crioula’. They are the old seeds.” Rib8, 26.01.2008).

4.1.5. Labour, machinery and tools

Most of the farm work in the fields and gardens was done by hand with a hoe, a wooden stick and a simple sowing machine, the so-called *matraca* (Figure 6a). A machete was used for cutting plants (Figure 6b). Farm work concerning plant management meant preparation of seed beds, sowing, planting, weeding, harvesting and watering.

On the settlement Ribeirão 3, five respondents owned a tractor (Figure 6c) that they bought together. The tractor was used for preparation of the seedbeds. On the settlement Maria Oliveira 1, one farmer owned a tractor that he hardly used. He used an ox and a plough instead: *“A gente usa a enxada e o pau. As vezes o trator. As vezes ele não tem olho e não compensa por o olho para o tamanho da área. A gente usa o boi e o arado.”* (“We use the hoe and the stick. Sometimes the tractor. Sometimes it doesn't have oil and it doesn't pay off to put in oil due to the size of the area. We use the ox and the plough.” MO15, 04.02.2008).

The families did the farm work together on all of the visited farms. Farmer MO1 and farmer MO13 were siblings and lived alone on their adjacent plots. They helped each other and sometimes, their sister who lived in Lucas do Rio Verde, was coming to help them: *“Uso a matraca para plantar. Pode usar para plantar feijão, milho, arroz, amendoim. A N. me ajuda, a gente troca dias assim, a I., a L., minha irmã que mora em Lucas também ajuda bastante. Ela também compra mudas e traz para cá. Um ajuda o outro.”* (“I use the *matraca* for

planting. You can use it for beans, maize, rice, groundnuts. N. helps me, we change days like this, I., L., my sister who lives in Lucas also helps me a lot. She also buys seedlings and brings them here. We help one another.” MO13, 01.02.2008).



Figure 6: Respondent with the *matraca* (a), respondent cutting manioc for planting (b), tractor of 5 respondents on the settlement Ribeirão 3 (c) (Source: Hanz K. 2008)

4.1.6. Water supply

The river Rio Verde that flowed along both settlements ensured water supply for irrigation of gardens and fields. Each dwelling had a water tank. There was one water pump for each settlement that pumped the water from the river into the farmers' tanks.

All respondents watered their plants during dry season either with a watering can or a hose. Also drop irrigation was used. Respondent MO1 described her drop irrigation system: “*Na seca eu molho as plantas. Pelo menos aqui na roda. Se as vezes eu ganho uma plantinha quase na época da seca eu já planto, tudo ficou, pode ver, por causa da água. Daí eu molho. No muitos pés de fruta na roda, eu faço um furinho com uma agulha num litro descartável e encho de água e ele vai gotejando. Uma água gotejando leva uns três dias na raíz. Tem outros que vão mais rápido com a água que vem da nascente, é o único jeito de segurar as plantas por causa assim.*” (“During dry season I am watering the plants. At least around the house. Sometimes when I get a plant in the dry season and I plant it, everything flourishes, as you can see, because of the water. That’s why I water [the plants]. There are a lot of trees around the house where I put a plastic waterbottle, I stung a hole with a needle, filled in water and it will go dripping. A bottle of water is lasting for three days. Others [other plants] grow faster with the water from the spring, it’s the only way to save the plants - doing it like this.” MO1, 18.01.2008).

4.1.7. Soil management

When asking the farmers about soil quality, all of the respondents on the settlement Maria Oliveira 1 answered that the soil would be weak, poor and acid, without a humus layer. Nevertheless, farmer MO1 already observed changes concerning soil quality due to her efforts: “*A terra daqui é muito ácida, ela não tem gordura, aquela quamada em sema, ela não tem. Agora ela está criando, porquê a gente deixou criar o mato para derubar para fazer quamada. Eu já anotei quando passei a enchada assim, já tem uma barrinha escura. Daqui mais uns dois anos, ela já está bem boa, mais tem que cuidar, nao pode queimar. Esse chão é duro.*” (The soil here is very acid, there is no humus layer. Now it’s about to evolve because we left plant material on the ground to build such a layer. I already recognized it when I worked there with the hoe, there is already some dark soil. In one or two years, it will be good, but you have to care for it, you must not burn it. This soil is hard.” MO1, 18.01.2008).

By contrast, all respondents on the settlement Ribeirão 3 said that the soil would be good, adding, though, that it would be necessary to prepare it well and to use enough lime and manure or chemical fertilizer: “*A terra aqui é muito boa. Uso calcário, adubo químico, também uso bastante adubo orgânico. Uso meio adubo químico, meio esterco. Jogo ele diretamente na*

terra." ("The soil is very good here. I use lime, chemical fertilizer, I use also much organic fertilizer. I use half chemical fertilizer, half dung. I put it directly on the ground." Rib3, 22.01.2008).

One respondent noticed that the soil quality in the South of Brazil, where she came from, would be much better than it was in Mato Grosso: *"É a costume aqui em Mato Grosso, tudo que planta com adubo. Lá no Sul tem lugar onde ninguém sabe o que é adubo. As vezes a gente põe esterco. É fazendeiro que planta muito e usa adubo, aqui planta pouco, o esterco é do gado."* ("Here in Mato Grosso it is normal to plant everything with fertilizer. In the South, there are places where no one knows what fertilizer is. Sometimes we use manure. It's the soy farmers who plant much and use fertilizer, here we plant little, the dung is from the cattle." Rib4, 22.01.2008).

All respondents except for one respondent on the settlement Ribeirão 3, used animal manure such as cow, sheep and chicken manure to prepare the soil for planting. Farmer Rib3 used chemical fertilizer only. Farmer MO13 used more chemical fertilizer than manure. All of the other respondents used more manure than chemical fertilizer. Three farmers stated that chemical fertilizer would be very expensive.

Farmer Rib5 said that she would use only manure in the garden, whereas it would be necessary to use chemical fertilizer for maize and beans. Farmer Rib 12 stated that he would use only manure. For maize he would buy chemical fertilizer.

Farmer MO19 was convinced that cow manure was very powerful. Besides, she knew receipes for making compost: *"A gente não produz com adubo químico. Muito raramente. A gente não usa. O esterco de vaca é muito mais poderoso, o adubo de esterco de vaca eu acho que em primeiro lugar. [...] A gente pega ele e amontoa ele, se quiser ele bem molinho você cobre ele. Na época da seca a gente mistura um pouco de água, na época da chuva pode pegar assim... O esterco fresco dá para ser usado em biofertilizante. A gente não está usando mas tem muito receita. Muitas pessoas forneceram para nos. Sempre ensinam [a preparar] o biofertilizante. A compostagem que a gente aprendeu a fazer. Eu quero fazer isso aí, só que na hora que tiver plantas para vender, para comercializar."* ("We don't use chemical fertilizer for producing. Very rarely. We don't use it. Cow manure is much more powerful, cow manure is on first place I think. [...] We take it and bank it up, if you want it to become more soft you have to cover it. During dry season we mix it with a little bit of water, during rainy season you can use it like that. Fresh manure you can use as biofertilizer. We don't use it yet but we have a lot of receipes. Many people gave them to us. They always teach us [to make] biofertilizer. We learned how to make compost. I want to do that here but not until we have plants for selling, for selling." MO19, 06.02.2008).

4.1.8. Pests, diseases and coping strategies

The respondents mentioned three pests and one disease regularly during the interviews: ants, bugs, caterpillars and soybean rust. They used the Portuguese term *veneno* for all kinds of pesticides. *Veneno* means 'poison'.

Farmer MO1 and farmer MO19 said that they would never apply any pesticides. Farmer MO1 mentioned that the farmers on both settlements and their lands would already be poisoned due to the adjacent soy farms. She claimed that it would be necessary to avoid the use of pesticides: *"Veneno não uso, acho que já temos envenenado desse povo que enroda. Essas fazendas só trabalham com veneno. Temos que procurar de pular longe do veneno. Meu pai nunca usou veneno."* ("I don't use poison, I think we're already poisoned by those people who surround us. The big farms only work with poison. We have to try to leap far away from the poison. My father never used poison." MO1, 18.01.2008).

Farmer MO19 said that the neem tree would function as organic insecticide: *"Eu não uso [veneno]. [...] tem o neem que é muito bom, é orgânico, pode usar também. Os venenos assim eu não uso não."* ("I don't use [poison]. [...] there is the neem tree which is very good, it's organic, you can also use it. I don't use poison." MO19, 06.02.2008).

