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SUSTAINABLE AGRICULTURE: AN ASSESSMENT OF BRAZIL'S FAMILY FARM PROGRAMMES IN SCALING UP AGROECOLOGICAL FOOD PRODUCTION

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SUSTAINABLE AGRICULTURE: AN ASSESSMENT OF BRAZIL'S FAMILY FARM PROGRAMMES IN SCALING UP AGROECOLOGICAL FOOD PRODUCTION

Ben McKay and Ryan Nehring *

Global poverty and hunger are most prevalent where food is actually being produced — in rural areas. Roughly 70 per cent of the 1.4 billion extremely poor people in the world live in rural areas (IFAD, 2010). The increasing volatility in food prices, erratic effects of global climate change, and the increasing scarcity of natural resources present new and immediate dynamic challenges for agricultural development. We can no longer attempt to address problems with a one-track approach, as was the case with Green Revolution policies, by solely focusing on increasing yield production. For too long, agricultural policies have been geared towards increasing productivity without taking into account the associated social and environmental impacts which are equally, if not more, important. A sustainable food system must consider the economic, social and environmental impacts of its production, consumption and distribution to ensure its economic viability, social and cultural inclusivity and environmental sustainability. Linking these three key tenets to agricultural policy is rarely done, as it requires valuing intangibles such as local culture, health and the environment in the context of a food production system.

One alternative agricultural approach which considers these three key tenets is that of agroecology. Based on a myriad of scientific research and satellite cases worldwide, there is a general consensus and growing support among experts around the world that an agricultural model based on agroecology can provide a sustainable, socially inclusive, productive and efficient way to increase food security and alleviate rural poverty.[1]

As one of the most biodiverse countries in the world and a leader in world food production, Brazil presents a case where large-scale agro-industry co-exists with almost 5 million family farmers who occupy less than one quarter of the total cultivated land (IBGE, 2009). While the former produce mainly mono(flex)crops for export, the latter produce 70 per cent of all food consumed by Brazilians, while receiving less than one sixth the budget allocation from the government (IBGE, 2009; Chmielewska and Souza, 2011). Further, the combination of high rates of rural poverty (25 per cent) and rapid deforestation is a cause for concern (IBGE, 2010; Fearnside, 2005). It is within this context that new initiatives, policies and programmes are emerging as an alternative way forward for agricultural development.

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Agroecology in Brazil is quickly gaining momentum with the recent passing of Decree 7.794 of 20 August 2012 for a National Policy for Agroecology and Organic Production (PLANAPO) and strong support from civil society organisations. While PLANAPO was officially launched on 17 October 2013, the implementation of this policy in terms of outreach, coverage and effectiveness is yet to be determined.

This study examines agroecological farm production in Brazil and the effectiveness of family farm programmes and policies in supporting a transition towards agroecological production. We also reveal the importance of family farms in Brazil and examine public policies and programmes implemented to support family farmers[2] in the country. We start this analysis by discussing the 'Brazilian agricultural dilemma' and its inherent contradictions and conflicts.

We then provide a comprehensive policy analysis based on government reports and complement this analysis with our empirical data based on field work conducted in April 2012. Based on these findings, we highlight several weaknesses and failures and implications going forward for scaling up agroecological production. With timely and relevant data, we hope this Working Paper contributes to the policy discussion based on agroecology and provides some key insights for future design and implementation.

Despite the contradictions inherent in Brazil's agricultural dilemma as highlighted in Section 2, we conclude that Brazil is equipped with a diverse range of promising elements to facilitate a national agroecological food system for family farmers. Innovative policies coupled with strong rural social movements create an enabling environment for agroecological food production, but four key weaknesses in carrying out such programmes must be addressed:

i) programme awareness;

ii) technical assistance and extension services;

iii) public-supported farmer networks; and iv) scale-up.

This paper is structured as follows: first, we will outline competing food systems — that is, the conventional food system which currently dominates today versus one that is sustainable, inclusive and productive. Next, we delve into the 'Brazilian agricultural dilemma'. Third, we discuss our research strategy, methodology, and location of study. The fourth section explores the advancement of agroecology in Brazil, followed by an analysis of the country's family farm programmes supporting agroecology-based production. The sixth section reveals the first-hand experiences of family farmers with agroecology and the aforementioned programmes. Finally, based on the insights and analytical findings we highlight the key weaknesses and put forward policy implications for agroecological food production, followed by our conclusions.

1 FOOD SYSTEMS

This section highlights some of the key structural issues with our current food system and the chronic problems it has produced in terms of hunger, malnutrition and unequal distribution. It then points to three central objectives that embody our food system according to the UN Special Rappporteur on the Right to Food. This is followed by an examination of a food system based on agroecology — its scientific principles and practices — as well as secondary case study data which discuss the issue of adequate productivity.

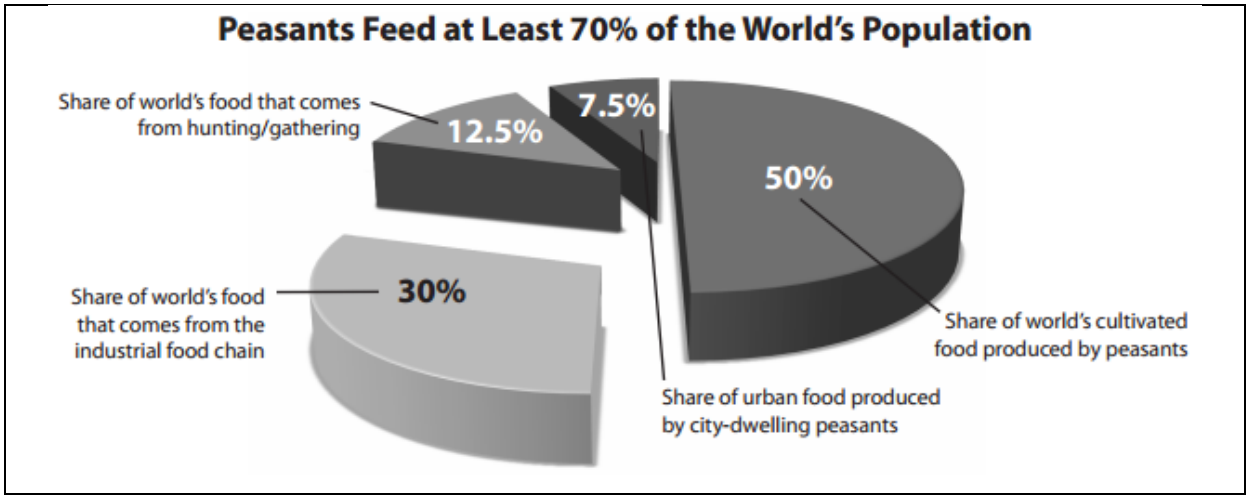
1.1 OUR FAILING FOOD SYSTEM

The way in which we produce, process and distribute food — and who controls these processes — encompasses our food system. On a global scale, the food system has become very concentrated, as just three companies control 53 per cent of the global commercial market for seed, while the top six agrochemical companies control 72 per cent of the agrochemical market and are also among the world's top 10 seed companies (ETC, 2009). Aside from the corporate control of conventional agricultural inputs, 40 per cent of the global supply of grain — an amount equivalent to the annual caloric needs of more than 3.5 billion people — is fed to livestock (Ibid.). This means that we already grow enough food to feed 9–10 billion people, but the bulk of such industrially produced grain goes to biofuels and animal feed (Altieri, 2012). With an estimated 925 million hungry people in the world today, the problem of world hunger is not only one of food production but, more importantly, of **access** due to corporate market control and distribution, consumption patterns and crop usage.

Global hunger is part of the poverty problematic, as much of the poor population cannot afford to purchase food in our current food system. The 'poor' people who do meet their daily caloric intake needs spend about 50–80 per cent of their income on food — meaning that a slight increase in food prices will have dire effects on their vulnerable living situations (IFAD, 2010). Meanwhile, the latest data from the World Health Organization (WHO) reveal that there are an estimated 1.4 billion people overweight and obese worldwide (WHO, 2012). The problem with our current food system then is not centred on **how much** food we produce, process and distribute, but **how** we do this, and **who** controls these processes. According to the ETC Group (2009), there are 1.5 billion peasant farmers on 380 million farms; 800 million growing urban gardens; 410 million gathering the hidden harvest of our forests and savannas; 190 million pastoralists; and over 100 million peasant fishers. These diversified groups of peasants constitute nearly half of the world's population and grow at least 70 per cent of the world's food, as shown in Figure 1.

FIGURE 1

Shares of World Food Production



Source: ETC Group, 2009.

In the context of our current rural reality, it is crucial that we support smallholder peasant livelihoods[3] and create a new food system to do this. The United Nation's Special Rapporteur on the Right to Food, Olivier de Schutter (2010), has outlined three objectives of food systems:

- Systems must ensure the availability, accessibility, and adequacy of food for everyone.
- Systems must develop in ways that increase the incomes of smallholders.
- Systems must be sustainable.

First, food systems which ensure the availability of food for everyone require supply-side measures which are available, accessible and adequate to all people — regardless of income, location, disabilities or age. The dominant food system that exists today prioritises food crops away from human consumption towards things such as animal feed and biofuels. In fact, the United Nations Environmental Programme (UNEP, 2009) estimates that, even if we account for the energy value of the meat produced, prioritising cereal production for animal feed instead of for human consumption results in a loss equivalent to the caloric needs of more than 3.5 billion people per annum. Moreover, due to the increasing demand of energy needs, national policies are encouraging the prioritisation of crops for biofuel rather than for human consumption. This prioritisation of crops away from human food is having drastic effects on world food supplies, resulting in hundreds of millions of people left hungry worldwide.

Second, food systems must support small producers, which in effect will increase employment opportunities and incomes for smallholder households. Higher incomes and employment levels could decrease the rapid rural-to-urban migration that has exacerbated the outward growth of slums due to an inability of urban economies to absorb rural migrants.

The hunger epidemic today is not due to the inability to grow enough food; it is the result of inaccessibility. By supporting small producers and increasing the incomes of poor populations, the productive capacity of small farmers and purchasing power of poor people will increase and positively complement each other. In fact, the *World Bank Development Report 2008: Agriculture for Development* indicates that Gross Domestic Product (GDP) which originates in agriculture is at least twice as effective in reducing poverty as GDP growth originating outside agriculture (World Bank, 2007). Despite increased rural-to-urban migration, poverty and hunger largely remain a rural problem, since the large majority of those living in poverty still reside in rural areas (IFAD, 2010). Thus, the need to support rural populations is more important than ever.

Third, while many would argue that we live in a world of finite resources, it is also important to consider how those resources are being distributed and used. The way in which we produce food must be sustainable. The current food system is destroying ecosystems, degrading arable lands, and relies on increased chemical inputs and unsustainable uses of freshwater sources. Climate change effects are leading to erratic weather patterns such as increased droughts and floods, as well as an increase in the severity and frequency of storms and natural disasters. The current food system is further contributing to the problem. Moreover, livestock and feed production account for roughly three quarters of total human-induced (anthropogenic) greenhouse gas emissions (FAO, 2011). The new geographies and rapid increases of meat production and consumption have been fuelled by the expansion of

large-scale maize and soybean plantations, with the area devoted to these crops worldwide increasing by 50 per cent and 400 per cent, respectively, from 1961 to 2009 (Weis, 2013:68). This type of monocrop agro-industrial expansion not only requires increased mechanisation and petroleum-based inputs but also leads to high rates of deforestation (Fearnside, 2001; Volpi, 2007; Barona et al., 2010)

1.2 THE AGROECOLOGICAL FOOD PRODUCTION SYSTEM

As a science and set of practices, agroecology is very knowledge-intensive, participatory, organised and innovative. Derived from the convergence of two disciplines — agronomy and ecology — agroecology implies farming methods based on diversification, biological interactions and agroecosystem synergies which generate and enhance soil fertility, productivity and crop resilience. In addition to its emphasis on sustaining the environment and social inclusion through participatory frameworks, agroecology-based models have produced impressive economic results in terms of yields, productivity and efficiency.[4]

Agroecology is quickly gaining ground in the development literature among academics, scientists, rural development experts and, recently, among policymakers. The de Schutter (2010) report to the UN Human Rights Council supports agroecological food systems as the way forward in combating rural poverty and environmental degradation and increasing food security. A report by the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD, 2008) was approved by 59 governments and highlights agroecology as a key approach to alleviate poverty, improve food security and address environmental issues. The UN Food and Agriculture Organization (FAO), UNEP and Biodiversity International have also supported the need for agroecology in recent publications (UNEP, 2005; SARD, 2007).

