

Norges miljø- og
biovitenskapelige
universitet

Master's Thesis 2016 30 ECTS
Noragric

Food, Fuel and Fury: Democratising a Sustainable Economy Through Community based food networks in North East Brazil

Brian WILLETT
Master of Science in Development Studies

FOOD, FUEL AND FURY: DEMOCRATISING A SUSTAINABLE ECONOMY THROUGH COMMUNITY BASED FOOD NETWORKS IN NORTH EAST BRASIL

BRIAN WILLETT

MASTER OF SCIENCE - INTERNATIONAL DEVELOPMENT STUDIES THESIS

NORWEGIAN UNIVERSITY OF LIFE SCIENCES: NORAGRIC

SUBMISSION DECEMBER 2016



This research analyses political structures and discourses surrounding the complex relationship between food, fossil fuels, and economic redistribution. It highlights and explores two competing agricultural development discourses and their impacts in North-Eastern Brazil: the struggle for modernisation through market economy, technology, export oriented development and a resource extraction economy versus the collaboration of social movements to promote peasant farming, organic agriculture, collectivization of power and a level of autonomy of food production from market forces. The research highlights the differences in the approaches and critically assesses the long-term implications they have for economic, social and environmental development.

E agora, José? A festa acabou,
a luz apagou, o povo sumiu,
a noite esfriou, e agora, José?
e agora, você? você que é sem nome,
que zomba dos outros, você que faz versos,
que ama protesta, e agora, José?

Está sem mulher, está sem discurso,
está sem carinho, já não pode beber,
já não pode fumar, cuspir já não pode,
a noite esfriou, o dia não veio,
o bonde não veio, o riso não veio,
não veio a utopia e tudo acabou
e tudo fugiu e tudo mofou,
e agora, José?

E agora, José? Sua doce palavra,
seu instante de febre,
sua gula e jejum,
sua biblioteca, sua lavra de ouro,
seu terno de vidro, sua incoerência,
seu ódio - e agora?

Com a chave na mão
quer abrir a porta,
não existe porta;
quer morrer no mar,
mas o mar secou;
quer ir para Minas,
Minas não há mais.
José, e agora?

Se você gritasse, se você gemesse,
se você tocasse a valsa vienense,
se você dormisse, se você cansasse,
se você morresse...
Mas você não morre,
você é duro, José!

Sozinho no escuro qual bicho-do-mato,
sem teogonia,
sem parede nua para se encostar,
sem cavalo preto que fuja a galope,
você marcha, José!
José, pra onde

What now, José? The party's over,
the lights are off, the crowd's gone,
the night's gone cold, what now, José?
what now, you? you without a name,
who mocks the others, you who write poetry
who love to protest? what now, José?

You have no wife, you have no speech
you have no affection, you can't drink,
you can't smoke, you can't even spit,
the night's gone cold, the day didn't come,
the tram didn't come, laughter didn't come
utopia didn't come and everything ended
and everything fled and everything rotted
what now, José?

what now, José? Your sweet words,
your instance of fever,
your feasting and fasting,
your library, your gold mine,
your glass suit, your incoherence,
your hate—what now?

Key in hand
you want to open the door,
but no door exists;
you want to die in the sea,
but the sea has dried;
you want to go to Minas
but Minas is no longer there.
José, what now?

If you screamed, if you moaned,
if you played a Viennese waltz,
if you slept, if you tired,
if you died...
But you don't die,
you're stubborn, José!

Alone in the dark like a wild animal,
without tradition,
without a naked wall to lean against,
without a black horse that flees galloping,
you march, José!
José, where to?

Carlos Drummond de Andrade - 1942

ACKNOWLEDGEMENTS

Mostly for my family who have given me much more liberty than I could ever ask for. I have so much gratitude for the people that gave me a huge helping hand in Pernambuco: Germano, João, Lou, Cledison and Sueli, Clovis, and especially to Ravi and my Pernambucan family. Thanks to the organisations and structures who have agreed to participate in the research or have helped me in some way: Government of Pernambuco, MST, SERTA, ANA, ABA, Olinda Library, Federal University of Pernambuco. Also to the friends that have put me up, and put up with me, in Norway, Australia and Brazil, particularly KP & Jerry. I would also like to thank my thesis supervisor John- Andrew McNeish and study coordinator Ingunn Bohmann at Noragric who have been so flexible and helpful despite my wanderings both mental and physical.

ABBREVIATIONS

ABA: *Associação Brasileira de Agroecologia* (Brazilian Agro-ecology Association)

ABC: *Agricultura de Baixo Carbono* (Low Carbon Agriculture)

ANA: *Articulação Nacional de Agroecologia* (National Agro-ecology Alliance)

CEASA: *Centro de Abastecimento e Logística de Pernambuco* (Pernambuco Supply and Logistics Centre)

IAASTD: International Assessment of Agricultural Knowledge, Science and Technology for Development

IMF: International Monetary Fund

EMBRAPA: *Empresa Brasileira de Pesquisa Agropecuária* (Brazilian Agricultural Research Corporation)

GMO: Genetically Modified Organism

INCRA: *Instituto Nacional de Colonização e Reforma Agrária* (National Institute of Colonisation and Agrarian Reform)

MAPA: *Ministério da Agricultura, Pecuária e Abastecimento* (Ministry for Agriculture, Livestock and Supply)

MDA: *Ministério do Desenvolvimento Agrário* (Ministry for Agrarian Development)

MST: *Movimento dos Trabalhadores Rurais Sem Terra* (Landless Workers Movement)

NGO: Non governmental organisation

PLANAPO: *Plano Nacional de Agroecologia e Produção Orgânica* (National Plan for Organic Production and Agro-ecology)

ProNAF: *Programa Nacional de Fortalecimento da Agricultura Familiar* (National Program to Strengthen Family Farming)

RedePTA: *Rede de Projetos de Tecnologias Alternativas* (Network of Projects for Alternative Technologies)

SERTA: *Serviço de Tecnologia Alternativa* (Alternative Technology Service)