Farmer Rib2 stated she would never use poison in the garden. She used organic insecticides that contained for example tobacco or ash. She admitted that her husband would sometimes apply insecticides to maize against the caterpillars: *"Tem o caldo de fumo. Você põe o fumo na água, depois põe no regador e rega as plantas. E põe o cinza também que é*

bom para matar os pulgões e para matar os bichinhos da terra, os cupins. Eu na horta só uso essas formas. Nunca passo um veneno comprado. O V. [marido] passa no milho para as lagartas, mas eu na minha horta não, pode morrer, esses pepinos estão morrendo, caldo de fumo não adiantou, caldo de cinza não adiantou... Deixo morrer, depois planto outro...." ("There is the *caldo de fumo*. You put tobacco into the water, put this water in the watering can and then you water the plants with it. And you can also use ash which is good to combat lice and other pests, termites. In the garden I only use these forms. I never apply poison that is bought. V. [husband] uses it against caterpillars, but in my garden no way, it can die, the cucumbers are dying, *caldo de fumo* didn't help, *caldo de cinza* didn't help... I let them die, and then I plant new ones..." Rib2, 21.01.2008).

Farmer Rib6 also had a special recipe for producing organic pesticide, using water mixed with cow urine: *"10 litros de água e um copo de xixi, você mata tudo se você coloque diretamente, seca tudo, contra os bichinhos. Na seca cada 2 ou 3 dias eu ponho na salada. Na seca a minha horta é uma relíquia, é linda... O xixi não deixa nada, não deixa cheiro, ele vira um adubo. Planto pé de losma, ajuda também contra os bichinhos."* ("Ten litres of water and a cup of urine, you kill everything if you apply it directly, it dries everything, against pests. During dry season I put it on the salad every two or three days. During dry season my garden is a relic, it's beautiful... The urine doesn't leave anything, there's no smell, it becomes manure. I plant *losma* trees which also help against pests." Rib6, 24.01.2008).

Farmer MO14 used the same recipe, admitting though, that it would not really work during rainy season: *"A gente usa 'veneno orgânico'. Por exemplo o xixi da vaca misturado com água. Só que funciona meio mal sem misturar uma coisa química. Teria que passar todos os dias. Agora na época da chuva não funciona."* ("We use 'organic poison'. For example cow urine mixed with water. Only it works half badly without mixing with something chemical. You should use it every day. Now during rainy season it doesn't work." MO14, 02.02.2008).

All respondents held the adjacent soy farms responsible for pests and the soybean rust invading their fields and their gardens especially during growth period of soy that coincides with rainy season. According to the respondents, invasions of pests occurred especially after soy farmers sprayed pesticides on their fields and during and after the soy harvest: *"Na época da chuva tem muitos bichos aqui. Muitos falam que é por causa da lavoura de soja aqui que os bichos vêem."* ("In the rainy season there a lot of pests here. Many people say that it's because of the soyfields that the pests come here." Rib5, 22.01.2008).

Respondents Rib7, MO14, MO15 and MO18 said, that they would have to apply pesticides in order to be able to harvest something and to keep their plants alive:

"Se a gente não usa [veneno], a gente não vão colher nada. Quando os fazendeiros aplicam o secante antes da colheita de soja, todos os bichos como fede-fede vêem para cá." ("If we don't use [poison], we don't harvest anything. When the soy farmers spray herbicide before the soy harvest, all the pests like for example bugs come here." MO14, 02.02.2008).

According to farmer MO18, soybean rust would not spare any plant: *"Por exemplo as nossas plantas ornamental dentro da nossa varanda elas são atingidas muitas vezes por essa ferrugem, essa ferrugem asiática que destrói a soja. Então ela destrói a lavoura de mandioca, na pastagem ela atinge a fruta do lobo. Ela atinge aquelas plantas no estágio antes da frutificação. Quando ela faz a floração, então com essas dias de chuva, desmanchou, ela só destaca seca já. [...] Mesmo que eu não quero usar química, eu tenho que usar para ela [arvore] sobreviver. [...] A nossa realidade é muito próxima a dessas grandes ataques de inseticida e fungicida."* ("For example our ornamental plants on our veranda are reached by this soybean rust, by this Asian soybean rust that destroys the soy. It destroys the manioc field, on the pasture it destroys the *fruta do lobo*. It reaches the plants before they build fruits. When they blossom, now with these rainy days, it dies, it comes out dry already. [...] Even if I don't want to use chemicals, I have to in order that it [tree] will survive. [...] Our reality is pretty close to those huge attacks of insecticides and fungicides." MO18, 05.02.2008).

Farmer Rib7 and her husband leased a few hectares to a soy farmer. Soy fields surrounded their house and garden: *"Da muitos pulgões na minha horta, arranquei tudo... A gente mora aqui no meio da lavoura e eles passam veneno aqui para matar os bichos e esses vêem tudo para a horta que não tem veneno. Perdi tudo o que eu plantei, os pés de alface, as abóbora, os pepinos estavam cheios de lagartas, a gente não usa veneno. A gente não usa*

veneno, nos arranca e joga fora... O meu marido passou um pouco agora nas frutas..." ("There are many lice in my garden, I had to root up everything... We live almost in the middle of the soy fields and they apply poison here for killing the pests and they all come to our garden where there is no poison. I lost everything I planted, lettuces, pumpkins, cucumbers have been full of caterpillars, we don't use poison. We don't use poison, we root it up and then throw it away... My husband used now some for the fruits..." Rib7, 25.01.2008).

4.1.9. Alimentation and commercialization of food plants

When asking the respondents which foodstuffs they would buy, all of them listed rice and beans. According to the farmers, cultivation of rice would only pay off growing it large-scale, which they could not afford. Ten respondents did grow beans for their subsistence. Nevertheless, all of them regularly bought beans.

One respondent started to plant coffee trees in order to be self-sufficient one day. Four respondents produced vinegar and wine made of the fruits of *Bactris sp. l.* (Figure 7a). *Bixa orellana* L. (Figure 7c and 7d) was used for coloring dishes. *Capsicum sp.* (Figure 7b) is a very typical spice in Brazil. All respondents had it at home. After they dried it, they preserved it in oil, using it mainly for flavouring meat dishes.



Figure 7: *Bactris sp. l.* (a), different varieties of *Capsicum sp.* (b), *Bixa orellana* L. (c, d) (Source: Hanz K. 2008)

All respondents produced primarily for their subsistence. One farmer (not a respondent) on the settlement Ribeirão 3 had a truck and drove to town on the weekends for selling his products. Sometimes he took along maize, manioc and other products for the farmers Rib2, Rib3, Rib4, Rib10 and Rib12 to Lucas do Rio Verde and Nova Mutum: "[Vendemos] na cidade. J. [vizinho] vai todo final de semana para Lucas. Quando ele não tem Mandioca, quando ele não está muito apurado, ele tem que ser descascada. Ele pede para nos, e a gente descasca. 40 quilos, 100 quilos, 70 quilos, tanto ele pediu. Quando ele vai, ele leva." ("[We sell our products] in town. J. [neighbour] goes every weekend to Lucas. If he doesn't have manioc and if he

is not so much in a hurry, the manioc has to be peeled. He asks us and we peel it. 40 kilos, 100 kilos, 70 kilos, as much as he asks us to peel. When he goes to town, he is going to take it along." Rib2, 21.01.2008).

Farmer Rib10 sold his products biweekly: *"Melancia, abacaxi e maracujá são para vender. O milho é para as vacas e tem a horta para a gente mesmo. Agora é a época da melancia e a gente vai cada quinze dias vender na cidade."* ("Melon, pineapple and passion fruit are for selling. Maize is for the cows and there is the garden for ourselves. Now is melon season and every two weeks we go to town to sell." Rib10, 28.01.2008).

Farmer MO13 sold his products when something was left over: *"Vendo na cidade quando sobre. Depois de se manter a gente vende se sobrar. Vendo feijão, milho, essas coisas nas armazenas, nos mercados, na feira."* ("I sell my products in town if something is left over. You sell if something is left over. I sell beans, maize, such things to the warehouses, to the supermarkets to the markets." MO13, 01.02.2008.)

Farmer MO15 quantified the amount of produced plants that he and his family used for their alimentation and for animal feed: *"A gente usa as plantas basicamente para a alimentação de nos e dos animais. 90 por centos para os animais, 10 por centos para nos, amigos e vizinhos."* ("We use the plants basically for our alimentation and the animals. 90 per cent for the animals, 10 per cent for us, friends and neighbours." MO15, 04.02.2008).

4.2. Opportunities for food plant diversity

4.2.1. Values

4.2.1.1. Identification with family and agricultural background

All respondents had an agricultural background. Their parents or grand parents have been either rural workers, or owned a piece of land or a small farm. All respondents migrated from the South of Brazil to Mato Grosso with the aim to get land for themselves by means of the agrarian reform.