Moreover, Wezel et al. (2009) reveal the rising interest for agroecology in the scientific literature, while also providing country case studies (Wezel et al., 2009). Recent publications by leading academics in the field point to an "agroecological revolution in Latin America" (Altieri and Toledo, 2011; Altieri, 2012). More specifically, others have highlighted the successes of agroecology as a state policy as in Cuba (Rosset et al., 2011). In the case of Brazil, scholars have noted numerous insights into agroecolgical production such as: sustainable consumption and collective learning (dos Santos and Chalub-Martins, 2012); public demand for local food systems (Lenhares de Assis, 2006); an improvement in the socioeconomic conditions and quality of life of the farmer (de Azavedo and Pelicioni, 2012); participatory control over natural resources (Guzmán, 1997); and sustainability of production and a variation of crops (Theodoro et al., 2009).[5]

The core principles of agroecology are based on using and recycling the nutrients and energy of the ecosystem in complementary and diversified ways to mimic nature and create a biodiverse, resilient and fertile environment. It is a discipline that is extremely innovative and knowledge-intensive, focusing on farmers' knowledge and using participatory methods and exchange networks to share ideas, techniques and practices in a horizontal manner between farmers. Using the knowledge and expertise of those most familiar with the ecosystem and its weather patterns, local farmers use a diversity of complex management schemes and adaptation techniques to strengthen ecosystem resilience and minimise dependence on agrochemical and energy inputs.[6] Table 1 highlights some of the methods used for agroecological production.

TABLE 1

Strategies for Agroecological Production

Technique	Description
Crop rotations	Temporal diversity incorporated into cropping systems, providing crop nutrients and breaking the life cycles of several insect pests, diseases, and weed life cycles (Sumner, 1982)
Polycultures	Complex cropping systems in which two or more crop species are planted within sufficient spatial proximity to result in competition or complementation, thus enhancing yields (Francis, 1986; Vandermeer, 1989)
Agroforestry systems	An agricultural system where trees are grown together with annual crops and/or animals, resulting in enhanced complementary relations between components increasing multiple use of the agroecosystem (Nair, 1982)
Cover crops	The use of pure or mixed stands of legumes or other annual plant species under fruit trees for the purpose of improving soil fertility, enhancing biological control of pests and modifying the orchard microclimate (Finch and Sharp, 1976)
Animal integration	Aids in achieving high biomass output and optimal recycling in agroecosystems (Pearson and Ison, 1987)

Source: Altieri, 2002.

By reducing, or removing altogether, dependence on external, synthetic inputs, smallholders will not have to use their incomes or become indebted to nurture their chemical-dependent crops. Though international food prices have increased in the past few years, the price of fertilisers and crude oil products have more than doubled the rise in foodstuff prices, making these external inputs increasingly more expensive for smallholders (de Schutter, 2010). Eliminating the reliance on such external inputs will, therefore, have a positive impact, not only on smallholder incomes but also on the long-term sustainability of their land and resources available.

The multi-functionality of agroecology, which is culturally and socially inclusive, is characterised by polycultures, agroforestry systems, crop–livestock mixtures etc. This type of production system is not compatible with large-scale, highly mechanised agro-industrial production based on mono-crop plantations but, rather, builds on the productive efficiency potential of small farms — referred to, and debated in, the literature as the inverse relationship between farm size and productivity.[7] This implies much more labour-intensive and diverse strategies in managing people, plants and animals. Due to the higher levels of underemployment in rural areas, a model of agriculture which is more labour-intensive could increase employment, decrease rural-to-urban migration and provide social protection for rural livelihoods through cooperatives, farmer-to-farmer support systems and participation in peasant organisations.

Notwithstanding, the current food system encourages monoculture plantations with 'cash crops', which makes farmers dependent on the price of one or two crops and contributes to the observation that "the largest number of poor, including smallholders, are net food buyers" (World Bank, 2007). Through agroecological food systems, farmers strengthen their sovereignty over the production and distribution processes, eliminating corporate monopolistic behaviour of setting prices, hoarding stocks, flooding markets and altering local diets. Moreover, agroecological food systems are conducive to strengthening links among farmers and between farmers and consumers. Food production is localised and diverse, increasing access through local distribution channels and maintaining traditional dietary consumption patterns.

In a comprehensive study by Pretty et al. (2006), 286 agricultural sustainability projects, 12.6 million small farmers in 57 least developed countries (LDCs) were evaluated after adopting agroecological practices. Occupying a total of 37 million hectares, or an average of just under three hectares per farmer, the average increase in crop yield from using agroecological techniques was 79.2 per cent, compared to yields using conventional methods.

Based on a variety of FAO farm system categories (smallholder irrigated, wetland rice, smallholder rain-fed humid, smallholder rain-fed highland, smallholder rain-fed dry/cold, dualistic mixed, coastal artisanal, urban-based and kitchen garden) smallholder irrigated and urban-based farms averaged the highest increases, with an average of 129.8 per cent and 79.2 per cent, respectively (Pretty et al., 2006). This study exemplifies the potential of pursuing an agroecological farm system. The 37 million hectares of farmland evaluated in the study represent a mere 3 per cent of the total cultivated area in LDCs. Therefore, scaling up agroecology-based farming systems has the potential not only to increase yields but also to produce adequate, accessible and nutritious food with less dependence on petroleum-based inputs. Peter Rosset (1999) has also shown the productivity potential of small-scale farms compared to large-scale farms in terms of output per hectare.

Further, in 2007, researchers at the University of Michigan conducted a meta-analysis of 293 studies to compare organic versus conventional food production systems by assessing the average yield ratio (organic: non-organic). The study concluded that organic agriculture could feed the current and future human population on the current agricultural land base, while maintaining soil fertility (Badgley et al., 2007). In fact, the study suggests that the actual output on organic farms would likely be much higher than estimated, since many organic farmers use polycultures and multiple cropping systems, and the study itself was based on yield ratios reported for individual crops. Table 2 shows the average yield ratios (organic: non-organic) with developed countries showing average yield ratios of slightly less than one, and developing countries greater than one. Developing countries show a greater potential for organic/agroecological production likely due to their rich genetic biodiversity, local indigenous knowledge and greater concentration of people working directly with the land and surrounding ecosystem (Altieri, 2012).

TABLE 2

Average Yield Ratio (organic: non-organic) **and Standard Error (S.E.) for 10 Individual Food Categories Recognised by the FAO and Three Summary Categories**

	World			Developed countries			Developing countries		
Food category	**No.**	**Av.**	**S.E.**	**No.**	**Av.**	**S.E.**	**No.**	**Av.**	**S.E.**
Grain products	171	1.312	0.06	69	0.928	0.02	102	1.573	0.09
Starchy roots	25	1.686	0.27	14	0.891	0.04	11	2.697	0.46
Sugars and sweeteners	2	1.005	0.02	2	1.005	0.02			
Legumes (pulses)	9	1.522	0.55	7	0.816	0.07	2	3.995	1.68
Oil crops and vegetable oils	15	1.078	0.07	13	0.991	0.05	2	1.645	0
Vegetables	37	1.064	0.1	31	0.876	0.03	6	2.038	0.44
Fruits, excl. wine	7	2.08	0.43	2	0.955	0.04	5	2.53	0.46
All plant foods	266	1.325	0.05	138	0.914	0.02	128	1.736	0.09
Meat and offal	8	0.988	0.03	8	0.988	0.03			
Milk, excl. butter	18	1.434	0.24	13	0.949	0.04	5	2.694	0.57
Eggs	1	1.06		1	1.06				
All animal foods	27	1.288	0.16	22	0.968	0.02	5	2.694	0.57
All plant and animal foods	293	1.321	0.05	160	0.922	0.01	133	1.802	0.09

Average yield ratio based on data from 91 studies: all countries, developed countries and developing countries.
Source: Badgley et al., 2007.

2 BRAZILIAN AGRICULTURAL DILEMMA

The role of agriculture in Brazil is crucial to the country's economic development and globally important for food security and environmental sustainability. Brazil is one of the most biodiverse countries in the world and a top producer in many important crops such as coffee, sugar, orange juice and soybeans. Brazil also contains 13.5 per cent of the world's equivalent potential arable land and an even larger share of proven renewable water resources (FAO, 2000). Its rich agricultural history has given rise to both a corporate-driven agro-industrial complex and engaged farmer organisation networks of cooperatives and associations and one of the largest peasant social movements in the world, the Movimento dos Trabalhadores Rurais Sem Terra (MST — Landless Workers' Movement). It is within this context that Brazil is confronted with an agricultural dilemma — politically, economically, socially and environmentally.

The economic growth generated by a concentrated group of politically influential agro-industrial entrepreneurs confronts the interest of the rural majority while threatening the rich biodiversity of the Amazon and Cerrado. This is further reflected in Brazil's two separate ministries for agriculture, the Ministry of Agrarian Development (MDA) and the Ministry of Agriculture, Livestock and Supply (MAPA). This system has been referred to as agricultural 'dualism' with different actors and drivers for particular aspects of agricultural and rural development in Brazil (Pierri, 2013).

2.1 AGRO-INDUSTRY AND THE 'NEW BIOECONOMY'

Agricultural activities in Brazil represent 10 per cent of total GDP — over twice the world's average (Hanrahan and Council, 2006). However, if we take into account the larger concept of agribusiness including inputs (fertilisers, pesticides) and the aggregate value of agricultural products within the supply chain from processing, packaging and transportation, the share of GDP more than doubles to 26 per cent (Sesso Filho et al., 2011). Moreover, including all activities in the 'new bioeconomy' would result in a much higher share of GDP, as it consists of food, feed, fibre, agricultural inputs (fertilisers, pesticides), chemical products (solvents, detergents), liquid fuels (ethanol, biodiesel), plastics and cosmetics, as well as contributing to the development of pharmaceuticals, vaccines, antibiotics, functional foods, nutraceuticals, cosmetics, and fragrances (Santana et al., 2012). According to the ETC Group, "industrial sectors with an interest in switching carbon feedstocks to biomass include the energy and chemical, plastics, food, textiles, pharmaceuticals, paper products and building supplies industries — plus the carbon trade — a combined market worth at least $17 trillion" — roughly one quarter of the Gross World Product (GWP) of US$71.83 trillion (ETC Group, 2011; CIA, 2012). This new economy is increasing demand for land, changing land use and can influence food prices — all of which can lead to drastic effects for local communities and livelihoods.

Increased corporate concentration and vertical integration of input and product markets have also coincided with the "rapid rise of supermarkets in Latin America", where supermarket chains have increased their share of the retail sector from an average of 10–20 per cent in 1990 to 50–60 per cent in 2000 (Reardon and Berdegué, 2002). In 2000, supermarket shares in Brazil accounted for 75 per cent of the country's food retail (Reardon and Berdegué, 2002). Further, Brazil has recently overtaken France as the fifth largest grocery market in the world (ETC Group, 2011). Although in some cases smallholders and family farmers can be integrated as a supplier in these processes, the necessary quality and safety standards often require substantial investments in physical, financial and human capital, which is difficult for most small farmer (Farina, 2002). This often leads to the exclusion of resource-poor farmers from the market and increasingly benefits land- and capital-rich farmers.

These trends coincide with large-scale mergers/acquisitions, which increasingly monopolise every step of the production value chain. For example, in 2008 the Brazilian beef processing company JBS bought the US meat packing company Swift & Co. for $1.4 billion and acquired Brazil's third largest beef company Bertin S.A., virtually monopolising the beef industry with a capacity to slaughter 90,000 cattle per day (ETC Group, 2011b). In 2009 poultry processor Perdigão S.A. acquired its competitor Sadia for $5.6 billion to form Brasil Foods, now the sixth largest industrial feed producer in the world (Ibid.). These types of mergers and acquisitions are also happening in input markets, with Brazil's Vale S.A — the world's leading miner of iron ore — acquiring Brazil's largest supplier of fertiliser ingredients, Bunge Ltd., for $3.8 billion in 2010 (Ibid.).

The increasingly concentrated nature of the retail sector is also characteristic of agricultural landholdings. Large-scale landholdings of over 1000 ha represent under 1 per cent of total farm establishments in Brazil but received over 43 per cent of total available agricultural finance, according to the latest agricultural census (IBGE, 2009). As the world's leading producer of sugarcane, Brazil accounts for over a quarter of world production and roughly 50 per cent of world exports (USDA, 2013a). In 2011, Brazil was the second largest producer of soybean, with 27.9 per cent of world production, and accounted for 40.2 per cent of total world exports (USDA, 2013b).