UNESCO: The United Nations Educational, Scientific and Cultural Organization

WTO: World Trade Organisation

CONTENTS

1. The Uncertainties of the Current Linkage Between Food and Fuel	8
2. Research Question	9
3. Methodology	10
4. Definitions and theoretical framework to re do.....	14
4.1 <i>Development</i>	14
4.2 <i>Economic Democracy</i>	15
4.3 <i>Sustainable Economy</i>	17
4.4 <i>Community Based Food Network</i>	18
5. Agriculture in Pernambuco: History and Current Context.....	19
5.1 <i>Geography and demography</i>	19
5.2 <i>Pre Colonial History</i>	22
5.3 <i>Colonial history</i>	22
6. Contemporary Structure in Brazilian Agricultural Production.....	25
6.1 <i>Key Government Structures and Programs relative to agriculture</i>	26
6.2 <i>Key non-government structures and actors in Pernambucan Agriculture</i>	31
7. Modernisation & Agro-ecology: Economic, environmental and social implications	39
7.1 <i>Ecological</i>	40
7.2 <i>Social & Economic Democracy</i>	43
7.3 <i>Biofuels</i>	54
8. Future national and regional sustainability.....	57
9. The global perspective.....	66
10. Conclusions	72
11. References	77
Annexe 1: Semi-structured Interview Schedule	85

FIGURES

Figure 1: The standard economic sphere (inside dashed box) embedded in macro biogeochemical processes (Vatn, 2005)	18
Figure 2: Map of Brasil: State and Regional Divisions	19
Figure 3: Pernambuco Climatic and Ecological Divisions: coastal urban (blue), zona da mata (green), agreste (yellow), sertão (red).....	20
Figure 4: Proportion of rural population (% of total population) (adapted from Pereira et al, 2012).....	21
Figure 5: Homicide rates of selected locations, 2012 (homicide / 100 000 inhabitants / year) (Secretaria de Defesa Social, 2014) (UNODC, 2013).....	21
Figure 6: Grains and Oilseeds in Brasil: production, yield and area under cultivation 1975-2011 (Pereira et al, 2012)	27
Figure 7: Division of funding for actions planned under PLANAPO (MDA, 2014) ¹ figures rounded in million BRL	29
Figure 8: Division of funding announced for PLANAPO (MDA, 2014).....	30
Figure 9: Examples of anti agro-chemical advertising (MPA, 2011).....	32
Figure 10: A community gathering point and school in an MST ocupação (my photo) ..	34
Figure 11: The MST ocupação in which I spent some weeks (my photo)	35
Figure 12: an MST ocupação as viewed from a discussion with some inhabitants (my photo).....	38
Figure 13: A man using pesticide without correct protection in a MST accampamento (my photo)	41
Figure 14: Students learning about solar technology in SERTA - sertão campus (my picture).....	44
Figure 15: Some examples of alternative technology and recycling taught at SERTA (my photos)	45
Figure 16: A basic list of emissions to calculate in an industrial food chain (adapted from Edwards Jones et al, 2008)	47
Figure 17: 1979-2011: Proportion of ethanol or ethanol capable light vehicles manufactured in Brasil (Indústria Automobilística Brasileira, 2013)	55
Figure 18: Sugar, Sugarcane and Ethanol Production in Brasil 1975-2010 (Pereira, Martha, Santana, & Alves, 2012)	56

Figure 19: The Hubbert Curve: Predictions of Peak Oil matched with global oil production until 2010 (Sorrell et al, 2010)	58
Figure 20: Community gardening work in MST accampamento	65
Figure 21: World - 1961-2011: Calories available per capita increases significantly above the basic per capita requirement (FAO, 2013)	67
Figure 22: an MST ocupação inhabitant	72
Figure 23: some future agents of the demos from an MST ocupação	76

1. THE UNCERTAINTIES OF THE CURRENT LINKAGE BETWEEN FOOD AND FUEL

"Agriculture at a Crossroads", a 606 page multi-stakeholder report (IAASTD, 2009) shows that across many levels of government and civil society worldwide, there are competing visions of agricultural development. As I mean to highlight and critically study in this thesis, in Brazil this is marked by two very distinct and competing discourses. Curiously, both of these are held up by different sectors of the international development community as agricultural success stories. On the one hand, there is a powerful discourse highlighting the country's rapid modernisation and transformation into one of the world's largest agricultural powers. This has occurred largely as a result of the occupation of vast areas of land by modernized mono-crops produced for export. On the other hand, Brazil is recognized as a good practice example for grassroot actions promoting agro-ecology, family farming, and nutrition and food security. While these competing discourses are comfortable to analyse as discrete ideal types, the reality is more complex and tangled, which makes this area all the more important to study. Understanding the future of our relations to food, non-renewable resource consumption, the environment and amongst ourselves is at stake.

There are several factors that will dominate the direction of future agricultural production. Peak oil, population growth, climate change, reduced biodiversity, depleted soils, water scarcity, the vertical and horizontal integration of the industrial food chain, and the political decisions made around these topics will define which of these directions to take. The economic, social and environmental implications of these decisions will resonate decades into the future, but how does this look on the ground in north-east Brazil?

Modernised agriculture is strongly dependant on fossil fuels, Pesticides and fertilisers, large machinery, transport systems, processing and packaging, are all available on an industrial scale because of the availability of oil. The entire modern food system is based upon the abundance of fossil fuels, and other exhaustible resources such as phosphorous which are non-renewable and as a result will become increasingly scarce. This relation between food and fossil fuels is inherently unsustainable and these systems need to be redesigned, delinking food production and fossil fuel dependency. However many proposals which are made in this direction are perceived as radical.

These proposals should be assessed by their ability to address the foundation of the social, economic and environmental issues we face, and will face in the coming decades.

The challenges seen in agriculture and the environment cannot be separated from the social and political-economic system within which they exist. Local social and environmental outcomes in Pernambuco are a result of a changing global system of exploitation and domination. Since the arrival of Europeans to Pernambuco 500 years ago, formal relations between humans, the environment and agricultural production have changed and evolved over time. This research will observe what that looks like and how it is perceived in practice.

At stake in this discussion are ideas that compete to determine the future of how we feed and govern ourselves, and arguments that are mirrored in other key discussions around democracy and resource usage. What will be the relationship of people to food and their environments be like in the near future where fossil fuels and other non-renewable resources are no longer available? How will power be distributed and how will this affect the ability to access nutritious food produced in ways that will promote harmony and symbiosis between people and between people & the ecosystems in which they live? Pernambuco provides a complex and rich picture of structures, forces and discourses that mirror debates happening locally, nationally and globally about the future of food and fuel and the conflicts. These have both ideological and physical foundations and I argue that they determine the relationship between people, food and each other.

2. RESEARCH QUESTIONS

With the previous pages as background the key research questions asked in this thesis are the following:

- What is the perception of key actors in Pernambuco towards modernisation and agro-ecology discourse?
- Is it possible for Brazil to transition to a democratic and post fossil fuel dependent economy by prioritizing organic community based food networks?

- How can positive action operating at different scales assist the transition away from a dependence on fossil fuel agriculture?

3. METHODOLOGY

The qualitative research conducted for this thesis aims to link the macro concepts discussed in the theoretical framework and apply them on multiple scales. The primary aim of the thesis is to consider the constitutions of these concepts in the State of Pernambuco in Brazil, and to reflect on parallels with agricultural policy at the national and global levels.