Farmer MO1 described what her life was like when she was a child: *"Eles [pais] moraram na colônia em Rio Grande do Sul, trabalharam na agricultura. O meu pai não queria que eu estudar mais alem da 4ª série. Os mais velhos trabalharam na roça, os mais novos eram gurí, não tinha mais chance de estudar. O meu pai vendeu a terra. Em Paraná, a gente também tinha terra- milho, feijão, arroz, soja, porco, cabrito, ovelha, gado. Eu aqui ainda não tenho, pasto já tenho plantado só que tem que fechar."* ("They [parents] lived in a village in Rio Grande do Sul and were employed in agriculture. My father didn't want me to study beyond 4th grade. The older children worked on the fields, the younger ones were too small, there was no more chance for me to study. My father sold the land. In Paraná, we also had land – maize, beans, rice, soy, pigs, goats, sheep and cattle. I still don't have cattle here, I have already planted the pasture, I still have to build a fence around it." MO1, 18.01.2008).

The respondents appreciated their lives and work as farmers. The phrase *"Fui criado na roça"* could be translated as "I was raised in the countryside" or also as "I was raised on the farm". All respondents used this phrase at least once when talking about their work.

Farmer MO18 described why she became a farmer and what this choice meant for her: *"Essa semana, a B., aquela pequena [menina], me perguntou: Quando você era pequena, o que é você queria ser quando você crescesse? Eu falei: Queria ser colona. Ela: Colona não vale. Ela me questionando: Porquê ser colona? Filha, eu falei, colona é quem produz o alimento para o medico, para o dentista, para todo mundo que vive na cidade, passa pelas nossas mãos, eu falei. É daquilo que vai para terra, que chega lá na cidade nos mercados que alimentam, que abastesse todo mundo. Eu falei: é nos - das nossas mãos que sai a saúde das pessoas. Ela ficou pensando, mas nem assim eu convenci ela. Eu falei para ela: Para a gente ser colono, a gente tem que ser um pouco agrônomo, um pouco economista, um pouco veterinário. Você tem que entender a psicologia dos bichos. Você tem que ser muitas coisas ao mesmo tempo."* ("This week B., this little [girl] asked me: When you were little, what did you want to be when you were grown up? I said: I wanted to be a farmer. Her: Farmer does not count. She asked me: Why farmer? Filha, I said, a

farmer produces food for the doctors, for the dentists, for everybody who lives in town, it passes through our hands, I said. It is him who plants and then it will be delivered to town to the markets which feed, which supply everybody. I said: It is us – from our hands emanates the health of people. She kept thinking about it but I couldn't convince her. I said to her: For being a farmer we have to be bit of an agronomist, a bit of an economist, a bit of a veterinarian. You have to understand the psyche of the animals. You have to be many things at the same time." MO18, 05.02.2008).

4.2.1.2. Family agriculture

Family agriculture is a well-known term in Brazil. It is used in the context of small-scale, family-run agriculture. For respondents Rib2, Rib3, Rib4, Rib6, Rib7, Rib9, Rib12, MO14 and MO19 family agriculture meant that all farm work was done by family members. As farmer Rib2 put it: *"Agricultura familiar é todas as pessoas da família participar na plantação, na colheita, cuidar, se sustentar com que a gente planta."* ("Family agriculture means that all family members participate in planting, harvesting, managing, subsisting with what we plant." Rib2, 21.01.2008).

Farmer Rib6 described family bonds as integral part of family agriculture: *"Acho que a agricultura familiar é produzir de tudo junto com a família. Para mim a agricultura familiar você está junto com a família, ter uma coisa que você vai trabalhar junto, uma lavoura... produzir de tudo... porquê se você não tem uma coisa [para comer], você tem outra..."* ("I think family agriculture is producing everything together with the family. For me family agriculture is when you are together with the family, have a thing that you work on together... a field... produce everything... if you don't have one thing [to eat] you have another..." Rib6, 24.01.2008).

For farmer Rib7, being her own boss was linked to family agriculture: *"Para mim é trabalhar junto aqui. A gente trabalha para a gente mesmo."* ("For me it is working together here, we work for ourselves." Rib7, 25.01.2008).

According to farmer MO14, family agriculture was a sustainable way of farming: *"[Agricultura familiar] é para trabalhar sem veneno. Trabalhamos em grupos. Nos vamos produzir o que o brasileiro come. Não só milho e soja."* ("[Family agriculture] is working without poison. We work in groups. We are going to produce what the Brazilians eat. Not only maize and soy." MO14, 02.02.2008).

Farmer MO19 said that family agriculture would employ a lot of people, in contrast to the industrialised agriculture. To her, it also meant independency from the industrial agriculture: *"A nossa definição da agricultura familiar é onde emprega a família toda, onde a família toda trabalha, desde as crianças de doze anos a cima, até doze anos pode ensinar para eles também. É mão-de-obra, muito mais do que nos sojeiros que usam tecnologia. A gente aqui é na mão mesmo por enquanto. O máximo que você faz é lavrar um pedaço com o trator mas o resto é tudo na mão. E produzir para se alimentar com segurança, não ficar dependente de muito agrotóxico. Se você vai comprar uma verdura lá na cidade, aquelas hortas de lá é puro agrotóxico."* ("Our definition of family agriculture is where the whole family is employed, where the whole family works, from approximately twelve years on, but you can also teach the younger ones already. It is manpower, much more than at the soy farms where they use technology. Here we do everything by hand so far. At most we use a tractor for preparing a piece of ground but the rest we work manually. It is producing for living food secure, not being dependent on agrochemicals. If you buy vegetables in town, in the gardens there they use a lot of agrochemicals." MO19, 06.02.2008).

4.2.1.3. Health

The respondents were aware that pesticides might be harmful and that aliments that were produced without pesticides might be healthier. They were proud of their healthy and tasty products: *"Pela saúde da gente [não usamos agrotóxicos], mesmo assim já é contaminada da soja, mas eu calculo que seja pelo menos menos um pouco. É mais saudável a comida sem agrotóxico, você sente o gosto. As pessoas que vêm aqui ao assentamento, todo mundo sai elogiando [a comida], gostam muito da comida."* ("Because of our health [we don't use agrochemicals], although it is already contaminated by the soy here but I calculate that at least it's

a bit less. Food without agrochemicals is healthier, it is very tasty. People who come here to the settlement leave praising [the food], they like the food a lot.” MO19, 06.02.2008).

Rib5 stated she would rather prefer to get along without vegetable than eating vegetables that have been produced using pesticides: *“Prefiro ficar sem verduras para não usar veneno. O veneno vai ficar dentro de você... Alimento que produz sem veneno faz melhor para nos.”* (“I prefer to live without vegetables instead of using poison. The poison will be remaining inside of you... Aliments that are produced without poison are better for us ” Rib5, 22.01.2008.)

Farmer MO14 still wanted to grow more different kinds of vegetables. Pests from the adjacent soy field invaded her garden regularly: *“Ter mais coisas na horta era bonito, mais a gente não quer usar veneno. Faz muito mal para a saúde, também está na comida...”* (“It would be nice to have more things in the garden, but we don’t want to use posion. It is very bad for your health, it is also in the food...” MO14, 02.02.2008).

4.2.2. Motivation

4.2.2.1. Approaches towards planting: Human-plant relationship

Farmers MO1, Rb2, MO19 stated that they would plant each plant they can get: *“A gente planta tudo o que vem em nossa frente.”* (“We plant everything that we can get.” MO19, 06.02.2008).

When talking about plants, farmer MO1 sometimes denominated plants with the word “as minhas plantinhas” which means “my little plants”⁵.

Farmer Rib6 seemed to have a very profound relationship with plants. She compared plants to children and explained why it is essential to treat plants in a tender and lovingly way: *“Eu planto porque eu gosto, eu adoro elas, eu amo [elas]. Quando você gosta [das plantas] você já planta com carinho. Se está todos os dias ali no pé delas, elas gostam de carinho, eu já anotei que elas gostam de carinho até as flores gostam. Tenho uma história: as minhas plantas eram lindas. Quando a gente veio para cá, eu fui longe para buscar água para elas e falava para elas não morrer por favor, para ficar ali. Só que eu acho que eu cansada assim daquela vida sem água, não dei carinho para elas, assim mesmo molhando elas, elas morreram. Não consegui salvar uma muda. Hoje vou ficar no pé delas conversando com elas para elas não morrer, porque sabe, elas sentem igual uma criança. Se você ia lá todos os dias e passar a mão nela, carinhar ela, gostar delas, elas vêem mesmo, vem a coisa mais linda. Se eu ir lá e molhava rapido, preocupei com outra coisa, larghei a mão, não passava a mão no pesinho delas, elas não gostam. Agora tenho que ter mais carinho com elas.”* (“I am cultivating plants because, I like, I adore, I love them [the plants]. If you like [the plants] you already plant with caress. When you are there with them everyday, they like caress, I already realized that they like caress, even the flowers like it. I have a story: my plants have been beautiful. When we moved here I had to go a long way for getting water for them and I asked them to not die please, to stay there. But I think, tired as I have been because of that life without water, I didn’t caress them, even though i watered them, they died. I didn’t succeed to save one single seedling. Now I stay with them, asking them not to die, because you know, they feel like children do. If you go there every day and pet them, caress them, like them, they grow, they grow beautifully. If I would go there and water them quickly, occupied with other things, don’t caress them, they wouldn’t like it. Now I have to be more fond with them.” Rib6, 24.01.2008).