The export market for soybeans and sugarcane is a major driver of government support for industrial agricultural methods in the country. These so-called 'flex crops' have multiple uses and can be easily and flexibly interchanged (e.g. soy for feed, food, biodiesel; sugarcane for food, ethanol) to avoid price shocks and reduce market volatility (Borras et al., 2012). This type of agro-industrial development has resulted in an increasing concentration of land in corporate monopolies involved in the new bioeconomy. As land prices increase, corporate buying power is able to displace smallholding farmers who do not realise the exact value of their land. For example, in February 2010 Royal Dutch Shell entered into a joint venture agreement with sugar giant Cosan to produce ethanol from Brazilian sugarcane.

The $12 billion investment is the largest commitment to biofuels that any oil company has ever made to date. The 8.89 million hectares of total land devoted to sugarcane in Brazil today is expected to double by 2020 (ETC Group, 2011). The highly agrochemical-dependent sugarcane industry is not only causing rapid deforestation and biodiversity loss in the Brazilian Cerrado;[8] it is also pushing soy producers and cattle ranchers into Amazonian territory (Klink and Machado, 2005). Furthermore, smallholders and family farmers increasingly feel the effect of the land squeeze, as the average price per hectare of crop land has increased by 430 per cent from 1994 to 2010 (Sauer and Leite, 2012).

A breakdown of Brazil's total energy resources reveals that the country has an overall participation of renewable energy of over 45 per cent, while the world figure is only 13 per cent. In 2010, biomass had a 31 per cent share in the Brazilian energy matrix, with sugarcane accounting for 17.7 per cent, wood 9.5 per cent, and other residues 3.8 per cent (Government of Brazil, 2012). While this level of use of renewable energy is commendable, the increased land use change for monocrop plantations — namely, soy and sugarcane — is a cause for a concern. The pursuit of biofuels as an energy alternative in general should be questioned not only for its negative externalities but also its energy potential as a whole.

The FAO-commissioned High Level Panel of Experts on Biofuels and Food Security recently released its new draft report for 2013, which states "if we would use the totality of the world's crops to produce biofuels, it would represent at most only 13% of the world's primary energy, which…would realistically be closer to 9%", concluding that this would require the use of 85 per cent of the world's freshwater resources (Wilkinson et al., 2013:1). Unless biofuel production policy builds on and integrates traditional rural livelihoods in a very inclusive and participatory manner, it is unlikely to lead to positive outcomes for poor people (Bastos Lima, 2013).

The result of these agricultural developments has been a significant increase in land use change and intensification for soy and sugarcane monocrop plantations over the last 20 years (Sauer and Leite, 2012). Logically, this has been accompanied by extensive growth in monocropping, with a 188 per cent increase in soybean production, 156 per cent in sugarcane and 138 per cent in maize since 1990 (IBGE, 2009). This form of large-scale production has been driven by genetically modified (GM) crop plantations, accompanied by an increasing amount of chemical inputs. Of the 59.6 million hectares of arable land in Brazil, GM crops cover 30.3 million hectares. Over the past three years, Brazil has been the global engine for the growth in GM crops, increasing its area of GM crops by 20 per cent per year over the past three years (Clive, 2011).

Since 2008, Brazil has maintained its status as the world's largest consumer of pesticides, overtaking China and the USA, while also being the world's second largest producer of GM crops, accounting for 19 per cent of the world's GM crop plantations[9] (Clive, 2011; AS-PTA, 2011).

From 2000 to 2009, the pesticide market in Brazil grew by 172 per cent, almost doubling the 94 per cent rate of increase worldwide (ANVISA, 2011; Chmielewska and Souza, 2011). Moreover, despite not publishing its data on pesticide volumes sold in 2010, Brazil's Union of Agrochemical Industries (Sindag) reported a 9 per cent increase in sales over 2009 figures (AS-PTA, 2011). Between 2003 and 2008, herbicide use in Brazil increased from roughly 2.8kg to 4.2kg (active ingredient) per hectare of soybean. In 2008, approximately 1.5kg of herbicide was used to produce 1 ton of soybean (Meyer and Cederberg, 2010). Meanwhile, a recent study shows that in 2009, total herbicide use for GM crops was 18.7 per cent higher than conventional (non-GM) crops (Brookes and Barfoot, 2011).

Despite promises of GM crops increasing yields while containing pest-, herbicide- and/or drought-resistant genes, there are clear links between increased GM crop plantations, pesticide use and new 'super' weeds and 'super' pests which are increasingly adapting and becoming resilient to these agrochemical inputs (Gilbert, 2013). In a recent field study conducted by the Brazilian Agricultural Research Company (EMBRAPA), researchers found 18 species of weeds resistant to herbicides, five of which are resistant to glyphosate, the active ingredient in Monsanto's Roundup herbicide (AS-PTA, 2011). This study shows, as do many others, the direct correlation between increased GM crop use and increased chemical-based pesticide use due to insect resistance and new 'super weeds' adapting to the chemical-based inputs (Meyer and Cederberg, 2010; Altieri, 2000). This creates a spiralling dependence on the increased use of patented GM seeds and their complementary pesticides. This is not only detrimental to crops and soil fertility but, more importantly, to human health from the consumption of GM- and pesticide-dependent crops, and pesticide handling by farmers.

The Analysis of Pesticide Residues in Food Programme, which is part of Brazil's National Health Surveillance Agency (ANVISA), conducted a study to analyse the amount and type of pesticides being used by Brazilian farmers. It analysed 2488 samples from 18 common fruits and vegetables in 26 states, with São Paulo refusing to participate. The results are quite worrisome: pesticide irregularities — meaning above recommended limits or unapproved substances — were found in 27.9 per cent of total samples.[10] It is also worrisome that 20 of the 50 authorised active ingredients in pesticides commonly used in Brazil have been banned in the European Union. Moreover, the highly controversial and highly toxic agrochemical endosulfan is still being used in Brazilian agriculture, despite already being banned in many countries including the USA and China. However, according to ANVISA, a ban on endosulfan in Brazil will come into effect from 31 July 2014 (ANVISA, 2011).

The WHO has published a study on the adverse health effects caused by ingesting selected classes of pesticides. The symptoms include kidney malfunction; abdominal pain; vomiting; seizures; irritation of the airways, skin and mucous membrane; respiratory failure; liver injury; and allergic reactions; among many others (WHO, 2008). Other studies show direct correlations between GM crop consumption and kidney and liver damage (de Vendomois et al., 2009); toxic pesticide traces in the blood of pregnant women and their foetuses (Aris and Leblanc, 2011); and breast milk contaminated with agrochemicals (AS-PTA, 2011), among many other studies showing the negative health impacts of GM crops and associated pesticide use.[11]

2.2 SMALL-SCALE FAMILY FARMING IN BRAZIL

Pressure from farmers' organisations and political changes in the early 1990s signified a shift to provide support for family farming in Brazil. Policies and institutions were created in order to provide financial and political support to the millions of family farm establishments in Brazil. Notably, the creation of the Ministry of Agrarian Development (MDA) and the National Programme for Strengthening Family Farming (PRONAF) have provided political space and expanded access to agricultural credit, respectively. Despite the tremendous growth of industrial agriculture, Brazil's family farms still supply over 70 per cent of all food products consumed by Brazilian daily (IBGE, 2009).

Family farm production systems in Brazil use one third of the quantity of external inputs consumed by Brazil's industrial agriculture (Castro and Teixeira, 2005). More sustainable agricultural practices can also reclaim neglected and degraded land instead of clearing more land. Even the former head of the Ministry of Agriculture, Livestock and Food Supply (MAPA), Luis Carlos Guedes Pinto (who typically represents industrial agriculture), said Brazil could cultivate an additional 50 million hectares "without cutting down a single tree" by reclaiming neglected lands deemed unproductive by industrial agriculturalists (Butler, 2007). MAPA has started a marketing and policy campaign for organic food aimed at the domestic market.[12] The organic division is currently engaged in registering producers to sell in the certified organic market, which highlights 'agroecological' production as one of its tenets but does not distinguish between the two. Nevertheless, the programme has launched the development of regional agroecological study centres to influence the extension services and agricultural research throughout the country.

With the recent Decree No. 7794 of 20 August 2012, there is now a policy in place which outlines 134 initiatives for assisting in the transition to organic and agroecological production coordinated across 10 ministries (MDA, 2013). With an initial investment set at R$8.8 billion over three years, existing programmes such as PRONAF, ATER, PAA, and PNAE will be scaled up to facilitate the transition to agroecological-based production (MDA, 2013). PLANAPO was officially launched on 17 October 2013.

Many social movements and farmers' organisations have also established agroecological networks outside the governmental apparatus. Municipalities throughout the country have established agroecological fairs where producers can showcase their products and have direct contact with the consumers. In southern Brazil the REDE ECOVIDA has brought together 180 municipalities and some 2400 producers organised in 270 groups in a network that links consumer demand for organic crops to local agroecological family farms (Altieri, 2012). The local circuits of production, which also include 30 non-governmental organisations (NGOs) and 10 ecological consumers' cooperatives, strengthen local markets and contribute to food sovereignty through local production and consumption.

Further, La Via Campesina in Brazil has brought together the following eight organisations which support agroecology as an official policy and as part of their political platform: The Brazilian Landless Worker's Movement (MST), Movement of Small Farmers (MPA), Movement of the Dam Affected (MAB), Movement of Campesina Women (MMC), Movement of Pastoral Youth (PRJ), the Pastoral Land Commission (CPT), the Federation of Agronomy Students of Brazil (FEAB) and the Indigenous Missionary Council (CIMI)(Holt-Gimenez and Patel, 2009). The approach of these organisations has been much more progressive, since they adopt and define a more inclusive idea of agroecology compared with government documents which cluster concepts of 'agroecology' and 'organic' together.

To systematically integrate the agroecological movement within Brazilian agriculture, the MST and Via Campesina-Brazil have initiated 12 secondary schools and introduced university courses in agroecology (Holt-Gimenez and Patel, 2009; Altieri and Toledo, 2011). These schools provide training and technical assistance on agroecology to young rural workers and family farmers. Moreover, The Latin American School for Agroecology (ELAA) was established in 2005 at the World Social Forum in Porto Alegre, Brazil, in a joint agreement between Via Campesina-International, the governments of Brazil and Venezuela, the state government of Parana, and the Federal University of Parana (UFPR) (Holt-Gimenez and Patel, 2009). This type of training and education strengthens the agroecological movement at its base and promotes an alternative to the dominant agro-industrial model for students, activists and rural workers.

This is the crux of Brazilian agriculture: two distinct models persist that serve different purposes and are supported by separate institutions. For social movements and NGOs, agroecology has developed as a central component behind their political demands. These demands have created tensions between different types (small, medium, large-scale) of farmers as well as in and between ministries. According to Decree No. 6323 of 17 December 2007, for example, MAPA — which should only deal with agribusiness issues — is responsible for implementing and regulating 'organic' agriculture in Brazil (as defined by Law No. 10831 of December 2003). This creates both tensions within the agro-industrial-focused MAPA and the Ministry of Agrarian Development (MDA) and Ministry of Social Development and Fight Against Hunger (MDS), which are responsible for supporting family agriculture, social development, and increasing food security. This complex structure creates contradictions and uncertainty, especially for family farmers who are under-prioritised compared to agro-industry. One thing is for certain: the industrial export model has experienced unprecedented growth — economically and territorially — and will continue to encroach on small and medium-sized farms without a more rigorous commitment to focus on all economic, social and environmental components of alternative agrifood systems.

3 RESEARCH STRATEGY

The objective of this research is to assess the movement towards, and outcomes of, agroecological food production in Brazil, and the extent to which programmes to support family farms are facilitating this process. Using the household as the key unit of analysis, we conducted a series of case studies in several communities with a variety of different actors. Using open-ended, semi-structured interviews we gained different insights from the points of view of government officials, community leaders, rural worker organisations, farmer cooperatives, non-governmental organisations and associations, and individual family farmers. These empirical data are combined with complementary secondary data from academic publications, government reports, international organisations, think-tanks, NGOs and a comprehensive policy analysis. We, therefore, use these mixed-methods data in an instrumental way to provide insights into the broader national context of the research topic. Despite the research location being confined to two small states in the northeast of Brazil, the deeper qualitative empirical data complement the broader nationwide quantitative/qualitative data collected through secondary sources.