Comparison is made here between two ideal types of future development scenarios relating to food production. The first is a continuation of the dominant development discourse based on indicators of economic growth, natural resource extraction and the social, environmental and economic relation of this. This is characterised as the modernised agriculture discourse. The second ideal type is more closely identified with agro-ecological movements in Brazil which focus on community based food networks, ecologically sensitive production and consumption, social justice through agrarian reform. I characterise as representing a form of agro-ecology, although no direct connection can be made to the formal agro-ecology movement of Brazil. These ideal types are useful for research purposes as they allow to characterise, compare and contrast ideas, however they should not be considered the only ways of thinking and speaking about agriculture and development in Brazil as they oversimplify the reality of socio-economic relationships and the range of alternatives. The two discourses selected are useful because they give a frame of reference to many discussions and interviews and may prove entirely untrue on the ground, however much of the available literature can acceptably fall into these definitions.

The thesis is based on a methodology that combines desk-based research, semi-structured interviews and direct observation recorded in field notes. This combination of methods was intentionally used to triangulate qualitative science information with natural science information, and create the basis for a flexible and inclusive ethnographic approach. It also seeks to reflect my own critical position on this topic. Reflexivity in this research is extremely important in order to attempt to eliminate researcher bias while studying these contested fields.

The results obtained through fieldwork are integrated into the thesis with the aim of providing a coherent picture of all of the arguments and analysis involved. There is no primary quantitative data collected in this research and therefore the quantitative figures presented are based on other available research. The results and analysis obtained from secondary sources are cited and primary research data such as quotes from interviews have been used where consent was given and the protection of the confidentiality of sources allowed.

The work for this research was undertaken during four separate periods, from September to December 2013, July to October 2014, October to December 2015 and October 2016. This separation is due to my ongoing employment with an emergency medical humanitarian organisation. I agreed to temporarily interrupt this research to return to the field several times in Myanmar, Tanzania/Burundi, Burkina Faso, Central African Republic, and the Democratic Republic of Congo. During the first two research periods time spent gathering data in Pernambuco, Brazil, totalling about 5 months in the field. During the majority of the time spent in Brazil I was based in Olinda, a UNESCO heritage city and also the first wood/sugar capital of Brazil. I also spent some weeks living in MST occupations and encampments taking notes and interviews. Two weeks were spent living with an agro-ecological NGO focused on education extension during which time formal interviews and informal discussions were also conducted and field observations recorded. Many other short field trips were organised and notes were also taken as a result of informal discussions with people I met during my time in Brazil. Interviews were conducted with a range of local actors including state government ministers, academics, farmers, activists, teachers, students and other members of the public.

In this research a large amount of secondary sources are used to explore frameworks and ideas. The aim of using desk research as one of the main methods to gain background analysis, and to link concepts together. These concepts are drawn from many different fields of research, and are used to link concepts from local empirical research to relate local ideas to global concepts. Some of the literature sources are academic books in Portuguese that were available in the Olinda public library, while most academic articles were sourced from internet searches and the Noragric library.

I used semi-structured interviews to reveal the dominant discourses amongst key informants and in general public circulation. This primary data is essential as it reveals what different stakeholders perceive as key issues and the ways of discussing them. This also enables critique or confirmation of what is written in secondary sources and also to provide a much more detailed and creative input from diverse backgrounds.

The interviews were conducted using a semi-structured schedule (see annexe 1). All questions were asked in the same order to all participants, however follow up questions and clarifications were used to ensure a full answer. I repeated my understanding of the answer back to the participant to verify that I had understood the response as intended. Often the interviews were quite informal matching the formality of the interviewee.

Most interviews came about as a result of application of a snowball method however there were specific key informants that were individually contacted without previous networking. A diversity of backgrounds and levels of knowledge were deliberately searched for with the intention of providing diversity of opinions and discourses from organic and non-organic farmers, government representatives, social movement organizers, academics, food processors, wholesalers and retailers.

The interview responses were recorded in a notebook that was also used to collect field observation data. This was done for several reasons. Firstly because the visual act of a researcher writing down responses rapidly shows value to what the respondent is saying and can encourage them to speak more confidently. Secondly because there are no sensitive or personal questions asked in the interviews and therefore having an obvious recording process was not seen to diminish the quality of the responses. There were two interviews in which voice recording was also used (with consent of the interviewee) for the purpose of efficiency as the interviewee had other pressing matters to attend to.

A translator was present for some of these interviews to assist in translating and clarifying responses. My Portuguese language skills are adequate, however some accents from rural areas were more difficult and some responses involved complex ideas, therefore a translator was essential to ensure that the quality of the information received was not diminished. The same translator was used throughout the interview stage and was a student of English Linguistics at the University of Pernambuco. Time

was spent discussing the theory and application of the concepts in this research so that he would have a good understanding of the terminology and the discourses likely to arise before the interviews began.

Each participant received a standard introduction to the interview which was relatively vague in an attempt not to show bias towards the subject and therefore lead the responses. In the standard introduction there was also a statement of confidentiality and informed consent with two questions. The first was to use the interview in the research, the second was to use the person's personal details such as name and profession in the final output of the research. If the answer to the first consent question was no, the interview would be stopped, however this did not occur. If the answer to the second question was no, the interview would continue however the lack of consent given would be marked on the interview responses recorded. Most of the participants agreed to both consent questions however some refused the second consent question, and thus their responses are taken into account in this research however they are not identified. In total, 9 key informant interviews were completed to supplement extensive field notes.

During the entire time in Brazil, field notes were taken in separate notebooks to the ones used in interviews. The field notes were based on observations, informal conversations, self-reflections and impressions and recorded by hand in notebooks either directly after events or at the end of each day, including personal reflections and feelings. This ethnographic and auto-ethnographic method has been intentionally used to allow for observation and informal data collection in the research process. This approach treats research as an active, reflective, political and socially conscious endeavour (Ellis, Adams, & Bochner, 2010).

The field notes and observations are included in the text as an integral part of the research process. There is an intention to transcend disciplinary boundaries and to pay attention to who might read this work, how might they be affected by it and how can it start/keep a conversation going.

The field notes and the interview results were coded chronologically with separate codes for interviews and field notes. They were subsequently correlated thematically and analysed to put find patterns and discrepancies. This primary data supported by secondary data is the basis for all work presented in this thesis.