4.2.2.2. Pursuit of independency

The respondents esteemed their independency. Farmers Rib5 and Rib7 stressed their satisfaction with being their own bosses: *“Prefiro de morar aqui independentemente, plantar as minhas plantas, aqui eu sou u meu chefe, é uma vida boa e tranqüila.”* (“I prefer to live here independently, plant my plants, here I’m my own boss, it is a good and calm life.” Rib5, 22.01.2008).

⁵ In Portuguese, the ending ‘-inha’ used with a noun or a forename is a term of endearment for something or someone.

Farmer Rib7 appreciated working for herself: *“Tem nada melhor do que trabalhar para você mesmo. Você faz o que você quer, não tem ninguém te mandando. Eu não gosto de ser mandado. Deus me perdoa, nunca gostei trabalhar para os outros assim, gosto de trabalhar para mim mesmo.”* (“There is nothing better than working for yourself. You do what you want to do, there is none telling you what to do. I don’t like to receive orders. May God forgive me, I never liked to work for others, I like to work for myself.” Rib7, 25.01.2008).

According to farmer MO19, having her own land would implicate a better way of living compared to living and being employed in town: *“Eu penso assim: eu sempre quis terra mas se a terra é para você viver pior do que se você está na cidade, então não preciso terra. Vou ficar tranqüila lá, vou ter algum emprego lá. Mas eu quero viver melhor.”* (“I think like this: I always wanted a piece of land but if the land makes living worse than living in town, I don’t need it. I would stay calm in town, have any job there. But I want to live better.” MO19, 06.02.2008).

4.2.2.3. Plans, wishes and visions

Six respondents (MO1, Rib5, Rib6, Rib7, Rib8, MO18) were speaking about their plans, dreams and wishes concerning their lives as farmers in the future.

Respondent MO1 wanted to get more different plants and seeds apart from what she had already planted. She wished to stay mentally and physically strong and healthy in order to be able to continue to work as a farmer as many years as possible.

Respondent Rib5 dreamed of living a self-sufficient live on her land. In future, she would like to be independent, without the need for buying goods anymore. She was aiming to produce everything herself.

Respondent Rib6 wanted to enter a new project. She did not specify what kind of project. The project should generate a sure income for her family. According to her, it was difficult to move forward without having any perspectives. Any project would be such a perspective. She also dreamed of seeing her grandchildren grow up on the farm.

When talking about what he would wish for, respondent Rib8 was referring to consumers and their buying behaviour: *“Desejo que a consciência do consumidor vai mudar – que eles comprem alimentos dos pequenos agricultores, alimento que é mais saudável.”* (“I wish that the consumers’ awareness will change – that they buy foodstuffs from small farmers, foodstuffs that are healthier.” Rib8, 26.01.2008).

Respondent Rib7 and her husband were leasing 8.5 hectares of their land to a soy farmer because they did not have the money to make a pasture and breeding sheep. They wanted to spend the money they would get from the soy farmer on buying grass seeds for the pasture and buying sheep for breeding. They were planning to no longer lease land to the soy farmer.

Respondent MO18 wanted to have the possibility of selling her products to improve her living conditions: *“A coisa que mais gosto é trabalhar com queijo. Eu gosto de produzir meus vinagres, meus vinhos, essas coisinhas artesanais. Eu gostaria de produzir isso não só para a minha alimentação era um pouco mais rica. Queria do meu trabalho, do fruto do meu trabalho, ter uma vida melhor, ter uma condição melhor de vida.”* (“What I like most is working with cheese. I like to produce vinegar, wine, those hand made things. I don’t want to produce this only in order to make my alimentation a little healthier. Due to my work, from the fruit of my work, I would like to have a better live, to have better living conditions.” MO18, 05.02.2008).

4.2.3. Organic agriculture

When asking the respondents what they would think about organic agriculture, all of them stated that it is a good way of farming. 4 respondents specified their perceptions.

Respondent MO1 would like to produce organic products. After her, she could never say that her plants are being organic because even if she never used pesticides or chemical

fertilizers, any time pesticides are applied on the adjacent soy fields, they would drift to her land.

Respondent MO19 said that organic agriculture was the farmers' dream on the settlements. When the settlements were established, it was even included in the settlements former statutes as preferred way of farming. She regretted the fact that the farmers on both settlements would never have the chance of getting an organic seal for their agricultural products. According to her, law for organic certification requires a minimum distance of 1,000 metres from the land being certified organic to the next cultivated area where agrochemicals⁶ are applied. None of the respondents' plots on both of the settlements meets this requirement.

Respondent Rib3 stated that organic agriculture meant less expense because one wouldn't have to spend money on chemical fertilizer or pesticides. Nevertheless, he was convinced that farming without applying pesticides and using chemical fertilizer was not possible on the settlements due to the adjacent soy fields and the poor soil quality.

Respondent Rib5 said that organic agriculture was a good thing because it wouldn't harm health: *"Eu acho muito bom, é sem uso de veneno, não prejudica a nossa saúde."* ("I thinks it's very good, it's without use of poison, it doesn't harm health." Rib5, 22.01.2008).

4.3. Constraints for food plant diversity: industrial agriculture

4.3.1. Industrial agriculture and business structures

Respondent Rib8 worked two months a year, usually in the period before and during soy harvest, as employee on soy farms. He appreciated the fact of being well paid for that work which facilitated a secure livelihood for his family. Nevertheless, he reported on the fact that if he wanted to buy a small sowing machine in Lucas do Rio Verde or Nova Mutum, he would not find such a machine. According to him, the warehouses are geared to industrial agriculture only and not to small farmers' requirements. He also mentioned that every soy farmer he knew would plant genetically modified soybeans.

Respondent MO18 reported on her husband wanting to buy a ton of fertilizer in a warehouse in Lucas do Rio Verde shortly after they had moved to their plot. The employees in the warehouse laughed at him. They gave him a ton of fertilizer for free from the rests that had fell on the ground. She said that this situation felt very humiliating to her husband. She stated that in the area of Lucas do Rio Verde and Nova Mutum, one was only recognized as farmer when he or she would possess more than 100 hectares of land. As respondent MO19 put it: *"A gente devia ser mais respeitado."* ("We should be more respected." MO19, 06.02.2008).

4.3.2. Leasing land to soy farmers

Seven respondents out of ten on the settlement Riberão 3 had leased land to soy farmers. The two main reasons for leasing land to soy farmers were lack of labour and machinery, and income generation.

"Nos temos uns 11 ha de soja arrendada. [...] Aquele pedaço de terra você não consegue plantar tudo se você não... aí o fazendeiro entra [...] uma pessoa que tem mas força, que tem uma maquinária. Acho que ele é um agricultor mais forte. Ele da aquela porcentagem nossa; ele vai dar o dinheiro. Ele vai vender lá porque ele tem nome, nos não temos nome." ("We have leased 11 hectares of soy. [...] A piece of land that you are not able to crop if you don't... There comes the soy farmers, [...] a person who has got more power, who has the machinery. I think he is a more powerful farmer. He gives a percentage to us, he gives us the money." Rib6, 24.01.2008).

⁶ Agrochemicals refer to synthetic pesticides and synthetic fertilizers used in agriculture.

Respondent Rib7 said that the soy farmers earn 50 sacks of soybeans per hectare and that she would get paid the value of six sacks of soybeans per hectare leased land.

Respondent MO1 said that in her opinion it was a big mistake of the INCRA to redistribute land in the middle of soy farms. She stated that the farmers on the settlement should not lease the land they have been fighting for such a long time.