Due to the lack of empirical national data on 'organic' or 'agroecological'[13] farm establishments in Brazil, the primary data collected in this study are extremely relevant and helpful in understanding the agroecological experience in the country. However, due to time

and resource constraints, this study is limited in terms of its geographical scope and thus relies on a deeper understanding of household experiences through qualitative data analysis in Brazil's northeastern states of Piauí and Ceará. Family farm household experiences with, and knowledge of, agroecology and supportive public policies are the crux of this study. Brazil's latest Agricultural Census (2006) provides the study with the most up-to-date quantitative statistics on family farms and agroecological production, but its age and lack of coverage must be considered. Further, throughout our fieldwork using the term 'agroecology' was not always useful, as some people were not familiar with this scientific/academic terminology but produced in this manner nonetheless. Brazil's Agricultural Census identified similar problems with farmers self-identifying as 'agroecological' or 'organic' producers and, therefore, based its statistics on those who either hold organic certification and/or self-identify as 'organic/agroecological' farmers (IBGE, 2009).

On the other hand, other studies reveal that some households simply cannot afford chemical-based inputs due to resource constraints and are, therefore, classified as 'organic' but are not producing in this manner by choice (Lambais et al., 2013). These nuances are significant if policy is to encourage agroecology as a viable, healthy and productive alternative to conventional agriculture.

3.1 JUSTIFICATION OF RESEARCH LOCATION

FIGURE 2

Research Location (Piauí: red; Ceará: blue)

This research was undertaken with a regional focus, concentrating on two states in Brazil's northeast: Piauí and Ceará. The reason for focusing on this region in particular is due to its significance in terms of rural poverty, food (in)security, agroecological production and the funding allocation of family farm support programmes.

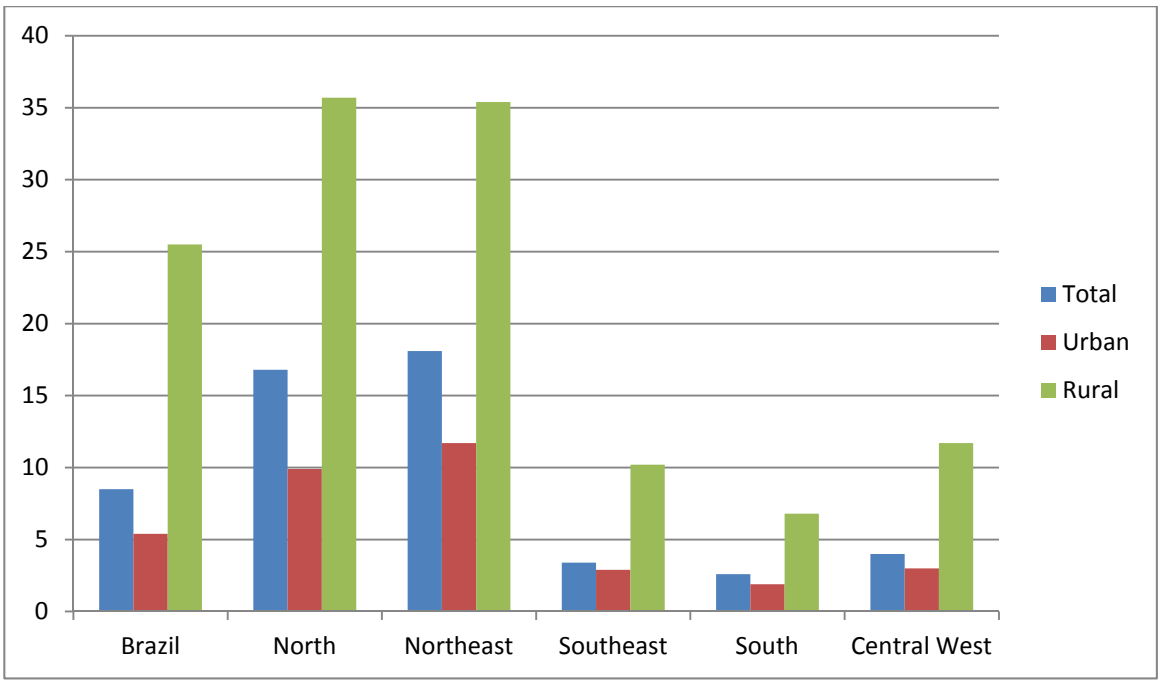
The agrarian structure in Brazil is quite pronounced, with 2,187,295 (50 per cent) of family farms located in the country's Northeast region. These family farms occupy just 11.35 per cent of total occupied farmland area. As a whole, Brazil's 4,367,902 family farms represent 84.4 per cent of the total agricultural establishments but occupy just 24.3 per cent (80.25 million

hectares) of total farmland. This leaves just 15.6 per cent of large-scale agricultural establishments controlling 75.7 per cent of the total occupied area. Despite these severe landholding inequalities, family farms produce 70 per cent of all food products consumed daily by Brazilians (IBGE, 2009).

Further, as indicated in Figure 3, the regional dimensions of rural poverty and malnutrition are also quite distinct, as rural poverty levels in Brazil's North and Northeast regions are over 35 per cent, while the country average is just over 25 per cent.

FIGURE 3

Percentage of Households in Brazil Living in Extreme Poverty by Region, 2010



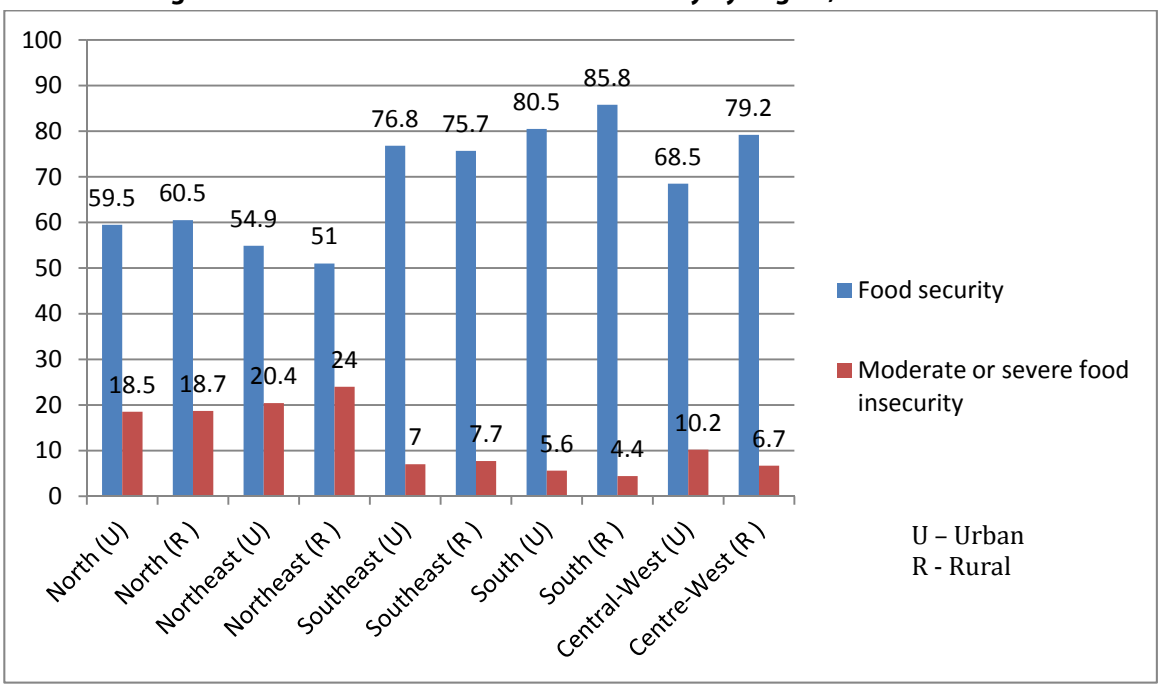
Source: IBGE, Universo preliminary do Censo Demografico, 2010. Created by author.

The food security situation in Brazil's northeast is also the country's lowest, with 49 per cent of rural household in a state of uncertainty and/or concern as to where their next meal will come from — considered 'mild food insecurity'. Roughly one quarter of rural households in the northeast live in much worse conditions concerning access to food considered either 'moderate or severe food insecurity'.[14]

The latest data from Brazil's Institute of Geography and Statistics (IBGE) reveal that 46.67 per cent of Brazil's 90,497 known 'organic/agroecological' agricultural establishments are located in the Northeast region (IBGE, 2009). Furthermore, one of the only family farm support programmes that encompasses a specific incentive for agroecological producers, Programa de Aquisição de Alimentos (PAA — Food Acquisition Programme), has targeted the Northeast region by allocating the majority of its resources there, as indicated in Figure 5.

FIGURE 4

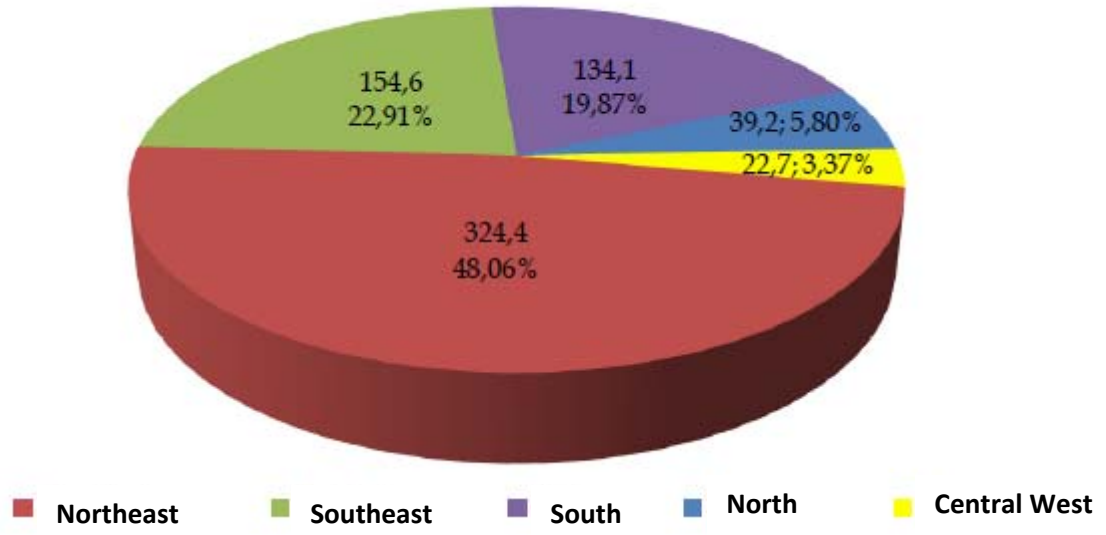
Percentage of Households in Brazil with Food Security by Region, 2009



Source: IBGE, National Household Survey 2009.

FIGURE 5

PAA Distribution of Financial Resources, by Region, 2010



Source: Gestor do PAA, 2010.

In the context of such a high concentration of family farm establishments, poverty incidence and malnutrition, agroecological production and allocation of PAA funds, this geographical region is ideal to conduct a two-week field study assessing family farm experiences with agroecology and their interaction with the available family farm support programmes encouraging such a transition. More than just examining the advancement towards agroecology and programme effectiveness, we reveal the experiences of agroecological producers and how this food production system alleviates poverty, malnutrition, social exclusion and environmental degradation.

4 THE ADVANCEMENT OF AGROECOLOGY IN BRAZIL

In Brazil, agroecology started gaining ground in academia as an alternative vision of agriculture in the 1980s. Researchers and NGOs, such as the Assessoria e Servicos a Projetos em Agricultura (AS-PTA), first started disseminating information on agroecological alternatives. This became central to cooperation and knowledge-sharing between farmers.[15] Under the Ministry of Science and Technology (MCT), the National Council for Scientific and Technological Development (CNPq) incorporated agroecology into its research initiatives, as did the Coordination of Improvement of Higher Education Personnel (CAPES) under the Ministry of Education. This played a major role in the institutionalisation of agroecology into research and implementation processes in academic and independent research institutions, government departments and, ultimately, on the farm (Altieri, and Toledo, 2011).

The Brazilian Association of Agroecology (ABA) — comprised of small farmers, researchers, and NGOs — has also been instrumental in the institutionalisation and implementation of agroecology in Brazil. The ABA works in conjunction with the Latin American Scientific Society of Agroecology (SOCLA), which is a regional network of researchers, professors, experts etc. that promote agroecology as an alternative to the crisis of industrial agriculture. In 2002, the National Articulation of Agroecology (ANA) emerged as an arena for movements, networks and civil society organisations to promote and share experiences of agroecological systems in practice. Even the agri-business-oriented Brazilian Agricultural Research Company (EMBRAPA) has programmes on agroecology and collaborates with ABA and ANA on agroecological research. The largest rural labour organisations in Brazil — MST, the National Confederation of Rural Trade Unions (CONTAG) and the Federation of Family Farmers (FETRAF) — have also been active, though to different degrees, in promoting and pursuing agroecology in practice. This type of grass-roots support, combined with the education and training initiatives of the MST and LVC noted above, has encouraged and influenced policy implementation at the state level (Cohn et al., 2006).