4. DEFINITIONS AND THEORETICAL FRAMEWORK

While the words used in the title of this research are words used in everyday language, they represent concepts that are highly contested and idealized. To set a clear framework for how they are used in this research it is necessary to have a reference point to draw consistency and meaning from the arguments presented. The key phrase that I will continue to refer to and which provides the thesis statement that underpins this research is part of the title: “democratising a sustainable economy through organic community based food networks”. However, before these concepts are addressed, a brief critique of development itself.

4.1 DEVELOPMENT

Development means many things to many people, and there are conflicting definitions. Development can be seen as modernization (Peet & Hardwick, 2009), development as freedom (Sen, 2000), development as trusteeship (Cowen & Shenton, 1996), development as a technology of control and a racist project (Duffield, 2007), development as a failed enterprise (Sachs, 1988). A common central characteristic is that of change towards a desired outcome. The nature of development in its application is a set of knowledge and ideologies which lead to development strategies, designed to provide certain outcomes which are perceived as beneficial to those who are being developed, doing the development, or developing themselves, the ‘beneficiaries’ (Peet & Hardwick, 2009). However in practice and in my experience, this application of development has proven not to provide all of the desired outcomes, nor are the common structures and discourses of development fundamentally able to deliver the desired outcomes as they are based in a set of false assumptions.

The concept and structures of development are social constructions and reflect both a westernisation of objectives and an internalisation of these westernised objectives by those who are to be or are being developed (Duffield, 2007). Development has traditionally been universalistic and culturally hegemonic and while many new forms of development have sprung up to contrast this criticism, such as participatory or bottom up development, in practice these seem to make little difference on the ground, rather more serving as anthropological material to better target and achieve program objectives.

One particular strain of critique of development is the post-development family, notably Ivan Illich (Illich, 1970), Arturo Escobar (Escobar, 2011) and David Harvey (Harvey, *The Limits to Capital*, 2006). This critique of development charts the history of the idea of development from historical examples to its modern manifestation, for example the well-known post WWII speech of Truman. This speech laid the conceptual framework for creating a hierarchy of underdeveloped (inferior) – developed (superior) nations (Escobar, 2011). This then meant that inferior nations should follow the pathway of Northern nations to become better and more advanced. It seems clear in hindsight that this kind of discourse is ethnocentric and universalistic. While new manifestations of development are forming that would challenge this universalistic view of development (‘south-south’ development for example), they appear to be within an internalized framework that replicates the same objectives whilst attempting to change the centres of power or circumvent classical development powers.

The post-development school critiques the singularity of development and advocates for a pluralistic way of understanding needs and socio-political development (Escobar, 2011). Post-development criticises the ownership of the space of development and the ideas of development and the implementation of development (Harvey, 2003), and by contrast attempts to overcome the inequality of powerful vs. excluded voices. Rather than holding to the ethnocentric discourse of development, post-development thinkers value the local culture and knowledge, taking a critical stance towards established and scientific discourses and promoting pluralised grass roots movements, those movements being critical and distrustful of established politics and development (Illich, 1970). There is no denial that there are many needs and changes that most people want to undertake, partly in response to the damage done by development, but that these responses should not be externally determined.

4.2 ECONOMIC DEMOCRACY

“Money power is not only the most governing and influential, but it is also the most unjust and deceitful of all earthly powers. It entails upon millions excessive toil, poverty and want, while it keeps them ignorant of the cause of their sufferings; for, with their tacit consent, it silently transfers a large share of their earnings into the hands of others, who have never lifted a finger to perform any productive labour” (Kellogg, 1849, p. 249)

While I have no intention to try to define democracy or choose the best from the multitude of propositions of definitions, there are some key cross-cutting characteristics which I will raise for the purposes of this research. Considering the phrase “democratising a sustainable economy” as the subtitle of this thesis, it is the sustainable economy which is subject to the democratising process. With this in mind it is essential to look separately at both a democratic economy and a sustainable economy. The specific word “*democratisation*” is used to describe a change or a process that occurs from the current state towards this outcome, assuming that the current state is not democratic.

Simply put, a democratic economy expresses the authority of the demos (community or people) over the economic sphere (Schweickart, 2011). This is useful to contrast an economic sphere where the authority does not rest with the community; the authority rests instead with the corporate managers and shareholders. The effect of this location of authority is the externalisation of costs, the subjugation of public good to profit, and a lack of democratic voice in economic policy decision making processes (Smith J., 2005). The global expansion and dominance of capitalist systems undermines democracy and the possibility of true participation and self-determination. The structure of a capitalist society rests on three pillars: firstly, the means of production are primarily privately owned either by individuals or by corporations who are in turn owned by individuals, secondly, products are exchanged in markets and competition + supply + demand are the determinants of price, thirdly, most people work for other people who own the means of production by way of wage labour (Schweickart, 2011). A democratic economy shifts power to larger groups of stakeholders such as workers and consumers rather than corporate managers and shareholders (Engler, 2010) (Schweickart, 2011) (Smith J., 2005).

Essentially, democratisation refers to large numbers of individuals who have had little political economic power becoming more involved in directing economic decisions and policies and in influencing future directions of their societies. Increased democracy implies informed participation in political economic life with tangible outcomes. This concept could be contrasted with a notion of capitalist democracy with power concentrated in the hands of an elite class which may, for example, hold elections, however the range of choices are limited and beyond elections there is little agenda setting by low power groups, even though they may be numerically very

important (Harvey, 2010). This is highlighted as a key concept to bring importance to the power relations between people, mainly using socio-economic class as a reference point but also referring to gender and ethnicity.

4.3 SUSTAINABLE ECONOMY

A sustainable economy attracts never ending attempts at definition, and there is no clearer consensus on a useful model, however, I will use one model commonly known as the triple bottom line: economic, social and environmental outcomes. This means that success should be measured in multiple fields and the concept is useful to challenge the supremacy of the economic growth discourse (Elkington, 1998). The leading strength of the triple bottom line is the will to measure and include what has previously been considered 'externalities' by standard economics.

Externalities are costs or benefits affecting a party who did not choose to incur or receive those costs or benefits (Buchanan & Stubblebine, 1962). A clear example of an externality is CO₂ emissions from transport. These are a cost to the environment and society that are not paid for either by the producers or by the users of internal combustion engine transport, they are external to the market transactions. If these externalities were measured and were part of the calculation of success, a producer or consumer may choose to produce or consume differently, based on economic or ethical preferences. Where social or environmental costs are externalities, the full cost of production and consumption is not reflected in the trading price of an item; therefore this type of market is inefficient.