4.3.3. Environmental impacts and health

Respondent Rib8 remembered that in the beginning of the 1980's, when there were still much more forests in the areas of Nova Mutum and Lucas do Rio Verde, the climate was much different from what is was almost thirty years later. Back then, rainy season lasted eight to nine months: *"No início dos anos 80 aqui tudo era mato, também em Terra Nova. Choveu 8, 9 meses com chuvas que demoraram dois até quatro semanas inteiras. Estava muito abafado, andava na chuva sem sentir frio. Hoje é tudo derrubado, quase não chove mais um dia inteiro."* ("In the beginning of the 1980s there were many forests here, also in Terra Nova. It rained 8, 9 months with rainfalls that lasted two to four whole weeks without stopping. The air was very hot and humid, I walked through the rain without feeling cold. Nowadays everything is cleared, it doesn't rain anymore a whole day through." Rib8, 26.01.2008).

Five respondents reported on the impact of agrochemicals applications close to their houses concerning their personal health, and the health of plants and animals.

Respondent Rib5 said that during days when agrochemicals are applied to soy fields nearby, she would have a headache and feel dizzy. She mentioned that she could scent a very strong smell then.

Respondents Rib7 and Rib 12 stated that when agrochemicals are applied on soy fields close to their houses, they could not bear to stay inside of their houses due to the strong smell.

Respondent MO14 said that sometimes the plants in his gardens and on his fields just died after agrochemicals had been applied on adjacent soy fields. He mentioned that some soy farmers again started using an agent that has already been prohibited for many years. He couldn't remember the exact name of that agent but he said that it was used during Vietnam War for defoliating trees.

Respondent MO19 reported on crop-spraying planes crossing the settlements. She said that it occurred once that chicken and pigeons of a neighbour on the settlement died after a soy farmer applied agrochemicals on a soyfield close to that neighbour's house.

4.3.4. Strategies to cope with the impacts of industrial agriculture

Exchange of seed and seedlings amongst the farmers could be identified as a coping strategy concerning the impacts of industrial agriculture. Through exchanging seeds of a traditional maize variety (chapter 4.1.4.), the farmers on the settlements were not dependent on buying hybrid varieties in town. Therefore it was important for them to keep the traditional maize variety from mixing with the hybrid maize varieties of the soy farmers, who plant maize after the soy harvest. In order to avoid such a contamination, respondent MO15 explained that it was necessary to adapt the sowing of their maize to the crop rotation of the soy farmers: *"Nosso milho é crioula ou milho colonial. É milho puro. A gente planta depois do milho dos fazendeiros. Os fazendeiros plantam a soja no mês de outubro e colhem em janeiro, depois eles plantam o milho. Nos plantamos o milho em outubro para o milho nosso e deles não mistura geneticamente."* ("Our maize is traditional or milho colonial. It is unaltered maize. We plant it after the soy farmers plant maize. They plant soybeans in October and harvest in January, after that they plant maize. We plant maize in October so that our maize and their maize are not going mix to genetically." MO15, 04.02.2008).

4.4. Hypotheses

According to my observations on the research site, I generated four hypotheses for complementing the research questions (chapter 1.3.):

H1: One's own autonomy is an important motivation for the cultivation of various food plant species and the diversity on the plots. As the farmers' level of school education is low, they do what they do because they prefer independence and living on their own land instead of being badly paid for an employment in town.

H2: The farmers' agricultural background plays an essential role in their commitment towards cultivation of different food plant species.

H3: An emotional human-plant relationship is correlated to diversity of food plants.

Hypotheses *H1*, *H2* and *H3* are based on the assumption that values and motivation influence human actions. Defined values and motivation in the context of this thesis are: independency, agricultural background and family agriculture, human-plant relationship, and health issues.

H4: Input intensive agriculture and agribusiness have an impact on lives and actions of farmers concerning cultivation of food plants.

Hypothesis *H4* is based on the assumption that the environmental conditions caused by adjacent soy farms and the agricultural business do influence the farmers' actions.

5. Discussion

5.1. Challenges and adjustments

I stayed in Mato Grosso from September to February. That period coincides with rainy season. During my four weeks field stay on the settlements, it was raining every day continuously for approximately 7 or 8 hours. In most of the cases, I had to walk several kilometers to get to another respondent's farm and I would have got soaked through the heavy rain showers. Due to this fact, I had to adjust my visits for the interviews according to those hours of rainfalls. During rainy season, only few food plant species were grown in the *hortas*, and only few plant species could be observed blooming. In the case of this field research, all these facts were not really causing any difficulties, but should be taken into consideration when planning such an endeavor. The advantage of conducting interviews during rainy season was that respondents were more flexible concerning interview periods and I had the impression that they did not feel to be kept from work so easily.

Very good language skills in Portuguese are highly recommended when conducting field research in Brazil. It should be taken into consideration that Brazilian Portuguese is very different from Portuguese that is spoken in Portugal concerning pronunciation and vocabulary.

I was staying four weeks on the settlements and only had very few moments of privacy during that time. One should be aware of the fact that a field stay might imply little or no privacy at all.

5.2. Critical reflections

I have to admit a bias towards the group of farmers who were participating in the *beijaflor* project. I conducted interviews exclusively with them and not with any of the other farmers on the settlements Maria Oliveira 1 and Ribeirão 3. The group of respondents included only migrants from southern Brazil and farmers who were born in Mato Grosso. Other farmers on the settlements who were not participating in the *beijaflor* project migrated from the northeast or from the north to Mato Grosso. Their origin and background could have given different information on food plant species.

A survey of distinct varieties within species and *in situ* conservation would have led to a better understanding of the respondents' means of preserving their independency from the agribusiness concerning seed.

Furthermore, interviews with representatives of the agribusiness and soy farmers would have complemented research findings. They would have pictured their point of views concerning the agribusiness and their perceptions of family farmers.

5.3. Food plant diversity and farm management

Objective 1: All food plant species including condiment species that are cultivated by the farmers will be documented and classified. The management concerning food plants will be presented. The usage of food plants will be presented.

The total number of 107 food plant and condiment species belonging to 41 families that were found on farms of 16 respondents on the settlements Maria Oliveira 1 and Ribeirão 3 was higher than in other findings. Major et al. (2005) who also focused on food plant and condiment species and surveyed 16 households in the Manaus region in Brazil found a total number of 79 species belonging to 39 families. The five most frequent species in

their study were avocado (*Persea americana* Mill., frequency (f) = 15), mango (*Mangifera indica* L., f = 15), coconut (*Cocos nucifera* L., f = 13), citrus (*Citrus* spp., f = 13), and cupuaçu (*Theobroma grandiflorum* (Willd. ex Spreng) K. Schum, f = 12). None of these five most frequent species matches with the five most frequent species found in this survey (pumpkin, manioc, banana, cashew, and sugarcane).

The total number of food plant species in this study also seems to be high taking into account the fact that the respondents on the settlement Maria Oliveira 1 had started to cultivate their land five years before this research took place and the respondents on the settlement Ribeirão 3 only two years prior to that.

The respondents of this study had diverse sources for plants. Especially women were keen on getting more and more different plants. Also, the respondents on both settlements seemed to be quite well connected to each other as well as to friends and family who did not live on the settlements but in the next urban areas of Nova Mutum and Lucas do Rio Verde. Exchange with neighbours, family and friends were the most important source for new plant species. Either the respondents took new plants with them to the settlements after they had visited their family and friends in town or visitors brought plants with them to the settlements. The forest was the least important source for plants and only mentioned by one respondent (chapter 4.1.2.2.).

All respondents on the settlement Maria Oliveira 1 highlighted the poor soil quality. By contrast, all respondents on the settlement Ribeirão 3 stated that the soil would be good if only they would use enough chemical fertilizer, manure, and lime (chapter 4.1.7).

The respondents mentioned ants, bugs, caterpillars as most occurring pests. They were convinced that the periodic invasions of pests on their fields happened due to the adjacent or nearby soybean fields of the soy farmers. Also soybean rust was severely damaging their food plants especially during growth period of soybeans and during and after soy harvest. Six respondents stated that they would never apply any pesticides. Four other respondents stated that if they wanted to harvest anything at all it would be necessary from time to time to apply pesticides due to the severe pest invasions (chapter 4.1.8.)

The respondents produced three out of four staple foods themselves. 15 respondents produced manioc, nine respondents produced beans, and seven produced maize. None of the respondents produced rice. The main purpose for producing food plants was for the respondents' subsistence.

8 respondents stated that they would appreciate very much the fact that they would not have to suffer from hunger. According to them, they would produce more than enough for their alimentation (chapter 4.2.).

5.4. Opportunities for food plant diversity

Objective 2: Underlying values and motivation for the cultivation of various food plant species will be highlighted.

All respondents appreciated and liked to work as farmers and chose to live on the settlements for several reasons. In their *model of pro-environmental behaviour* (chapter 2.5.2.) Kollmuss and Agyeman (2002) show that the higher the synergy between internal (motivation, environmental knowledge, values, attitudes) and external factors (institutional, economic, social, cultural) is the bigger is the positive impact on pro-environmental behaviour.