In practice, it is the small family farms which have implemented agroecological techniques. According to Cohn et al. (2012), over 200,000 family farms have adopted agroecological farming practices in Brazil today, showing average yield increases of 300 per cent and 100 per cent for black beans and corn, respectively, as well as increasing resilience to irregular weather patterns (Government of Brazil, 2012; Cohn et al., 2006).

In 2003, the National Council for Sustainable Rural Development (CONDRAF)[16] was created by Decree 4854 as a platform led by the MDA to "propose guidelines for the formulation and implementation of active public policies, constituting a forum for consultation and coordination between different levels of government and civil society organisations for

sustainable rural development, land reform and family farming" (MDA, 2012c). This form of participatory inclusion has allowed civil society and other NGOs to engage in the political discussion and represent multiple stakeholder interests. Further, in 2007, CONDRAF created the Standing Committee of Agroecology through Resolution No. 64. This committee comprises participants from both governmental and non-governmental organisations and is responsible for monitoring and evaluating public polices supporting agroecology, submitting proposals and guidelines for programme implementation, and analysing strategies to support the agroecological transition in Brazil. Essentially this multi-stakeholder committee discusses, scrutinises and monitors public policies and strategies supporting agroecology, to give assessments and recommendations. Further, this committee has played a lead role in developing and passing the National Policy for Agroecology and Organic Production (PNAPO).

4.1 BRAZIL'S NATIONAL POLICY FOR AGROECOLOGY AND ORGANIC PRODUCTION

The PNAPO was drafted in April 2012 at the ANA conference in Brasilia. The proposal brought together 133 organisations and 24 social movements/networks from all over the country to articulate a comprehensive national policy for agroecology — perhaps the biggest movement for agroecology in Brazil. The proposal was drafted after a series of five regional seminars throughout Brazil with a policy of open participation for all. The document was finalised in April 2012 and further elaborated on in May 2012 by the National Council on Food and Nutritional Security (CONSEA), which consists of government and civil society actors engaging, discussing and proposing guidelines for policy towards food and nutrition.

PNAPO calls for a restructuring of both agricultural systems in Brazil: family farming and industrial agriculture. Specific actions include revising the definition of family farming in Brazil to include more activities and livelihoods. All access to family farm policies in Brazil is provided through registration in Brazil's family farming registry (Declaration of Eligibility to the National Program for Strengthening Family Agriculture — DAP). Complementary to these actions, the PNAPO promotes the expansion of family farm policies (PAA, PNAE, PRONAF, ATER) and the specific expansion of the role of agroecological and organic products within those policies.

It advocates for institutional space in several government ministries and agricultural bodies for family farmers, peasants and traditional communities. Specific actions are presented such as: the expansion of agroecological research in Brazil's agricultural research institutions; a national plan for a transition to agroecological production; the expansion of 'family agriculture schools'; the improvement of infrastructure for the rural population (roads, communication, health, education etc.); the provision of space for the PNAPO and its members and network into Brazil's agricultural research company (EMPRAPA) and its programme for agroecology. Table 3 shows PNAPO's specific investment initiatives to be completed by 2015.

On the social side the PNAPO outlines numerous areas but notably the creation of an 'agroecological youth' programme that would promote agroecological production through information exchanges, youth education for public policies and technical assistance. A similar component calls for the creation of an 'agroecological women' programme with similar objectives as for youth but targeted specifically at women.

Regarding industrial agriculture the document calls for a monitoring mechanism on the effects of agrochemicals on plantation workers and the responsibility of the owners to compensate relevant health costs. Additionally, industrial agriculture will no longer have

exclusive access to seed banks and the genetic rights to those seeds. The document also calls for consumer education so that they can be informed about what they are eating, where it comes from and how it is produced.

TABLE 3

PNAPO Goals for 2015

- R$ 6.5 billion in credit and investments for PRONAF and ABC
- R$ 758 million in ATER
- R$ 600 million in social technologies, water access, and production
- R$ 100 million for the strengthening of agroecology networks in agroextractivism and organic production ;
- R$ 8.4 million on strengthening productive capacity of rural women
- R$ 15 million to strengthen the program for productive inclusion of rural youth
- R$ 150 million in the acquisition and distribution of plant and animal genetic resources, native seed varieties, and organic/agroecological crops through the PAA
- R$ 17.1 million in the implementation of community seed banks
- R$ 165 million in organic and agroecological food purchases through the PAA
- R$ 24 million to support and promote organic and agroecological products
- R$ 65 million in research and extension technology Source: MDA, 2013

The national policy has also created National Commision for Agroecology and Organic Production (Comissão Nacional de Agroecologia de Produção

Orgânica, Cnapo) to monitor the adoption and implementation of PNAPO. The commission is comprised of 14 governmental two thirds civil society members and one third government institutions and federal ministries. Funding for the PNAPO and the commission would come from a variety of sources such as a provision in the federal budget, environmental fines, private foundations, and various ministries relating to different components of agroecological production (i.e. Ministry of Environment, Ministry of Agrarian Development, Ministry of Agriculture) (MDA, 2013; CONSEA, 2012; ANA, 2012a; 2012b).

This policy was the result of a long process of negotiation and struggle between civil society and governmental actors, and the final version of plan does not encompass the exact elements presented in the aforementioned proposal. Nonetheless, this policy represents a new tool for famers to challenge the expanding agro-industrial complex and demand more support and resources for sustainable agricultural practices.

5 BRAZIL'S FAMILY FARM PROGRAMMES SUPPORTING AGROECOLOGY

Brazil's 2012–2015 National Food Security Plan emphasises the need to restructure the food system away from a corporate-controlled system of chemical-dependent monocultures and towards a new model based on food sovereignty, sustainability and nutrition. The challenge, as the Plan highlights, is to increase support for family farming and incorporate the principles, methods and technologies of agroecology into the production system (CAISAN, 2011). In fact, Brazil's Interministerial Committee on Food and Nutritional Security, in collaboration with the MDS, MMA and MFA, recently translated the extensive report and literature review by the UN Special Rapporteur on the Right to Food, Olivier de Schutter, on agroecology as a way forward for agricultural development to solve the hunger epidemic and create a system of agriculture that is economically, socially and environmentally sustainable (CAISAN, 2011).

Within the country's current programmes to support family farmers, the following initiatives are already in place with elements to encourage and support agroecological production:

i) the Food Acquisition Programme (PAA);

ii) the National School Feeding Programme (PNAE);

iii) the participatory and integrated school meals project (Project ELO);

iv) Technical Assistance and Rural Extension Services (ATER); and

v) the Integrated and Sustainable Agroecological Production project (PAIS).
The following section provides a deeper examination of the design and implementation of these programmes and how they contribute to building stronger agroecological food systems.

5.1 PROGRAMA DE AQUISIÇÃO DE ALIMENTOS (PAA)

In 2003, the government developed the PAA with Law No. 10.696 within the overarching Zero Hunger Programme. The PAA is a multifaceted programme which supports vulnerable family farms with market access and minimum price guarantees; supplies food-insecure populations with food donations; and provides incentives for agroecological producers. This gives family farmers a secure guarantee for their crops and allows them to organise and plan production based on market assurance (Nehring and McKay, 2013).

In 2011, Law No. 12.512, Article 17, established that agroecological or organic products may be procured at a price increase of up to 30 per cent in relation to the prices set for conventional products by CONAB. Based on our research in the field and discussions with CONAB officials, prices offered to family farmers through the PAA are, on average, much higher than selling to a private intermediary — anywhere from 30 to 300 per cent. However, not a single family farmer producing agroecologically and/or participating in the PAA had ever heard of this agroecological incentive through the PAA. This lack of programme awareness and outreach was a common theme throughout our field research, which we will elaborate on further in this paper.

Nonetheless, the PAA has made great strides in procuring organic/agroecological crops. According to CONAB (2012), the PAA procured R$8,565,623.10 worth of organic products in 2011, up from R$4,264,638.42 in 2009 (See Table 4).

TABLE 4

Evolution of Procurement of Organic Products by the PAA, 2009–2011

Region	Value (R$)		
	PAA 2009	PAA 2010	PAA 2011
Central West	75,900.25	43,475.48	371,873.82
Northeast	779,352.70	1,318,664.84	935,534.41
North	166,500.00	0	0
Southeast	877,527.68	1,040,746.38	1,517,012.91
South	2,365,357.79	4,225,832.13	5,741,201.96
Total	4,264,638,42	6,628,718.83	8,565,623.10

Source: CONAB, 2012.

However, there remain severe regional discrepancies as to where organic products are being procured. Table 4 shows that over two thirds of the total amount of organic crops procured in 2011 were from the Southern region. If we compare this to the latest official data on regional agroecological production in Brazil, we can conclude that there is a severe regional bias in PAA organic procurement. The latest Agricultural Census of 2006 reveals that 46.7 per cent of known organic establishments were located in the Northeast region, while only 21.3 per cent were located in the Southern region. Although outdated, these data still shed light on the minimal amount of PAA procurement relative to the number of organic farms in the Northeast compared to the Southern region. This could be due to a variety of reasons, such as a lack of programme awareness, a lack of organic certification, a minimal amount of technical assistance, a lack of access, a lack of organisation etc. However, it is clear that this regional discrepancy must be addressed to not only support those producing agroecologically and encourage the transition but also to support the region of Brazil with the highest number of family farmers combined with the highest incidence of poverty.

In aninterview with Brazil's former Secretary of Family Agriculture of the Ministry of Agrarian Development, Laudemir Müller, it was revealed that the total PAA budget in 2011 was R$775 million, benefiting 204,000 family farmers. This is a substantial increase from 2003 when the programme started with a total of R$144.92 million and benefiting just 42,077 family farmers (Gestor do PAA, 2010). Moreover, this increase is also largely being allocated in the Northeast region, with 48 per cent of total PAA funds distributed there in 2010 (Ibid.). Large discrepancies remain, however, as to organic procurement — an issue that must be addressed by both the technical assistance services (ATER) and PAA management.

Despite this effort, the 2011 figures still only represent a mere 4.67 per cent of the total number of family farmers registered in the 2006 Agricultural Census. Thus, one of the main

issues to be addressed is to scale up the programme to not only cover the vast majority of family farmers but also improve on some of the obstacles that participants are currently facing (see Nehring and McKay, 2013).

5.2 PROGRAMA NACIONAL DE ALIMENTAÇÃO ESCOLAR (PNAE)

Brazil's PNAE was established in 1955 to supply school meals to public schools (FNDE, 2005). In 2009, PNAE established new guidelines to expand its scope through Law 11.947 to provide free meals for students enrolled in day care centres, nursery schools, preschools, elementary and secondary education, special education and all other forms of basic public education.

The programme aims to provide adequate, healthy and safe food for students, while encouraging increased school attendance and improving student performance. By the same law, schools participating in PNAE must acquire at least 30 per cent of their food supply from local family farmers. While the purpose of the programme is to increase the level of food security for students attending public schools, it also creates a new market opportunity for local family farmers. This 30 per cent local procurement policy, which was only established in the national policy in 2009, is based on Project ELO, a local initiative which we will discuss in more detail below.

PNAE now acts as a transformative programme to foster local development through food and nutritional security as well as supporting local family farmers. As a complementary programme to the PAA, PNAE extends market opportunities to family farmers and increases yearly income limits for public procurement. Combining both demand- and supply-side support results in a variety of positive outcomes. With quality and nutritious meals provided at schools, students are more likely to attend school, reducing drop-out rates. This also contributes to student health and is conducive to improving school performance. By procuring at least 30 per cent of school meals from local family farmers, the local food culture is maintained with respect to local/regional habits. Support for diverse local food varieties reinforces regional crop diversity and strengthens the resilience of the food system to better withstand climate change and price shocks.

This support to family farmers is beneficial for the local economy and generates employment and income for the community. Further, this entire process requires planning and organising, encouraging social cohesion and community participation, which leads to the strengthening of social capital and positively impacts the community as a whole.

Through PNAE, family farmers can earn a maximum of US$5027/year, which is roughly US$418/family/month. The programme budget for 2011 was R$3.1 billion, benefiting 45.6 million students enrolled in public education throughout Brazil. With at least 30 per cent of total funds to be allocated for family farmers, at least R$930 million should have gone directly to family farmers in 2011. PNAE's total budget allocation for family farmers is, therefore, higher than that of the PAA, according to 2011 data, which was R$775 million. Combined, these two procurement programmes provided R$1.705 billion for family farmers in 2011 (FNDE, 2010).