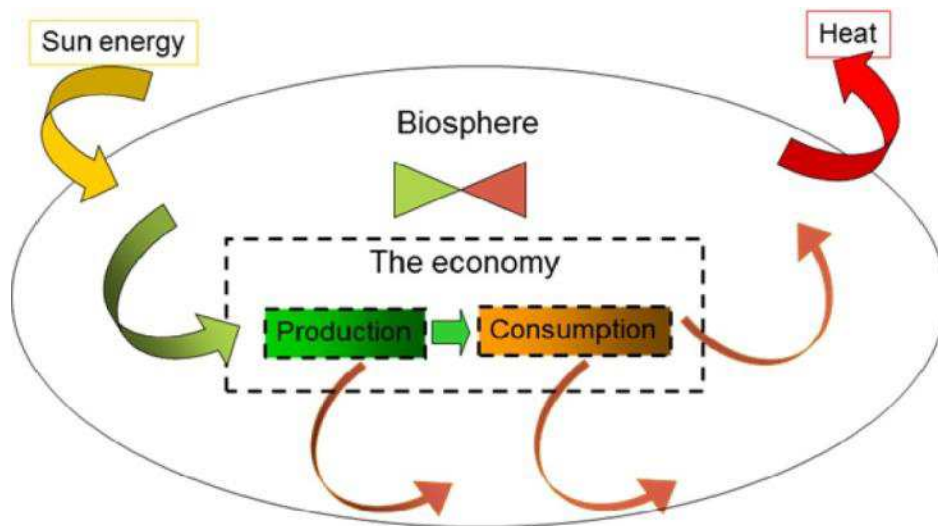


Figure 1: The standard economic sphere (inside dashed box) embedded in macro biogeochemical processes (Vatn, 2005)

Consider Figure 1 as a model to show normal current economic relations contrasted within an ecological framework. Current economic policies generally only recognise the economic sphere as transactions that take place within the dashed line. Biogeochemical process which occur outside of this rectangle and by-products which occur are largely considered external to this process (Vatn, 2005). Considering regulating this then further creates thousands of options that are considered by economists of all types. Efforts to internalise these to the economic sphere are generally done through taxes, caps (or cap and trade), incentives or prohibitions.

4.4 COMMUNITY BASED FOOD NETWORK

Community based food networks embed the food system within social relations and within the limits of biogeochemical processes. The University of Michigan (2009) Urban and Regional Planning Capstone Project defined this type of system as “A food system in which everyone has financial and physical access to culturally appropriate, affordable, nutritious food that was grown and transported without degrading the natural environment, and in which the general population understands nutrition and the food system in general.” (p4). The main determinants of the benefits and drawbacks of community based food networks extends beyond the discussions of food chain, quality of food and climate emissions (Cardoso, 2012). The key elements are the social and economic forms of organisation which accompany a community based food network (Edwards-Jones, et al., 2008). A food ‘network’ is a far more inclusive view of what actually constitutes the elements involved in food production and consumption. A chain

implies a linear process and excludes many important elements while network implies interconnectedness and reciprocal relationships.

5. AGRICULTURE IN PERNAMBUCO: HISTORY AND CURRENT CONTEXT

5.1 GEOGRAPHY AND DEMOGRAPHY

“At first I thought this was restricted to the area where I lived - the mangrove region. Then I realized that the mangroves were like a promised land in the starving scene of north-eastern Brazil. They attracted men from other areas where hunger was even worse - regions of drought and sugarcane monoculture; where the sugar industry crushed men and sugarcane alike, turning everything into bagasse” (de Castro, 1967)

Pernambuco is located close to the equator in the north-east of Brazil with a small coastline in between the states of Alagoas and Bahia to the south and Piauí to the west, and Ceará and Paraíba to the north. By area it is the 19th largest state of Brazil (out of 26).

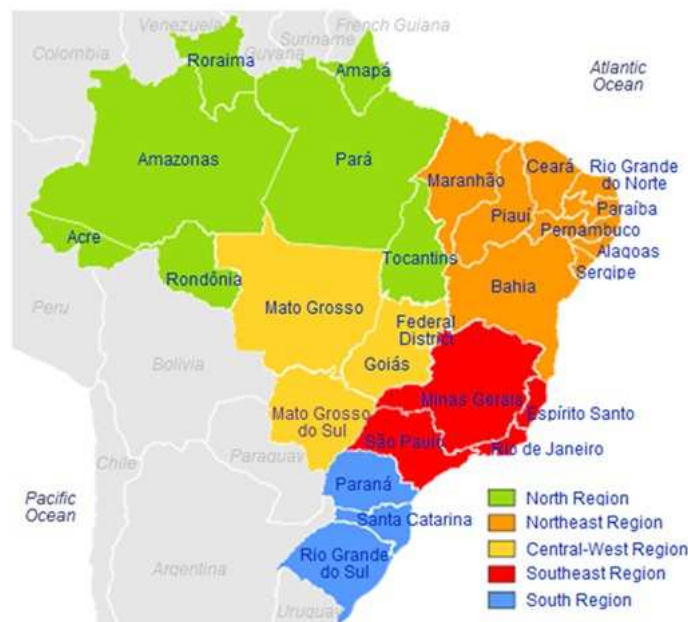


Figure 2: Map of Brazil: State and Regional Divisions

The state can be broadly divided into four climatic and ecological areas (Figure 3). There is the coastal urban zone, which hosts the state capital, Recife, and other urban areas extending from there. It also contains Olinda, a UNESCO heritage city and the

first seat of Portuguese power in Brazil. This was an extremely important city for the Portuguese, particularly for the wood and sugar trade (Freyre, 1985). The Mata Atlântica (zona da mata – Atlantic Rainforest) has almost entirely been destroyed in Pernambuco both during the colonial Portuguese period and after that with the continued expansion and intensification of the sugarcane industry (Pádua, 2002). The *agreste* is moderately populated and hosts many marginal farmers. It is drier than the Mata Atlântica zone and has some semi-deciduous forests. The *sertão* is a plateau at a higher altitude, much drier, with different rainfall patterns and temperatures than the zones closer to the coast. This area is well known for its 'katinga' biome characteristics and is the least densely populated of the state.



Figure 3: Pernambuco Climatic and Ecological Divisions: coastal urban (blue), zona da mata (green), agreste (yellow), sertão (red)

Pernambuco has around 9 million inhabitants, the 7th most in Brazil and the 6th highest population density, even with the sparsely populated sertão (IGBE, Sinopse do Censo Demográfico, 2010). It has the 21st highest GDP per capita in Brazil (IGBE, 2012) and the 23rd highest HDI score (UNDP, 2013), which while these are entirely insufficient indicators to describe wellbeing; they are a relative measurement of standard development outcomes. It has an ethnic composition of 55% mixed race, 38% white, 6% black, and 0.5% indigenous (IGBE, 2008). The population is highly stratified and has some of the highest rates of monetary poverty in Brazil. There has been a significant transformation of the population and their productive functions over the last decades.