In this research, agricultural background, family agriculture (*agricultura familiar*), and health could be identified as important values of the respondents. For the respondents, family agriculture meant working together with the family members, producing food to a great extent without agrochemicals, living food secure, and producing locally, healthy and diverse food. Two respondents highlighted the fact that family agriculture is responsible in

a large part for the food production of the Brazilian population. The IBGE and the Ministério de Planejamento, Orçamento e Gestão (2006, chapter 1.2.) confirm as a matter of fact that small farmers in Brazil are responsible for the most part for the production of staple food.

The phrase “*Fui criado na roça*” (“I was raised in the countryside” or “I was raised on the farm”) might point out the respondents’ appreciation of their agricultural background, and their knowledge about food plants.

Important motivations for the respondents were their human-plant relationship, pursuit of independency, and their plans, wishes, and visions. Family agriculture and pursuit of independency are interlinked: two respondents highlighted their satisfaction with working on their own land and being their own bosses. Reproduction of maize was an important means for the farmers in order to stay independent of the agroindustry.

Organic agriculture could have been clearly an opportunity for food plant diversity but it will never be possible for the respondents to get their products to be certified organic due to the adjacent soyfields.

5.5. Constraints for food plant diversity: industrial agriculture

Objective 3: The challenges farmers face due to the adjacent soy farms will be pointed out.

All respondents were concerned with the socio-economic impacts of industrial agriculture on their lives. Those concerns were related to their experiences with business structures that are geared to industrial agriculture, their observation of environmental changes and their health, and their perceptions of their status within society.

Frequent pesticide use causes environmental damage and health risks for people and animals that are exposed to it (Fearnside, 2001; Steward, 2007). One respondent indicated that she would get a strong headache and dizziness on any of the days when pesticides are applied on soy fields that are situated close to her house. Another two respondents reported that once it occurred that their plants and animals were dying after pesticide applications on adjacent soy fields. Three respondents pointed out the strong smell of pesticides they scent after the applications and that made it sometimes impossible for them to stay inside their houses. One respondent who had already lived in the area of Lucas do Rio Verde since the beginning of the 1980’s observed that the duration of rainfalls during rainy season steadily decreased since that time. He ascribed his observation to the fact that back then the area was still covered with forests that were continuously cut or burnt down the last decades.

Especially in Mato Grosso, export-oriented soybean production has lead to income re-concentration and elitism (Bickel, 2005; Fearnside, 2001; Kaimowitz et al., 1999). Powerful stakeholders leave visual “*imprints*” such as monocropping fields and cleared forests in the environment (Bryant and Bailey, 1997). True agrarian reform can only be implemented through reproduction of peasantry based on redistribution of land and on disempowering of large property owners (Sauer, 2006). Soybean producers see themselves as important contributors for the rise of the Brazilian economy. In their view, small farmers do not play an important for economic development (Steward, 2007). Seven respondents had leased land to soy farmers for reasons of lack of labour and machinery, and income generation (chapter 4.3.2.).

Two respondents gave examples on how business structures of warehouses in Lucas do Rio Verde and Nova Mutum are geared to industrial agriculture and how they would not meet the needs of small farmers: small sowing machines were not available, only hybrid maize was sold, and it was hard to get to buy a smaller amount of fertilizer. Another

respondent claimed that they should be respected considerably more than they were in order to be able to live and work with dignity (chapter 4.3.1.).

Through exchanging seeds of a traditional maize variety, the farmers on both settlements could keep their own maize seed were not dependent on buying hybrid varieties in town (chapter 4.1.4.).

6. Conclusion and prospect

Despite adverse conditions in their environment the respondents on the settlements Maria Oliveira 1 and Ribeirão 3 were cultivating a large number of food plant species. On the one hand, external factors such as agroindustrial business structures, and exposure to pesticides made it more challenging for the respondents to live and work on the settlements: warehouses did not meet the needs of small farmers, pests were regularly invading the respondents' fields and gardens, and their personal health was affected by pesticides. On the other hand, the fact of being deeply rooted in agriculture as such and also the convenience of working independently seemed to be important factors for the respondents to keep on running their farms defying socio-economic and environmental impacts caused by industrial agriculture. The respondents were fully committed to being farmers and they very much appreciated their independent lives on the settlements. Most of the respondents' sons and daughters were attending agricultural schools and were most likely to take over these farms from their parents.

Some respondents reflected about their status in society. They were proud of being farmers and having an agricultural background. However, some of them had had bad experience with how they were treated by assistants in warehouses and people living in town. Considering that *"food security means [...] the food is obtained in a manner that upholds human dignity"* (WHO, 2008) we have to start implementing this definition by encouraging those responsible for producing diverse and healthy foods.

A big part of staple and other food consumed by Brazilians is produced by small farmers in Brazil. Yet a quarter of the population suffers from food insecurity. The four pillars of food sovereignty – the right to food, access to land and other resources, adequate trade policies, and sustainable production principles – must be implemented immediately by policy makers in order to decrease food insecurity, to strengthen family agriculture, and to disempower large estate owners.

The sample size of this study was too small and the interviews were not detailed enough in order to draw significant conclusions on the respondents' reasons for cultivating a broad variety food plant species. I recommend collecting data with a bigger sample size in order to be able to carry out quantitative analysis of data. A combination of qualitative and quantitative surveys seems to be useful. Nevertheless, this study is an outline for further research on food plant diversity and the values and motivations for their cultivation

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10. Abstract

Food plant diversity is an essential part of agrobiodiversity and as such fundamental for food security, livelihood security and food sovereignty of all people as well as for human well-being. 19 farmers on two agrarian reform settlements in Mato Grosso, Brazil were investigated regarding their reasons for the cultivation of diverse food plant species and the challenges they were facing due to industrial agriculture. Semi-structured interviews and participant observation were implemented. A total number of 107 food plant and condiment species belonging to 41 families was observed and documented. The five most frequent food plant species were *Cucurbita* sp., *Manihot esculenta*, *Musa X paradisiaca* L., *Anarcadium occidentale* L., and *Saccharum officinarum* L. Exchange of plants between the farmers and their neighbours, family and friends was the most important means for getting new plant species. Agricultural background, family agriculture (*agricultura familiar*), and health issues were the most important motivating factors for the cultivation of diverse food plant species. Yet socio-economic impacts like inadequate business conditions and environmental impacts such as exposure to pesticides, and pests constitute the farmers' most serious constraints. Despite those challenges, they appreciated working as farmers on the settlements for they could thereby live independently.

Key words: food plant diversity, motivating factors, family agriculture, industrial agriculture, agrarian reform

11. Resumo

A diversidade das plantas alimentares é uma parte essencial da agrobiodiversidade e, como tal fundamental para a segurança alimentar, segurança da subsistência e a soberania alimentar de todos os povos, bem como para o bem-estar humano. 19 agricultores em dois assentamentos da reforma agrária em Mato Grosso, Brasil, foram investigados em relação as suas razões para o cultivo de diversas espécies vegetais alimentares, e os desafios que estavam enfrentando, devido à agricultura industrial. Entrevistas semi-estruturadas e observação participante foram implementadas. Um total de 107 espécies de plantas alimentares e condimentos pertencentes a 41 famílias foi observada e documentada. As cinco espécies mais freqüentes de plantas alimentares foram *Cucurbita sp.*, *Manihot esculenta*, *Musa X paradisiaca* L., *Anarcadium occidentale* L., e *Saccharum officinarum* L. O meio mais importante para obter novas espécies de plantas foi a troca de plantas entre os agricultores e os seus vizinhos, famílias e amigos. O fundo agrícola, a agricultura familiar, e a saúde foram os fatores mais importantes para motivar o cultivo de diversas espécies vegetais alimentares. No entanto, os impactos sócio-econômicos, como inadequadas condições de negócio e os impactos ambientais como a exposição a pesticidas e pragas constituem as limitações mais graves para os agricultores. Apesar desses desafios, eles apreciaram a trabalhar como agricultores nos assentamentos para que pudessem viver assim independentemente.