5.3 PROJECT ELO

In 2006, São João do Arraial, a municipality in Piauí, started a groundbreaking initiative to deliver high-quality, local food to students. The local government, schools and the community came together to create a school-feeding local development initiative to support both producers and consumers. With a high degree of organisation and cooperation, communities around São João do Arraial are providing free school meals to students, with 70–100 per cent of the food procured from local family farmers. This local community initiative feeds roughly 234 students from several communities around São João do Arraial and provides market access to numerous local family farmers.

After winning a UNDP Millennium Development Goal Award, Project ELO became a reference point for Brazil's PNAE, which now requires schools to procure at least 30 per cent of their school meals from family farmers. Project ELO has received much praise and has had huge success. But for the community, it was just something that made sense. And it does. Why wouldn't local farmers feed the local community? The current global food system has become so entrenched with vertically integrated agro-industrial complexes controlling every step of the supply-chain process that we have become accustomed to our food travelling an average of 2000 miles from farm gate to dinner plate (McMichael, 2000). The idea of bringing 'the local' back into our food system has lost its place — so much so that (not to discredit Project ELO) a simple idea of procuring community school meals from local farmers wins an MDG Award.

As opposed to PNAE, Project ELO adapts the school's menu according to the seasonal crops available. Farmers meet with the local school's nutritionist once a month and plan the month's school menu. Due to the proximity of family farmers to the schools, transportation has not been an issue for these communities. The project has not only generated income for the community but has also had a positive impact on school attendance and the quality of school meals. According to the mayor, school attendance went from 87.2 per cent to 98.2 per cent from 2005 to 2007. Moreover, based on discussions with local farmers and school staff, farmers are more conscious of the inputs they are using in production, knowing that their produce is going to local schools and, in many cases, their own children. In fact, all local family farmers we interviewed were producing their crops using diversified agroecological methods, without any agrochemical inputs. This was simply the way they always produced food, and they had no need for chemical inputs in their diverse agro-ecosystems.

5.4 ASSISTÊNCIA TÉCNICA E EXTENSÃO RURAL (ATER)

Technical assistance and rural extension services have a tumultuous history in Brazil. Important extension services were established in the late 1940s, aimed at boosting agricultural production for post-war industrialisation. It was not until the 1970s that the military regime nationalised the technical assistance and extension services. The military regime was primarily concerned with boosting targeted yields in compliance with the 'green revolution'. Rapid urbanisation and agricultural intensification increased land concentration and the presence of large-scale industrial agriculture. Then in 1990 the newly democratic government nearly abolished federal funding for the national rural extension service, which placed the responsibility of agricultural extension services on state governments. As a result, Brazil's extension services became uneven as many states in the northeast were either unable or unwilling to financially or logistically support government extension.

However, the lack of extension services in the early 1990s provided space for national and international NGOs and private contractors that provided mixed services, especially in the case of dispersed family farms. For over a decade the government used contracts to outsource extension that had no central mandate or goal to provide a specific production method. The decentralised system allowed for the creation of several progressive NGOs but removed the potential for the government to have a national mechanism of controlling extension services geared towards more sustainable production, such as agroecology.

In 2003, with the election of the Partido dos Trabalhadores (Workers' Party) and President Luiz Inacio Lula da Silva, a new phase of Technical Assistance and Rural Extension (ATER) was inaugurated by the government. The Workers' Party re-established the Department of Technical Assistance and Rural Extension (DATER) within the MDA and initiated the process to re-implement and restructure these services. In 2004, the National Policy of Technical Assistance and Rural Extension (PNATER) was established with participation from both governmental and non-governmental personnel. Under this arrangement, ATER services were carried out by state agencies and NGOs with private contracts. However, since 2003 this form of management and financing has experienced many limitations in terms of bureaucratic inefficiencies, accountability, funding continuity and quality assistance. These inadequacies have resulted in the limited implementation of the goals and principles of PNATER, particularly in relation to the transition to agroecological production systems and participatory methodologies (MDA, 2012).

In 2010, the government enacted Law No. 12.188, which consolidated PNATER and established the National Programme for Technical Assistance and Rural Extension (PRONATER). The programme is based on the following principles:

1. Sustainable rural development compatible with the adequate use of natural resources and the preservation of the environment
2. Gratuity, quality and accessibility of technical assistance and rural extension[17]
3. Adoption of participatory methodology
4. Adoption of the principles of ecological agriculture as the basic approach of choice for the development of sustainable production systems
5. Gender, racial and ethnic equality
6. Contribution to food security, food sovereignty and nutrition.

Source: Law 12.188, 11 January 2010.

The 1st National Conference for Technical Assistance and Rural Extension (CNATER) was held on 23–26 April 2012 in Brasilia, which brought together over 700 delegates representing civil society and government entities. The conference was held to discuss the policy and programme for technical assistance and rural extension and ways in which it could be improved. The outcome of the conference was an impressive 26-page document highlighting the challenges, priorities and strategies for the future. Agroecology is emphasised throughout, mentioned a total of 17 times as a key priority for PNATER. Table 5 summarises the key outcomes of the document.

TABLE 5

Key Outcomes of CNATER to Promote and Support the Transition to Agroecology

Agroecology is recognised as the scientific basis for PNATER in achieving sustainable rural development.
PNATER must work to help family farmers transition away from agrochemical inputs.
Increase incentives for sustainable agriculture/agroecological initiatives.
Create and expand strategies to stimulate consumption of organic/agroecological crops.
Promote and support the role of women in the agroecological transition.
Prepare and educate rural technician teams to improve agroecological technical advice and assistance.
Promote the adoption of the institutionalisation of agroecology in the public education system.
Create a National Endowment to support family farmers in transitioning to agroecological production and compensation for environmental conservation and preservation.
Ensure adequate financing for ATER.
Value the importance of local knowledge in developing new agroecological techniques.
Improve the process of organic/agroecological certification.
Support and promote participatory processes for farmers to share knowledge.

Source: MDA, 2012b.

This is a very important document with a mandate to revamp technical assistance and rural extension in Brazil after decades of deterioration. The challenge, of course, will be to live up to these ambitious goals with concrete action. This needs to start with education and outreach — both of which will largely depend on supporting ATER with sufficient budget allocation and the institutionalisation of agroecology in school and training systems. It is promising to see that the budget allocation for ATER has increased from just R$46 million in 2003 to R$657 million in 2012 — a 14-fold increase in nine years (MDA, 2012b). Even given this scale-up, the 2012–2013 ATER budget aims to only provide assistance to 480,000 farmers, which is just under 11 per cent of the total number of family farmers registered with DAP.

Brazil's plan to eradicate extreme poverty, Brasil sem Miséria, has promised to provide one technician with a university degree and 10 mid-level technicians for every 1000 families by 2014 (Government of Brazil, 2012). This is an ambitious goal, as thousands of technicians will need to be educated and hired within two years. Many of the technicians already promoting agroecological production methods exist but are not necessarily incorporated into government programmes.

During our field research in Piauí and Ceará technical assistance was nearly non-existent. The vast majority of family farmers had received little to no technical assistance and even fewer from government-funded ATER services. Those who had received technical assistance had received it from local NGOs and associations or through farmers' networks facilitated by these organisations.

In the state of Ceará, technicians from the Centro de Estudos do Trabalho e de Acessoria ao Trabalhador (CETRA — Centre for Labour Studies and Worker Advisement) are providing many family farmers with essential services not covered by the government.[18] CETRA compensates for the lack of government technicians and is part of a civil society network that provides technical assistance and facilitates farmers' networks around agroecological production. Central to its work is the capacity-building of formal and informal farmers' networks, cooperatives and associations as well as promoting its agroecological market in the municipality of Itapipoca, Ceará. It also manages a small credit programme that provides low-interest loans for agricultural transitions and infrastructure improvements. Recently, it has also become involved in the promotion of rural livelihoods and supporting women's rights. A photography programme gives rural children the opportunity to document their lives and showcase their photographs in the state's capital, Fortaleza. In strengthening women's rights, CETRA organises workshops on income-generating activities and empowerment for gender equality and solidarity.

During our time with CETRA we were able to see one of the best examples of integrated agroecological production, where a farmer was able to make around R$900 a month on only 2 hectares of land (personal interview). The farmer participated in both the PAA and PNAE and was active in the farmers' network and agroecological market facilitated through CETRA. Due to his participation and success through CETRA, the farmers' network benefited greatly from his experience and was able to teach others the techniques he uses to maximise yields in his highly integrated production method.

Another example of technical knowledge was the Escola Familia Agrícola dos Cocais (EFA Cocais — youth agricultural field school) in the municipality of São João de Arraial, Piauí. Brazil's Territórios da Cidadania (territorial development strategy) allowed for funds to be allocated for the construction of the school in 2008. After the start-up costs were provided by the federal government, the school's budget comes largely from the state, with a small contribution (10 per cent) from the municipality. A small fee is incurred (R$20) by the students which covers two weeks lodging at the school and all meals during that time. Throughout those two weeks the students (14–26 years old) take coursework on agroecological production methods and agribusiness management and complete oral and written exams. To finish the programme, the students apply their own project during a follow-up period of 15 days and present the results to the school at the end. As an incentive, each year one of the projects is selected by the school's staff to receive a R$10,000 credit for the students to fully carry out their project. Within the state of Piauí there are 16 total EFA Cocais schools (roughly one for every three municipalities) that were funded through the territorial development programme, but only three of them were actively teaching agroecological methods (personal interviews).

We also participated in farmer-to-farmer network meetings facilitated by the Centro Cocais (Centre for Community Organisation and Support for Social Inclusion) in São João de Arraial. This organisation is instrumental in providing support and assistance for family farmers in the region. It not only organises farmers' markets and strategies for accessing new markets

but also connects farmers in the region to share knowledge and provides information on available public policies and programmes. We participated in one meeting with 26 family farmers and the President of EFA Cocais, the head of the community's rural workers' union, the mayor of São João de Arraial and the community organisers affiliated with Centro Cocais.

These meetings are extremely important, as they bring together key individuals in the community to discuss market opportunities, farming techniques and production planning and exchange ideas. During the meeting, we asked the 26 family farmers about agroecological production and their participation in the PAA, PNAE and other programmes. All 26 used various agroecological techniques and without any agrochemical inputs. All 26 also participated in the PAA, yet none had even heard of the 30 per cent price increase for agroecological/organic crops. This was a common occurrence during our field research, as we informed nearly every community that we visited of the PAA's agroecology incentive and other public programmes that eligible farmers were not receiving.

Nonetheless, organisations such as Centro Cocais, CETRA and EFA Cocais are filling crucial roles in assisting farmers in a variety of ways, in the absence of ATER. However, the re-establishment of ATER along with a growing number of these key NGOs will provide the much needed strengthened institutional capacity to provide technical assistance and rural extension for Brazil's family farmers.

5.5 PRODUÇÃO AGROECOLÓGICA INTEGRADA E SUSTENTÁVEL (PAIS)

In 1999 a Senegalese agronomist, Aly Ndiaye, who had come to Brazil to study, and a group of family farmers developed a new agroecological production system called the *Produção Agroecológica Integrada e Sustentável* (PAIS — integrated and sustainable agroecological production'). After it showed successful results in terms of productivity, diversity, efficiency and transferability, the Ministry of National Integration (MI), the Bank of Brazil Foundation (FBB) and the Brazilian Service to Support Micro and Small Enterprises (SEBRAE) agreed to jointly finance the project. The MDS now supports the project, and CONAB has been involved in the evaluation process. The PAIS initiative supports family farmers in communities with the lowest Human Development Index (HDI) throughout Brazil.

This model of social technology allows family farmers to grow a diversity of crops for both consumption and the market. The PAIS unit is designed with a chicken coop in the central area, three vegetable beds surrounding the henhouse, and grazing land. Families receive a kit containing all material inputs needed for the construction of the unit with the help of state government partners.

The average cost of each kit is roughly R$3500, which includes all construction materials, a water tank, drip irrigation system, and installation (IPEA, 2007). Other costs include managing, monitoring and technical assistance. Participating family farmers are also required to take a four-day training course with SEBRAE to learn about PAIS production and agroecology. Since 2005, close to 10,000 family farms are producing with PAIS throughout Brazil's poorest regions (MDS, 2012; SEBRAE, 2009). This model of agroecological production seeks to: (i) reduce dependence on external inputs; (ii) diversify production; (iii) use water efficiently; (iv) achieve sustainability on small farms; and (v) enable production in harmony with natural resources (MI, 2012).