The significant transformation was part of a greater industrialisation process that also characterised a rapid urbanisation process. At the same time there was significant

expansion into new areas and construction of much infrastructure for transporting products in larger quantities more rapidly. With urbanisation, political power also shifted from the countryside to the urban areas. The proportion of rural population in Brazil decreased from 64% in 1950 to 32% in 1980 and 16% in 2010 and in north-eastern states from 74% in 1950 to 49% in 1980 to 27% in 2010 (see Figure 4) (Pereira, Martha, Santana, & Alves, 2012).

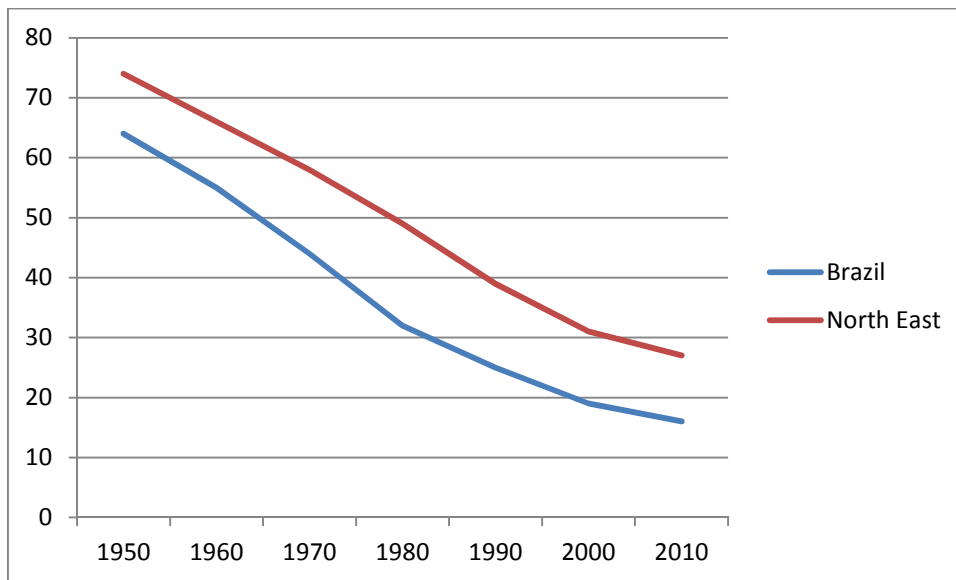


Figure 4: Proportion of rural population (% of total population) (adapted from Pereira et al, 2012)

Urban monetary poverty is very high and there is a significant level of discontent with political representation and economic opportunities. The northeast is known as still having people working under conditions of slavery and child labour. Crime rates are high; violent crime rates in Brazil are amongst the highest in the world with both urban and rural areas in Pernambuco having extremely high (decreasing trend) homicide rates (see Figure 5).

State/Country	Pernambuco	Brazil	Colombia	Norway	Australia
Rate	36	25	31	0.9	1.1

Figure 5: Homicide rates of selected locations, 2012 (homicide / 100 000 inhabitants / year) (Secretaria de Defesa Social, 2014) (UNODC, 2013)

5.2 PRE COLONIAL HISTORY

The north east of Brazil is one of the many areas of the world for which there is little or no historical literature of the biological and social determinants of human organisation and evolution. Much of what is now known about pre-colonial societies in the north east of Brazil is based upon early colonial writings in the 16th century (Freyre, 1985).

The groups of human beings that lived in the north east of Brazil before colonial times can be characterised as closed societies, they did not trade, exchange or barter with outside societies and were self-sufficient with the resources immediately available to them. There is no evidence of accumulation, the main purpose seemingly reproduction (Cavalcanti, 2007), loosely based on the reciprocity notion of Polanyi in his pre-market economic interaction modes. Once reproduction was assured, cultural development was able to happen and this was generally reverence of nature and a harmonious relationship.

It seemed to the early colonisers that the actions of ‘savages’ who lived in the *zona de mata* before colonial times caused only minor damage when compared to the environmental devastation brought by the Portuguese colonialists. It is clear that all human settlements have impact on the ecosystems around, however the lush diversity of the Atlantic Rainforest in the early writings of the colonialists makes it clear that the relations between humans and their lived environment were not visibly destructive. The lush vegetation that once reigned in the *zona de mata* has but little traces left behind of its former grandeur. What remains today are reminders of unparalleled natural wealth that has been destroyed in less than 500 years of colonial history (Cavalcanti, 2007).

“Thus they passed millennia, until they came up against the armed agents of our civilization, with their capacity to attack and mortally wound the miraculous balance achieved by those complex life forms” Darcy Ribeiro (Leonel, 2000)

5.3 COLONIAL HISTORY

The history of Brazil and particularly the northeast is entwined with history of sugar itself. The ‘harmonious relationship’ that existed in pre-colonial societies was to be shattered by a new model of open societies that engaged in trade and exploitation of resources for non-local needs. Self-determination and self-sufficiency were no longer

the models of the human habitants of the north east (Cavalcanti, 2007). Large armed fleets left Portugal towards the end of the 15th century, driven by competition for wealth to expand lands and natural resource acquisition. From the first Portuguese arrivals to the north east of Brazil, around 1500, the environmental splendour and diversity was admired “these trees are so large and so thick with such a vast quality of foliage that it cannot be calculated” (Prado, 1931). New trade relations were built which were not advantageous to indigenous people and exploitation started and grew directed by people who were ignorant of the original ecosystems of the lands. They were driven to squeeze the highest returns out of the new ventures in the shortest period of time possible.

The urge for societal (not yet individual) prosperity at all costs engrained a ‘foreign’ mindset and developed a disregard for ecological processes (Prado, 1931). Adventurers came to seek impossible fortunes with no thoughts to set down permanent roots in the land. The colonial economy of northeast Brazil can be characterised as an ‘*economy of plunder*’ (Herrera, 1996). More than an economy based upon exploitation and trade, an economy of plunder designates a specific type of human settlement that “tends to rip out its mineral, vegetable or animal raw materials with no idea or means of replenishment”. (Herrera, 1996)

The colonialists used slash and burn techniques, similar to those previously used by indigenous people however on a much larger and merciless scale. This was the beginning of the sugarcane plantations. The exportation of wood and sugar from the north east of Brazil represented the transfer of wealth from the colonial periphery to the metropolitan Portugal, with no cost to the crown. In the 1630s the Dutch West Indies Company took control of the captaincy from the Portuguese while leaving sugar trade in their hands. For the first time in Brazil, white Europeans, black Africans and Indians collaborated to fight and eventually oust the Dutch after 24 years and return to Portuguese captaincy in 1654. Economic activities continue to expand and with this expansion population also expanded. The sugar industry became more important than the wood industry and other industries and in 1710 there were 246 sugar mills operational in Pernambuco producing approximately 13300 tons of sugar annually (Freyre, 1985).