Palavras-chaves: diversidade das plantas alimentares, fatores motivantes, agricultura familiar, agricultura industrial, reforma agrária

12. Kurzzusammenfassung

Die Vielfalt von Nahrungspflanzen ist ein wichtiger Bestandteil der Agrobiodiversität und somit von großer Bedeutung für die Nahrungssicherheit, die Sicherung der Existenzgrundlage und die Lebensmittelsouveränität aller Menschen sowie für das menschliche Wohlergehen. 19 Bauern und Bäuerinnen wurden in zwei Siedlungen der Brasilianischen Agrarreform in Mato Grosso, Brasilien, zu ihren Beweggründen für die Kultivierung verschiedener Nahrungspflanzenarten und die damit verbundenen Herausforderungen aufgrund der industriellen Landwirtschaft befragt. Die Daten wurden mit einem Interviewleitfaden und partizipativer Beobachtung erhoben. Insgesamt 107 Nahrungs- und Gewürzpflanzenarten aus 41 Familien wurden gesammelt und bestimmt. Zu den fünf häufigsten Nahrungspflanzenarten zählten *Cucurbita sp.*, *Manihot esculenta*, *Musa X paradisiaca* L., *Anarcadium occidentale* L., und *Saccharum officinarum* L. Die wichtigste Quelle für neue Nahrungspflanzenarten war das Tauschen von Pflanzen zwischen den Bauern und Bäuerinnen und deren Nachbarn, Familien und Freunden. Landwirtschaftlicher Hintergrund, familiäre Landwirtschaft (*agricultura familiar*) und Gesundheit konnten als wichtige motivierende Faktoren für die Kultivierung vieler verschiedener Nahrungspflanzenarten identifiziert werden. Im Gegensatz dazu stellten sozioökonomische Aspekte wie für eine kleinstrukturierte Landwirtschaft unangemessene Geschäftsstrukturen und Umwelteinflüsse wie die Belastung durch Pestizide und Schädlinge die größten Einschränkungen für die Bauern und Bäuerinnen dar. Trotz dieser Umstände schätzten sie ihre Arbeit in der Landwirtschaft sehr, weil sie dadurch ein unabhängiges Leben führen konnten.

Schlagwörter: Vielfalt von Nahrungspflanzen, motivierende Faktoren, familiäre Landwirtschaft, industrielle Landwirtschaft, Agrarreform

13. Annex

13.1. Guidelines for interviews (Portuguese)

Dados pessoais

Nome

Onde você nasceu?

Onde você cresceu?

Onde você morou antes de vir ao assentamento?

Desde quando você está aqui?

Você mora com quem?

Você estudou?

Qual é a situação fundiária do seu lote?

Qual é a sua renda?

Um salário mínimo ☐

Dois salários ☐

Três salários ☐

Plantas e conhecimento, manejo, venda

Quais plantas de/para comer você conhece?

Quais plantas do mato/Cerrado/nativas/silvestres que conhece que pode comer?

Destas plantas que você falou têm algumas que você planta aqui?

De onde vieram as plantas que você planta?

Tem algumas que vêm de longe? De onde?

Como você escolhe quais plantas cultivar/plantar? O que leva você a escolher uma planta para cultivar?

Quem ensinou essas plantas para você?

Como você consegue a semente/muda para você plantar?

Você sempre planta as mesmas plantas? Porquê?

Quem planta em casa?

Quem cuida das plantas? Como?

Como é a terra daqui para plantar?

O que você usa para plantar?

Tem alguma forma de mecanização?

Como você faz molhar as plantas?

O que você faz com as plantas que você colhe?

Como você faz para guardar o que você colheu?

Você pretende de plantar algumas plantas que você ainda não plantou aqui?

Alimentação

O que você usa na sua alimentação que vem de fora?

De onde vem?

Valores e empenho

O que é que / o que significa a agricultura familiar para você?

O que é que você acha da agricultura orgânica?

Qual é a sua profissão? Você se considera o que?

Turnê guiada

Esse lugar tem nome?

Qual é o tamanho da área aberta?

Você tem área arrendada?

Qual é o tamanho do pasto?

13.2. Guidelines for interviews (English)

Personal Data

Name

Where have you been born?

Where did you grow up?

Where did you live before coming to the settlement?

Since when have you been living here?

With who do you live here?

Did you go to school?

What is the legal status of your land?

Do you have a regular income?

One minimum wage

☐

Two minimum wages

☐

Three minimum wages

☐

Plants and knowledge, management, commercialisation

Which food plants do you know?

Which native plants or plants in the forest/in the bush/in the Cerrado do you know that you can eat?

Which plants from the plants that you mentioned now have you planted here?

Where do the plants that you plant here come from?

Are there any plants that come from far away? Which?

How do you decide which plants to plant?

Who did show these plants to you?

How do you get the seeds/seedlings for planting?

Do you always plant the same plants? Why?

Who is planting (in your family)?

Who is looking after the plants? How?

What do you do with what you have harvested?

How do you store what you have harvested?

Do you pretend to plant plants that you have not planted so far?

What is the soil like for planting?

What do you use for planting?

Do you have any machinery?

How do you irrigate the plants?

Alimentation

What do use in your alimentation that you have to buy?

Where does it come from?

Values and commitment to agriculture

What does family agriculture mean to you?

What do you think of organic agriculture?

What is your profession? Which profession do you consider yourself?

Farm walk

What is the name of this place?

What is the size of the arable land?

Do you have land leased?

What is the size of the pasture?

13.3. Table of codes

Table 2: Codes used for analysing interviews

Code	Description
Age	Age of respondent
Background	Agricultural background of respondent
Brazilian agriculture	Development considering Brazilian agriculture
Children	Number of children of respondent
Civil Status	Civil Status of respondent
Commitment	Commitment to plants, to agriculture
Education	Level of education of respondent
Family agriculture	Perception of family agriculture, <i>agricultura familiar</i> Production of healthy products
Farm size	Data on farm size
FP	Food plants planted on the farm
Health	Values, attitudes and motivation of respondents
Human-plant relation	Values, attitudes and motivation of respondents
Independency	Values, attitudes and motivation of respondents
Institutions	Opinion on institutions being involved
Leased land	Land that respondents leased to soy farmers
Mgmt / Machinery	Farm Management: Agricultural production techniques
Mgmt / Manure	Farm Management: Manure
Mgmt / Farm soil	Farm Management: Data on farm soil, quality of soil
Mgmt / Fertilizer	Farm Management: Chemical Fertilizer (adubo químico)
Mgmt / Irrigation	Farm Management: Irrigation of plants
Mgmt / Pesticides	Farm Management: Pesticides used
Mgmt / Pests and diseases	Farm Management: Occurring pests and diseases
Moon	Farm practices according to moon phase
Native Plants	Native food plants
Organic agriculture	Perception of respondents on organic agriculture
Origin	Origin of respondent
Origin of planting material	Exchange of seed, seed stock, information between farmers, neighbours, institutions
Plans, wishes, visions	Values, attitudes and motivation of respondents
Plant sources	Sources for seed, seedlings
Position within society	Perception of respondents on their position within society What it is like to be a "Sem terra" Feeling marginalized Being independent

	<i>A gente devia ser mais repseitado</i>
Power	Adjacent soy fields and farmers influence plant management on settlements
Progress	Statements of respondents on agricultural progress Genetically modified organisms
Rhythm	Rhythm of planting considering seasons, hybrids of the soy farmers, moon phases: Dry season (Época da seca) Rainy season (Época da chuva) Hybrid maize (Milho híbrido) Waxing moon (Lua minguante)
Agricultural background	Values, attitudes and motivation of respondents: "I was raised in the fields" (<i>fui criado na roça</i>)
Vocabulary	Vocabulary used by farmers concerning food plants: Soybeans (Soja), Self-sufficient (subsistência), soy farmers (fazendeiro), crop up („cresce nativo“), <i>semente crioula, milho crioula, milho comum, milho híbrido</i>
Commercialisation	Selling of agricultural products
Bought foodstuffs	Foodstuffs that farmers have to buy
Income	Family income