The PAIS project has produced great results and has been transformative for family farmers in terms of changes in their production, consumption and income levels. The main features of the production system are: its resource efficiency with drip irrigation; its crop diversity through crop rotations and polycultures; its enhanced soil fertility with animal integration, cover crops and agroforestry systems; its low input cost with a complete absence of chemical-based pesticides, herbicides and fertilisers; and its relatively low start-up costs, transferability and little to no continued financial commitment for the government.

Just outside São João do Arreal, Piauí, we visited a family farm participating in the PAIS project. Francisco, from the Chapada da Sinda settlement, said that since producing with PAIS, his productivity, crop health, income and quality of life had all increased substantially (personal interview). Francisco grew a diversity of crops for household consumption and local markets. The wide diversity of crops he produced allowed his family to use some production for consumption, thus substantially decreasing their expenditures. Of the produce sold to markets, 70 per cent went to the PAA and PNAE, while 30 per cent was sold directly at local markets. Despite producing 100 per cent agroecologically and being involved in the PAIS programme, Francisco was still not a certified agroecological/organic producer, so he was not receiving the 30 per cent price increase for his products through the PAA. In fact, Francisco was unaware of the PAA's agroecology incentive and was very curious to know how he could participate and gain certification after we told him about the opportunity.

Another family farm participating in PAIS in the Piranhas Assentamento was having similar success. Jose and Alcinede, along with their two children, were participating in PAIS, selling to the PAA, PNAE and local markets, and receiving the Bolsa Familia conditional cash transfer. They said that since participating in these programmes they have been able to climb out of poverty and even start saving. They were an extremely happy family, very proud of participating in these public programmes and the manner in which they produce food. Similar to the previous case, Jose and Alcinede produced 100 per cent agroecologically, sold to the PAA but did not receive a 30 per cent price increase and had not heard of this incentive.

Nonetheless, the PAIS project as a model of production is having great success and transforming the way family farmers produce and consume food. It also requires very little assistance once the project is implemented. The project itself, however, could also be assimilated and reproduced in various forms, without depending on the so-called 'PAIS kit' for implementation. PAIS is simply based on a production system which encompasses agroecological principles. While the project itself has produced great results, this model could be reproduced for others through farmer-to-farmer networks of learning and sharing techniques. The roughly 10,000 PAIS projects currently in operation could serve to spark more interest within the communities in which they are based, but it would be useful to launch a scale-up campaign to encourage knowledge-sharing and the dissemination of the agroecological production model.

6 REFLECTIONS FROM THE FIELD

Although many of Brazil's family farm support programmes are beginning to implement policies to support the transition, agroecological production has largely been independent of government.

The aforementioned public policies and programmes which provide incentives for agroecological producers were largely irrelevant to family farmers in Piauí and Ceará. Even family farmers participating in the PAA and using agroecological farming techniques were unaware of the potential benefits they could be receiving from the programme. Many people were simply using diversified cropping systems, crop rotations, cover crops etc., because these techniques had been passed down from previous generations and integrated into the agrarian culture.

Other communities not too distant, however, had contrasting experiences and reasoning. These communities felt they had become dependent on chemicals and feared abandoning their agrochemical inputs, as this might threaten the growth and health of their crops and, therefore, their livelihoods. This was, in large part, due to the introduction of chemical-based inputs into the community which had created a wave of dependence on such external inputs with long-term negative results.

What became evident regarding agroecological food production is the importance of NGOs and associations in bringing farmers together and facilitating farmer-to-farmer networks or building technical capacity with assistance. Apart from the ability of the policies, programmes, incentives, networks, associations etc. to encourage a transition to agroecology, the farmers we encountered who were actually using a system of agroecological production were doing so with success — in terms of productivity, yields, diversification, crop health, resource efficiency and quality of life (farmer interviews, 2012).

Throughout the research we encountered several common themes regarding the concept of agroecology, the programmes encouraging such a production system, and the outcomes of agroecological farm systems: (i) farmers' lack of knowledge of the term 'agroecology'; (ii) the lack of awareness of and access to the public programmes available; and (iii) the overwhelming satisfaction and success of agroecological farming systems.

Although the term 'agroecology' is increasingly gaining popularity in academia, research institutes and rural social movements, many people, including farmers using 'agroecology'-based techniques, are unaware of the term. This is understandable, as agroecology, by definition, can be interpreted as a scientific discipline, as a political movement or as a practice. Although the term emerged in the 1930s, it was not until the 1990s that agroecology really became institutionalised and consolidated (Wezel and Soldat, 2009).

Although it still has a long way to go, agroecology in Brazil is becoming institutionalised in government documents, NGO research and projects, the education system, rural worker movements, and farming practices. In Piauí, the Regional Superintendents of both INCRA and CONAB, Francisco das Chagas Limma and Mr. Mendes, voiced the importance of agroecology for family farmers' livelihoods, food security and sustainability. Mr. Limma of INCRA said that agroecology is part of INCRA's vision, but it will depend on ATER and the ability to institutionalise agroecology within the technical assistance programme. Moreover, Limma added that a transition to agroecology is dependent on three key pillars: (i) technical capacity; (ii) political will; and (iii) adequate management structure to ensure implementation. He considers that agroecology will play an important role and is already gaining ground in INCRA Piauí, but he says that ATER services still have a long way to go to build its capacity for agroecology-based technical assistance.

In rural Uniao, Piauí, we visited a recent INCRA settlement containing 1112 hectares, occupied by 30 families. Each family has a piece of land measuring 100 by 50 metres, while roughly 20 per cent (246 hectares) of the entire settlement is preserved for natural vegetation and babaçu forest. The remaining area is collective property for the entire settlement. All 30 families of the settlement are registered with DAP and participate in the PAA, while 22 access credit through PRONAF's credit line 'A'.

These family farmers have experienced a tremendous improvement in quality of life since being granted access to land and its productive resources. Their participation in the PAA has also increased their capacities to plan and increase production — breaking the exploitative cycle they formerly had with private intermediaries who would visit the community and offer much lower prices for their crops. Due to a lack of transportation and market access, these farmers had little choice but to settle with the offer from the private intermediaries. Now these family farmers say that their incomes have increased three-fold, while the impacts on quality of life and self-esteem have been remarkable.

When asked about agroecological production, the farmers were not familiar with the term. However, they did acknowledge that they use agrochemical inputs for fertilisers and pesticides. The farmers said they would like to produce without the use of agrochemicals, but they feel dependent on these inputs. "We need these agrochemicals to make sure our crops grow fast and healthy," one farmer said. These family farmers — who, in general, are relatively new landowners and decision-makers — did not have the experience or training of growing crops without agrochemical inputs. This lack of knowledge of such agroecological techniques and the farmers' willingness and interest in eliminating agrochemical inputs highlight the importance of technical assistance and farmer-to-farmer networks in sharing expertise and farmers' experiences. Nonetheless, these farmers continue to rely on these external inputs and indicated that they spend roughly R$150 each per half hectare (100 by 50 metres) per harvest. For family farmers starting out, this is indeed a substantial input cost. The farmers also stated that they are noticing an increasing dependence on using larger quantities of external inputs. Although they have yet to see any other negative impacts on their crops, the land or their own physical health, they have only been using agrochemical inputs on this settlement for two years.

When we visited the settlement, we noticed areas of roughly 800m^2 of unused land. After the discussion on agroecological farming techniques, we suggested that the family farmers should collectively experiment growing without agrochemical inputs on these open land areas. Using manure/green manure, planting polycultures and using crop rotation were a few ideas we discussed as an experiment for which they could try out different techniques to see the results of not using chemical inputs without compromising their main crops for retail and consumption.

We also talked about the 20 per cent land area that is preserved and only used for harvesting babaçu. Babaçu palm is an extremely useful plant which grows naturally in the region and is best known in Brazil due to the Movimento Interestadual das Quebradeiras de Coco Babaçu (MIQCB — Interstate Movement of Babaçu Coco Breakers). This women farmers' movement has had tremendous success in producing babaçu products such as cooking oil, coal, soaps, flour and handicrafts (MIQCB, 2012). Babaçu can also be used for cleaners, skincare products, medicines, beauty aids and beverages. We talked to the farmers about the possibility of planting appropriate crops around the babaçu palm trees in the area to create an agro-forestry system which can enhance soil fertility and increase productivity and biodiversity.

Further, they could use these crops to sell through the PAA and receive a 30 per cent price increase for agroecological production. The farmers expressed interest in these ideas and were very interested in the 30 per cent price increase for agroecological crops. However, technical assistance and/or knowledge-sharing through farmer-to-farmer networks would be essential to implement this process.

Another settlement, Canto Assentamento, formally titled to the farmers in 2010 had a very different outlook on production methods. The 26 families each occupy a land area of 100 by 50 metres, and work 1070 hectares collectively. According to one family, Alidiani Maria and her husband, Domingo, none of the families use chemical inputs. Instead, they collectively grow a variety of crops including rice, corn, beans, babaçu, oranges, bananas and manioc, among others. "We don't use agrochemicals because they hurt the land, animals and human health. The fight to get this land was based on producing without agrochemicals, so this is a principle we believe in," added Domingo. While also selling to the PAA, they too had not heard of the agroecological incentive.

7 POLICY IMPLICATIONS FOR SCALING UP AGROECOLOGICAL FOOD PRODUCTION

Empirical data from the field reveal the key failures in policy implementation and design which ought to be addressed if agroecological production systems are to expand and persist. Combining these original testimonies from family farmers in Brazil with an analysis of the programmes and policies in place to support the agroecological transition exposes the key weaknesses and implications for policy improvement. The key weaknesses are as follows: i) programme awareness; ii) technical assistance and extension services; iii) public-supported farmers' networks; and iv) scale-up.

7.1 PROGRAMME AWARENESS

The majority of family farmers we encountered during our field visits in Piaui and Ceara were unaware of the incentives available for the promotion and support of agroecological farming. A national information campaign implemented by municipal governments and promoted through rural workers' unions and organisations would likely increase awareness and participation in these support programmes. Once these initiatives start spreading from farmer to farmer, not only will agroecological production be likely to increase through policy incentives, but new techniques and knowledge-sharing will emerge as farmers adapt to new methods according to the agroecological environment. Being informed also induces increased political participation, which creates stronger links between the State and society for optimal outcomes.

7.2 TECHNICAL ASSISTANCE AND EXTENSION SERVICES

Technical assistance and extension services, including education, knowledge-sharing and participation by farmers is a crucial component for scaling up agroecological production. As stated throughout this paper, agroecology is a knowledge-intensive, innovative practice that must adapt to each agroecological environment. With the dismantling of ATER throughout the 1990s and early 2000s, the programme for technical assistance is being reconstructed,

especially with PLANAPO. This is an extremely important step to not only promote integrated learning and assistance for a transition to agroecology but also to build up new knowledge and practices throughout the country based on unique environments and growing conditions.

7.3 PUBLIC-SUPPORTED FARMERS' NETWORKS

Many of the successful initiatives discussed throughout this paper highlighted the importance of community networks and local NGOs. Organisations such as CETRA, Centro Cocais and the AS-PTA have all played key roles in building farmer-to-farmer networks and spaces for knowledge-sharing. They have also been crucial in facilitating farmers' participation in public programmes such as the PAA and PNAE, connecting farmers to markets and filling in the gaps which have been overlooked in the programme design. These locally led initiatives function with a very low number of staff members, some of which are volunteers. However, the local-level knowledge and understanding of the local setting allow these organisations to function extremely efficiently and tackle the main problems that arise for farmers. Therefore, it is highly recommended that more funding is made available to support these organisations that are doing invaluable work on the ground and building the capacity of their communities in an inclusive, participatory and sustainable way.

7.4 SCALE-UP

A general recommendation for scaling up agroecological initiatives is necessary to reinforce the inequalities in budget allocation and continued agro-industrial bias which diverts the large majority of Brazil's agricultural expenditures away from the country's 4.8 million family farmers. To alleviate rural poverty, increase food security and reduce environmental degradation, it is necessary to transition away from the agro-industrial farming method towards a more inclusive and sustainable strategy. The recommendations highlighted above do not require massive budgetary spending, but they do require strategic, well-designed initiatives and a long-term commitment to the process. To date, Brazil has been a leader in designing policies and programmes that support agroecological production, but as we have argued elsewhere (Nehring and McKay, 2013), without scaling up these initiatives they will continue to have minimal impacts and fail to deliver intended outcomes.