Early sugarcane plantations in Pernambuco needed no fertilising, no irrigation and could be cut for multiple years with no need to replant (Cavalcanti, 2007). Initially

the colonialists had tried to use the indigenous as slaves however they were not habituated to the manual labour required, were not numerous enough, and could not fulfil the requirements of the dreams of the Europeans. Slaves were brought from Africa *en masse*: in total around 4 million slaves arrived to Brazil, many hundreds of thousands of these arriving to Recife in Pernambuco in the 16th and 17th century (Walvin, 2014). Land was appropriated, burned, cultivated, and once showing signs of depletion, sold off for a trifle and new lands were moved on to. The commoditisation of humans and particularly Africans paralleled the commoditisation of the ecology in what was perceived as eternal sources of wealth and prosperity waiting to be exploited. In this system, the value assigned to human life was negligible, as was the relevance of conserving natural resources. They served as sources of income for land owning elites and for the state machine. Successful sugar cane plantations needed several characteristics: ‘good’ lands (in this case rich clay soils), sufficient water supplies, fuel wood supplies for burning or constructing, good slaves and oxen. Essentially: “land, water, wood, negroes and oxen” (Freyre, 1985).

In 1875 the tangible notion of the environmental destruction in Pernambuco was described for the first time as such:

“for 375 years a routine depletive culture, based on the broad-axe and the firebrand, has felled trees and shattered branches, uprooting from the fertile soils of Brazil the elements of grandeur and prosperity of future generations” Nicolau Joaquim Moreira in (Pádua, 2002).

The deforestation and cultivation of sugarcane not only destroyed the forest life but also depleted and impoverished the topsoil. Erosion of the fertile topsoil into the rivers was caused by a lack of flora along the banks which had previously structured the soils preventing the loss of the rich humus. The ecosystems were irreparably simplified. After independence from Portugal in 1822, the north east of Brazil continued to be tumultuous with various rebel and gang movements particularly until the 1930s and overall continued largely the social structure and activity seen prior to independence through to the major waves of industrialisation in the 1960s.

“[Sugarcane] entered here like a conqueror in enemy lands: killing the trees, drying out the forest, destroying and scaring away the animals and even the natives, wanting to take over the entire power of the land for

itself. Only the sugar cane should grow lush and triumphant from the midst of all this ruined virgin vegetation and indigenous life crushed by the monoculturalist” (Freyre, 1985).

Amongst all of the interviewees and field notes that I took during this research, every person that I had interacted with knew the history of slavery and the destruction of the *mata atlantica* to a certain extent however there was a disconnection from the past with current ‘realities’ experienced by people predominantly in the city areas. The contrast between rural and urban perceptions of the priority of economy or environment remained relatively stark among young adults or less highly educated groups with the economic growth discourse retaining its dominant or at least unchallenged position. Among leaders and more highly educated individuals from many backgrounds (with the exception of government representatives I spoke with) the connection of the history to present phenomenon was far more clear.

“The first Portuguese settlers who landed in this blessed turf of America found incredibly fertile forests, real treasure troves built up over centuries and more centuries on virgin soils; this fertility fascinated them, as they felt it was inexhaustible, which was the prime cause of the deadly system of pillaging the land that they launched, a true theft; this was the system that has been deeply rooted in our agricultural practices since colonial times”
Miguel Antônio da Silva in (*Pádua*, 2002)

6. CONTEMPORARY STRUCTURE IN BRASILIAN AGRICULTURAL PRODUCTION

Brazilian agriculture is largely separated into two categories: family farming and agribusiness. Each has its own structure and discourse, to the point where there are essentially two national ministries for agriculture: *Ministério da Agricultura, Pecuária e Abastecimento* (MAPA: Ministry for Agriculture, Livestock and Supply) and the *Ministério do Desenvolvimento Agrário* (MDA: Ministry for Agrarian Development). Of the 4 367 902 farms in Brazil, 84.4% are family farms however they occupy only 24.3% of agricultural lands and produce around 70% of the food consumed domestically in Brazil (Cardoso, 2012). Smaller farmers produce mainly for consumption on local markets and some export while large farms produce for mainly

export and some domestic consumption (Pereira, Martha, Santana, & Alves, 2012). In all types of farming in Brazil, success is measured in recognised standard ways such as productivity and total income. Social or environmental wellbeing indicators do little to influence agricultural policies. There is also the full list of regular contributors in an industrial food chain: wholesalers, processors, transporters, and retailers. There are several significant social movements that are involved in agriculture also, such as the agro-ecology movement and the *Movimento dos Trabalhadores Rurais Sem Terra* (MST: Landless Workers Movement).

6.1 KEY GOVERNMENT STRUCTURES AND PROGRAMS RELATIVE TO AGRICULTURE

MAPA describes itself as being responsible for small, medium and large agriculture and with the public policies to stimulate agribusiness (MAPA, 2014). Its function lies with the regulation of agriculture, processing, transport and distribution of agricultural products of Brazil. It works from a rational perspective and focuses on market and technology expansion and the organisational systems both domestically and for agricultural exports. The perception of MAPA by most people I spoke to was that it is primarily for the large scale agriculture industry, and had very little to do with the family farmer. Especially in the social movements, the reputation of MAPA was that it is focused on modernisation of the agriculture sector and technological rational market solutions.

One of the key organs of MAPA is the *Empresa Brasileira de Pesquisa Agropecuária* (EMBRAPA: Brazilian Agricultural Research Corporation) which is the science and technology research organ and was the most commonly discussed government organ by people that I spoke with and is well known internationally for its scientific research (EMBRAPA, Quem Somos, 2014). It is geographically decentralised however functions on a national scale. EMBRAPA is largely representative of the first and second Green Revolution technologies in Brazil. In keeping with the scientific requirements but recognising the advances made, EMBRAPA recognised agro-ecology as a science in 2006 after much advocacy from the Brazilian Agro-ecology Association (Cardoso, 2012).