13.4. Food plant species found on research site

family	genus	species	local common name	Exotic/Native
ANARCADIACEAE		<i>Anarcadium occidentale</i> L.	Caju	N
ANARCADIACEAE		<i>Spondias Mombin</i> L.	Serigüela	N
ANARCADIACEAE		<i>Mangifera indica</i> L.	Manga	E
ANARCADIACEAE		<i>Spondias dulcis</i> Parkinson	Cajá-manga	E
ANARCADIACEAE		<i>Spondia cf. Lutea</i>	Jaracatiá	N
ANNONACEAE		<i>Annona squamosa</i> L.	Ata, Pinha	E
ANNONACEAE		<i>Annona squamosa</i> L. XA. <i>cherimola</i> Mill.	Atemóia	E
ANNONACEAE		<i>Annona reticulata</i> L.	Ata, Pinha, Fruta do conde	E
ANNONACEAE		<i>Annona muricata</i> (L.)	Graviola	E
ANNONACEAE		<i>Rollinia salicifolia</i> Schtdl.	N.N	N
ANNONACEAE		<i>Annona dioica</i>	Ariticum	N
APIACEAE		<i>Coriandrum sativum</i> L.	Coentro	E
APIACEAE		<i>Daucus carota</i> L.	Cenoura	E
ARACEAE		<i>Colacasia esculenta</i> Schott.	Inhame	E
ARACEAE		<i>Xanthosoma violaceum</i> Schott.	Taioba	N
ARACEAE		<i>Xanthosoma saginifolium</i> Schott	Mangarito	N
ARECACEAE	<i>Syagrus sp.</i>		Coco do mato	N
ARECACEAE		<i>Cocos nucifera</i> L.	Coco da Bahia	N
ARECACEAE	<i>Allagoptera sp.</i>		Gueroba	N
ARECACEAE	<i>Attalea sp.</i>		Babaçu	N
ARECACEAE	<i>Bactris sp. I</i>		Tucum	N
ARECACEAE	<i>Bactris sp. II</i>		Pupunha	N
ARECACEAE		<i>Euterpe oleracea</i> Mart.	Açaí	N
ASTERACEAE		<i>Cichorium intybus</i>	Almerão, Chicória	E
ASTERACEAE		<i>Lactuca sativa</i> L.	Alface	E
BIXACEAE		<i>Bixa orellana</i> L.	Urucum	N
CAESALPINIACEAE		<i>Caesalpinia Ferrea</i>	Juca	N
CAESALPINIACEAE		<i>Tamarindus indica</i> L.	Tamarindo	E
CAESALPINIACEAE		<i>Hymenaea courbaril</i> L. Var. <i>stilbocarpa</i> (Hayne) Lee et Lang	Jatobá	N
CARICACEAE		<i>Carica papaya</i> L.	Mamão	N
CARYOCARACEAE		<i>Caryocar brasiliense</i> Camb.	Pequi	N

CLUSIACEAE		<i>Rheedia brasiliensis</i> Mart.	Copará	N
CONVOVULACEAE		<i>Ipomoea batatas</i> (L.) Lam.	Batata doce	E
CRUCIFERAE		<i>Brassica oleraceae</i> var. <i>capitata</i>	Repolho	E
CRUCIFERAE		<i>Brassica oleraceae</i> var. <i>botrytis</i>	Couve-flor	E
CRUCIFERAE		<i>Brassica oleraceae</i> var. <i>italica</i>	Brócolis	E
CRUCIFERAE		<i>Brassica oleraceae</i> var. <i>acephala</i>	Couve	E
CRUCIFERAE		<i>Raphanus sativus</i> L.	Rabanete	E
CRUCIFERAE		<i>Eruca sativa</i>	Rúcula	E
CUCURBITACEAE		<i>Sicana odorifera</i> (Vell.) Nandin	Jambelão, Cruá, Melão caipira	N
CUCURBITACEAE	<i>Cucurbita</i> sp.		Abóbora	E
CUCURBITACEAE		<i>Cucurbita moschata</i> Duchesne ex Poir.	Cabotiá	E
CUCURBITACEAE		<i>Cucurbita maxima</i> Duchesne	Moranga	E
CUCURBITACEAE		<i>Momordia charantia</i> L.	Melão de São Caetano	E
CUCURBITACEAE		<i>Cucumis anguria</i> L.	Maxixe	E
CUCURBITACEAE		<i>Citrullus lanatus</i>	Melancia	E
CUCURBITACEAE		<i>Cucumis melo</i> L.	Melão	E
CUCURBITACEAE		<i>Cucumis sativus</i> L.	Pepino	E
DIOSCOREACEAE		<i>Dioscorea trifida</i> L. f.	Cará	N
EBENACEAE		<i>Diospyros kaki</i> L. f.	Caqui	E
EUPHORBIACEAE		<i>Manihot esculenta</i>	Mandioca	
FABACEAE		<i>Crotalaria spectabilis</i> Roth	Feijão crotalária	E
FABACEAE		<i>Dipteryx alata</i> Vogel	Barú	N
FABACEAE		<i>Cajanus cajan</i> (L.) Millsp.	Feijão andu, Feijão guandu	E
FABACEAE		<i>Arachis hypogaea</i> L.	Amendoim	E
LAMIACEAE		<i>Rosmarinus officinalis</i> L.	Alecrim, Rosmarinho	E
LAMIACEAE		<i>Origanum majorana</i>	Manjerona	E
LAMIACEAE		<i>Ocimum basilicum</i> L.	Manjerição	E
LAURACEAE		<i>Persea americana</i> Mill.	Abacate	E
LILIACEAE		<i>Allium cepa</i> L.	Cebola	E
LILIACEAE		<i>Allium sativum</i>	Alho	E
LILIACEAE		<i>Allium schoenoprasum</i>	Cebolinha	E
MALPIGHIACEAE		<i>Malpighia emarginata</i> Sessé & Moc. ex DC.	Acerola	E
MALPIGHIACEAE		<i>Bunchosia armeniaca</i> (Cav.) DC.	N.N.	E
MALVACEAE		<i>Theobroma grandiflorum</i> (Willd. ex Spreng) K. Schum	Cupuaçu	N
MALVACEAE		<i>Hibiscus sabdariffa</i> L.	Groselha	E
MALVACEAE		<i>Abelmoschus esculentus</i> (L) Moench	Quiabo	E

MIMOSACEAE	<i>Inga sp.</i>		Ingá	N
MORACEAE		<i>Morus nigra</i> L.	Amora	E
MORACEAE		<i>Ficus carica</i> L.	Figo	E
MORINGACEAE		<i>Moringa olifeira</i> Lam.	Moringa	E
MUSACEAE		<i>Musa X paradisiaca</i> L.	Banana	E
MYRTACEAE		<i>Myrciaria coronata</i> Mattos	Jabuticaba	N
MYRTACEAE		<i>Eugenia stipitata</i> McVaugh	Araça-boi	N
MYRTACEAE		<i>Psidium guajava</i> L.	Goiaba	N
MYRTACEAE		<i>Eugenia uniflora</i> L.	Pitanga	N
MYRTACEAE		<i>Syzygium malaccense</i> (L.) Merr. & L.M. Perry	Jambu roxo	E
MYRTACEAE		<i>Syzygium jambos</i> (L.) Alston	Jambu vermelho	E
MYRTACEAE		<i>Eugenia pyriformis</i> Cambess	Ovaia, Ovalha	N
MYRTACEAE	<i>Campomanesia sp.</i>		Guabiroba	
MYRTACEAE		<i>Syzygium cumini</i> (L.)	Jambulão, Jemalão	E
OXALIDACEAE		<i>Averrhoa carambola</i> L.	Carambola	E
PASSIFLORACEAE		<i>Passiflora alata</i> Curtis	Maracujinha, Maracujá doce	N
PASSIFLORACEAE		<i>Passiflora edulis</i> Sims	Maracujá	N
PASSIFLORACEAE		<i>Passiflora quadrangularis</i> L.	Maracuja gigantesca	N
PEDALIACEAE		<i>Sesamum indicum</i> L.	Gergelim	E
POACEAE		<i>Saccharum officinarum</i> L.	Cana	E
POACEAE		<i>Zea mays</i> L.	Milho	E
PUNICACEAE		<i>Punica granatum</i> L.	Romã	E
QUENOPODIACEAE		<i>Beta vulgaris</i>	Beterraba	E
RHAMNACEAE		<i>Hovenia dulcis</i> Thunb.	Uva japonesa	E
RUBIACEAE		<i>Coffea arabica</i> L.	Café	E
RUTACEAE		<i>Citrus aurantifolia</i> (Christm.) Swingle	Limão galego	E
RUTACEAE	<i>Citrus sp.</i>		Lima	E
RUTACEAE		<i>Citrus sinensis</i> (L.) Osbeck	Laranja	E
RUTACEAE		<i>Citrus medica</i> L.	Cidra	E
RUTACEAE		<i>Citrus deliciosa</i> Ten.	Bergamota	E
SOLANACEAE		<i>Capsicum frutescens</i> L.	Pimenta malagueta	N
SOLANACEAE		<i>Capsicum chinense</i> Jacq.	Bodinho, Pimenta de cheiro	N
SOLANACEAE		<i>Capsicum baccatum</i> L.	Malaguetinha	N
SOLANACEAE	<i>Capsicum sp.</i>		Pimenta doce	
SOLANACEAE		<i>Solanum melongena</i> L.	Berinjela	E
SOLANACEAE		<i>Solanum gilo</i> Raddi	Jiló	E

SOLANACEAE		<i>Lycopersicon esculentum</i> Mill.	Tomate	E
STERCULIACEAE		<i>Guazuma ulmifolia</i> Lam.	Mutamba	N
VITACEAE		<i>Vitis labrusca</i> L.	Uva	E
ZINGIBERACEAE	<i>Curcuma sp.</i>		Açafrão	E