8 CONCLUSION

Brazilian agriculture remains wrought with contradictions as the country continues to be the world's largest consumer of pesticides and home to one of the largest surface areas of GM crop plantations, while also having arguably the most progressive and effective package of family farm support programmes, one of the world's largest and most influential peasant movements (MST), joined with one of the most advanced agroecology movements. Despite the government still having a clear agri-business bias with a budget allocation of over six times that to family farming (US$59.3 billion versus US$9.6 billion in 2009/2010), the over 4.8 million family farmers have organised and mobilised together with other civil society to increase their influence and agency in the decision-making process (Chmielewska and Souza, 2011).

The family farmer programmes supporting the transition to agroecology are undoubtedly important, but the movement in Brazil has largely been fuelled by NGOs and family farmers themselves. The lack of programme awareness, technical assistance and extension services, public-supported farmers' networks and education have been the key obstacles in the transition to agroecology in Brazil. These obstacles, however, are just a small part of the bigger picture of Brazil's agrarian structure and agro-industrial bias. Family farms and agroecology do not provide attractive market opportunities for investors and corporations and, therefore, are underrepresented at the government level. The agro-industrial complex, mainly consisting of flex crops such as soy, maize and sugarcane, are the central focus for investment and support driven by increased global demands for food, feed and fuel. Nonetheless, many farmers — particularly small-scale family farmers — combined with civil society, NGOs and associations listed in this paper, have been key to supporting the transition to agroecology in Brazil and adopting the concept as a central component of their political demands and movement. If these efforts can continue to be scaled up through movements from below, they will likely be met with policy efforts from above, such as PNAPO, which will work to increasingly and continually scale up agro-ecological food production systems through capacity-building and support to farmers.

The PNAPO is a remarkable advance for agroecological production, as it emphasises the need to strengthen programmes, incentives, technical assistance and rural extension, education, outreach and awareness for agroecology across the country. Our research in the field highlights these weaknesses in the current family farm programmes as key hindrances to the movement. Therefore, it is essential that the PLANAPO be implemented effectively and followed up with its proposals of developing and strengthening institutions, programmes and incentives.

Due to the inherent exclusion of the corporation from the agroecological food system, this transition will undoubtedly be challenged and met with new obstacles and interests in the future. Agroecology in Brazil, however, has largely been led from below — by grass-roots organisations and farmers — and is now becoming institutionalised in policies, programmes and legislation. This progress has been driven by the success of agroecological production — its sustainability, productivity, efficiency, diversity and ability to be culturally sensitive. Increasing the exposure of agroecological production systems, especially through the creation of farmer-to-farmer networks, is a fundamental component in scaling up agroecology on a national level. Strong rural workers' organisations, civil society and community organisers are undoubtedly important to foster this type of horizontal diffusion, but so too are the policies designed to support and create space for these networks, enable access to land and its productive resources and provide access to markets. In Brazil, the strong movement 'from below' is increasingly influencing policy decisions and creating programmes to support and scale up agroecology throughout the country.

Agroecology still has a long way to go, but the transition is continuing to expand horizontally. The institutional framework that exists and that which is currently in the making with PNAPO provides an exceptional pathway forward for not only supporting small-scale family farmers but also improving the food security and nutrition situation in Brazil in a socially inclusive and sustainable manner. This framework is important and can serve as a blueprint for other countries around the world. The next step for Brazil is to institutionalise these ideas into action-oriented policies and programmes to produce concrete results. With a strong civil society movement and the enthusiasm and participation of family farmers, Brazil can lead the transition to agroecology and continue to be a leader in the global South.

APPENDIX I
GLOBAL AREA OF GM CROPS IN 2011: TOP 10 COUNTRIES
(MILLION HECTARES)

Rank	Country	Area (million hectares)	Biotech crops
1	USA	69.0	Maize, soybean, cotton, canola, sugarbeet, alfalfa, papaya, squash
2	Brazil	30.3	Soybean, maize, cotton
3	Argentina	23.7	Soybean, maize, cotton
4	India	10.6	Cotton
5	Canada	10.4	Canola, maize, soybean, sugarbeet
6	China	3.9	Cotton, papaya, poplar, tomato, sweet pepper
7	Paraguay	2.8	Soybean
8	Pakistan	2.6	Cotton
9	South Africa	2.3	Maize, soybean, cotton
10	Uruguay	1.3	Soybean, maize

Source: Clive, 2011.

APPENDIX II
PESTICIDE RESIDUES ON SELECTED CROPS IN BRAZIL

Number of samples analysed by crop and unsatisfactory results
(actual number and percentage of total samples analysed):

(1) Unsatisfactory samples with unauthorised agrochemical residues (NA);

(2) Unsatisfactory samples with authorised agrochemicals, but above maximum allowed (>LMR);

(3) Unsatisfactory samples with two irregularities (>LMR and NA); (1+2+3) Sum of all unsatisfactory samples.

Highlighted in yellow are the five most contaminated crops.

Product	Number of samples analysed	NA (1)		>LMR (2)		>LMR and NA (3)		Total Unsatisfactory (1+2+3)	
		No.	%	No.	%	No.	%	No.	%
Pineapple	122	20	16.4%	10	8.2%	10	8.2%	40	32.8%
Lettuce	131	68	51.9%	0	0.0%	3	2.3%	71	54.2%
Rice	148	11	7.4%	0	0.0%	0	0.0%	11	7.4%
Potato	145	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Beets	144	44	30.6%	2	1.4%	1	0.7%	47	32.6%
Onion	131	4	3.1%	0	0.0%	0	0.0%	4	3.1%
Carrot	141	69	48.9%	0	0.0%	1	0.7%	70	49.6%
Cauliflower	144	35	24.3%	4	2.8%	7	4.9%	46	31.9%
Beans	153	8	5.2%	2	1.3%	0	0.0%	10	6.5%
Orange	148	15	10.1%	3	2.0%	0	0.0%	18	12.2%
Apple	146	8	5.5%	5	3.4%	0	0.0%	13	8.9%
Papaya	148	32	21.6%	10	6.8%	3	2.0%	45	30.4%
Mango	125	05	4.0%	0	0.0%	0	0.0%	5	4.0%
Strawberry	112	58	51.8%	3	2.7%	10	8.9%	71	63.4%
Cucumber	136	76	55.9%	2	1.5%	0	0.0%	78	57.4%
Pepper	146	124	84.9%	0	0.0%	10	6.8%	134	91.8%
Cabbage	127	8	6.3%	0	0.0%	0	0.0%	08	6.3%
Tomato	141	20	14.2%	1	0.7%	2	1.4%	23	16.3%
Total	**2488**	**605**	**24.3%**	**42**	**1.7%**	**47**	**1.9%**	**694**	**27.9%**

Source: ANVISA, 2011.

APPENDIX III
DESCRIPTION OF HOUSEHOLD FOOD SECURITY SITUATION

Situation of food security	Description
Food security	Households have regular and permanent access to quality food in a sufficient quantity without compromising the access of other necessities
Mild food insecurity	Preoccupation or uncertainty of sufficient food in the future; inadequate quality of food resulting in strategies that aim to not compromise the quantity of food
Moderate food insecurity	Quantitative reduction of food between adults and/or a complete change in the diet resulting in the lack of food for adults
Severe food insecurity	Quantitative reduction of food between the children and/or a complete change in the diet resulting in the lack of food between children; hunger (when someone goes the whole day without eating due to lack of money to buy food)

Source: MDA, 2012.

APPENDIX IV
BRAZIL'S *ASSESSORIA E SERVICOS A PROJETOS EM AGRICULTURA* (AS-PTA)

Participatory Farmer Network

Step 1	Engage with local farmers' organisations about alternative food systems
Step 2	Identify main problems and potentials of farmers' agroecosystems
Step 3	Analyse problematic causes using a participatory rural appraisal (PRA), engaging farmers, scientists, technicians, academics etc.
Step 4	Broadcast the results of the PRA on local radio, televisions, community noticeboards
Results	**Participatory and productive** 1. 100,000 agroecological family farmers 2. 100–300 per cent average yield increases 3. AS-PTA PRA system spread to over 200 communities in 15 municipalities involving 10,000 farmers in the state of Parana alone **Sustainability and resilience** • Agronomic problems resolved issues of soil management, fertilisation, pest controls, traditional variety seed production and improvement, agro-forestry. • Traditional crop varieties recovered: beans, corn, potatoes, rice, wheat, manioc. **Efficient and cost-effective** • Government extension agency through PRONAF calculates a yearly cost of $500 per farmer assisted, which is 10 times more than agroecological participatory development approaches which also include research and farmers' organisations' capacity-building costs.

APPENDIX V
CONDRAF REPRESENTATIVES

ABA (Associação Brasileira de Agroecologia)	FASER (Federação Nacional dos Trabalhadores da Assistência Técnica e Extensão Rural e do Setor Público Agrícola do Brasil)
ASBRAER (Associação Brasileira das Entidades Estaduais de Assistência Técnica e Extensão)	FETRAF-Brasil (Federação dos Trabalhadores na Agricultura Familiar do Brasil)
AS-PTA (Assessoria e Serviços a Projetos em Agricultura Alternativa)	INCRA National Institute of Colonization and Agrarian Reform (Instituto Nacional de Colonização e Reforma Agrária)
CONAB National Supply Company (Companhia Nacional de Abastecimento)	MAPA Ministry of Agriculture, Livestock, and Supply (Ministério da Agricultura, Pecuaria e Abastecimento)
CONSEPA (Conselho Nacional das Entidades Estaduais de Pesquisa)	MDA Ministry of Agrarian Development (Ministério do Desenvolvimento Agrário)
CONTAG (Confederação Nacional dos Trabalhadores na Agricultura)	ME Ministry of Education (Ministério da Educação)
FCA (Fórum das Certificadoras por Auditoria)	MME Ministry of the Environment (Ministério do Meio Ambiente)
Setor Público Agrícola do Brasil	UNEFAB (União Nacional das Escolas Famílias Agrícolas do Brasil)
	UNICAFES (União Nacional das Cooperativas da Agricultura Familiar e Economia Solidária)

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NOTES

1. See, for example, Altieri and Nicholis (2005); FAO (2007); IAASTD (2008); de Schutter (2010).

2. 'Family farms' as defined by Brazil's Law 11.326/2006 of 24 July 2006, Administrative order MDA No. 111 of 20 November 2003 and Resolution No. 3.467 of 2 July 2007: (1) An establishment or area of economic activity in a rural area of less than four fiscal modules – which size is defined per municipality. (2) A majority of the labour used on the farm is sourced from the family members. (3) A majority of the income comes from agriculture, fishing or gathering. (4) The establishment is managed by the family.

3. Hereafter, we will refer to smallholders, smallholder peasants, small farmers and family farmers interchangeably, although we do recognise the differences among rural agricultural workers.

4. See, for example, Pretty et al. (2006; 2011).

5. For a more complete list, please see Theodoro et al. (2009).

6. For a thorough review of agroecology as a concept, science and practice, see Wezel et al. (2009).

7. The 'inverse relationship between farm size and output' is widely recognised by agricultural economists. See Barrett (1996); Ellis (1993); Rosset (1999); Deninger (1999); and Binswanger, Deininger and Feder (1995).

8. The central savannah in Brazil (*cerrado*) is one of the most diverse ecosystems in the world, with high levels of endemism, and is disappearing at twice the rate of the Amazon due to the rapid expansion of soybean production and livestock grazing.

9. See Appendix I: Global Area of GM Crops in 2011.

10. See Appendix II: Pesticide Residues on Selected Crops in Brazil.

11. See, for example, the many studies referred to in Shiva et al. (2011).

12. See the website: <http://www.prefiraorganicos.com.br >.

13.The terms 'organic' and 'agroecological' are used interchangeably in Brazilian government texts, though a distinction should be made. 'Organic' agriculture is a legally defined category that requires eliminating chemical inputs and genetically modified organisms (GMOs). Organic farms are not necessarily agroecological (e.g. high dependence on external 'organic inputs') and vice versa.

14. See Appendix III for definitions of food security. Also see the IBGE's National Household Survey on Food Security 2004–2009, <http://www.ibge.gov.br/home/estatistica/populacao/seguranca_alimentar_2004_2009/pnadalimentar.pdf> (accessed 13 September 2013).

15. See Appendix IV.

16. See Appendix V for all representatives in the CONDRAF.

17. Available to family farmers registered through the Declaration of Eligibility to the National Programme for Strengthening Family Agriculture (DAP).

18. For more information about CETRA's history and activities, see <http://www.cetra.org.br>.

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