According to researchers from EMBRAPA, there are 3 determinants to agricultural productivity: human capital, technology generation and dissemination, and the adequacy of natural resources and weather (Pereira, Martha, Santana, & Alves,

2012). Human capital should be developed by education and organised research should develop technology which should then be disseminated to end users. Given the rate of increase in production over the past decades, technological and modernised agriculture has greatly increased crop yields and total food output with a smaller increase in area under cultivation (see Figure 6). For grains and oilseeds, the area under production increased 32% from 1976 to 2011 while the output increased 240% and yields 257% (Pereira, Martha, Santana, & Alves, 2012). This increase in production from grains, oilseeds and sugarcane crops is estimated to have required 78 million hectares of extra land (approximately twice the size of Norway) if there had been no concurrent increase in yield, therefore this agriculture is seen as reducing the need for agricultural lands and can be framed as creating positive environmental outcomes by affecting less land area.

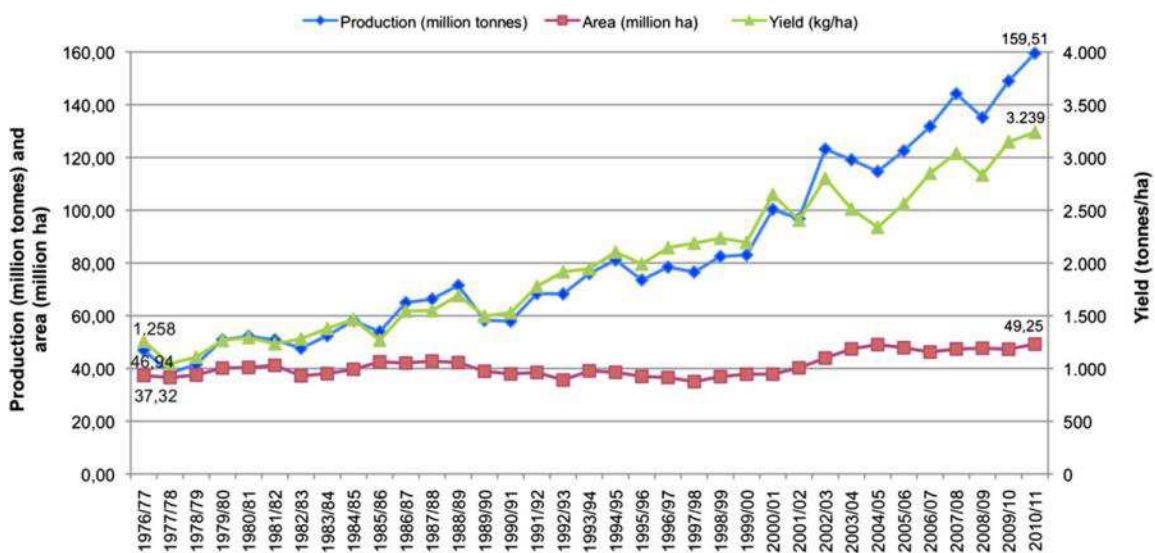


Figure 6: Grains and Oilseeds in Brazil: production, yield and area under cultivation 1975-2011 (Pereira et al, 2012)

Along with EMBRAPA, one of the relevant programs within MAPA is the *Agricultura de Baixo Carbono* (ABC: Low Carbon Agriculture). This program is a credit line managed by MAPA which promotes the adoption of greenhouse gas reducing activities in agriculture. It is attempting to improve the image of Brazilian agriculture through providing credit for adopting climate smart strategies, targeting larger scale farmers and promoting techniques such as biological nitrogen fixation, which means using less chemical fertiliser by sourcing nitrogen from traditional sources through organic matter decomposition (plants, manure etc.) (EMBRAPA, 2014).

More relevant to the family farmers, the MDA was established in 1999 to promote land reform and sustainable agricultural practices (MDA, Missão, Visão e Valores, 2014). It is the primary government linkage for the large social movements and its programs target primarily family farmers and contrasting MAPA, MDA declares that it focuses on socially and environmentally inclusive programs for small farm economies.

One of the key organs of MDA is the *Instituto Nacional de Colonização e Reforma Agrária* (INCRA: National Institute of Colonisation and Agrarian Reform). Its main goal is working for agrarian reform to achieve sustainable rural communities. It has five stated guidelines. Firstly, to work for the democratisation of access to land and devolution of land ownership decreasing violence and monetary poverty in the countryside and leading to increased equality. Secondly, to work in a participatory manner with principles of legality, impersonality, morality, transparency and efficiency in partnership with civil society organisations. Thirdly, to monitor the social function of rural properties and to promote agro-ecology food chains. Fourth, to provide basic infrastructure, credit, social and technical advice in conjunction with other public organs for the fulfilment of labour and environmental laws. Finally, to certify and register rural properties and to allocate public lands (INCRA, 2014).

Another key program of the MDA is the *Programa Nacional de Fortalecimento da Agricultura Familiar* (ProNAF: National Program to Strengthen Family Farming). This is a microfinance credit line available to family farmers with small lands and low income. Loans are available with low interest rates and are promoted as being available to family farmers to modernise or industrialise their production systems (Banco Central do Brasil, 2014). Professor Francisco Caporal, former president of the Brazilian Agro-ecology Association and Professor at the Federal Rural University of Pernambuco, was extremely critical of this program during our interview. He sees it as an indirect transfer of money from government to large corporations via the small farmers, which the farmers then have to pay back to the government regardless of the outcome of the investment. That type of development instrument does not increase democracy and resilience, it increases specialisation and productivity with a focus on production for market.

In the metropolitan areas, little is known about MDA and INCRA, however in the rural areas they are quite visible and accessible, with agents spending time in the field and being linked in with the social movements, particularly MST and agro-ecology organisations.

In October 2013, the president of Brazil introduced a long-awaited plan which had been announced the year earlier: the *Plano Nacional de Agroecologia e Produção Orgânica* (PLANAPO: National Plan for Organic Production and Agro-ecology). The implementation of the national policy on agro-ecology is planned to be active by the end of 2015 with an investment of BRL8.8billion (~EUR3b) to go to around 125 different initiatives over 3 years (MDA, 2014). This involves 10 national ministries and the key program elements will be implemented by the MDA and MAPA. This policy procedure has the possibility to represent a significant change in the power and structure of Brazilian agriculture and land ownership, and a significant achievement of the voice of the social movements.

Element of PLANAPO	Funding: 3yrs ¹	% of total
Credit: ProNAF and ABC	6500	77,36
Technical assistance/extension	758	9,02
Access to water for production	600	7,14
Produce purchase by PAA	165	1,96
Seed and animal distribution by PAA	150	1,79
Strengthening agro-ecology and organic networks	100	1,19
Research and technological extension	65	0,77
Promotion of produce	24	0,29
Seed banks and storage	17	0,20
Rural youth inclusion	15	0,18
Womens' production groups	8	0,10

Figure 7: Division of funding for actions planned under PLANAPO (MDA, 2014)
¹figures rounded in million BRL

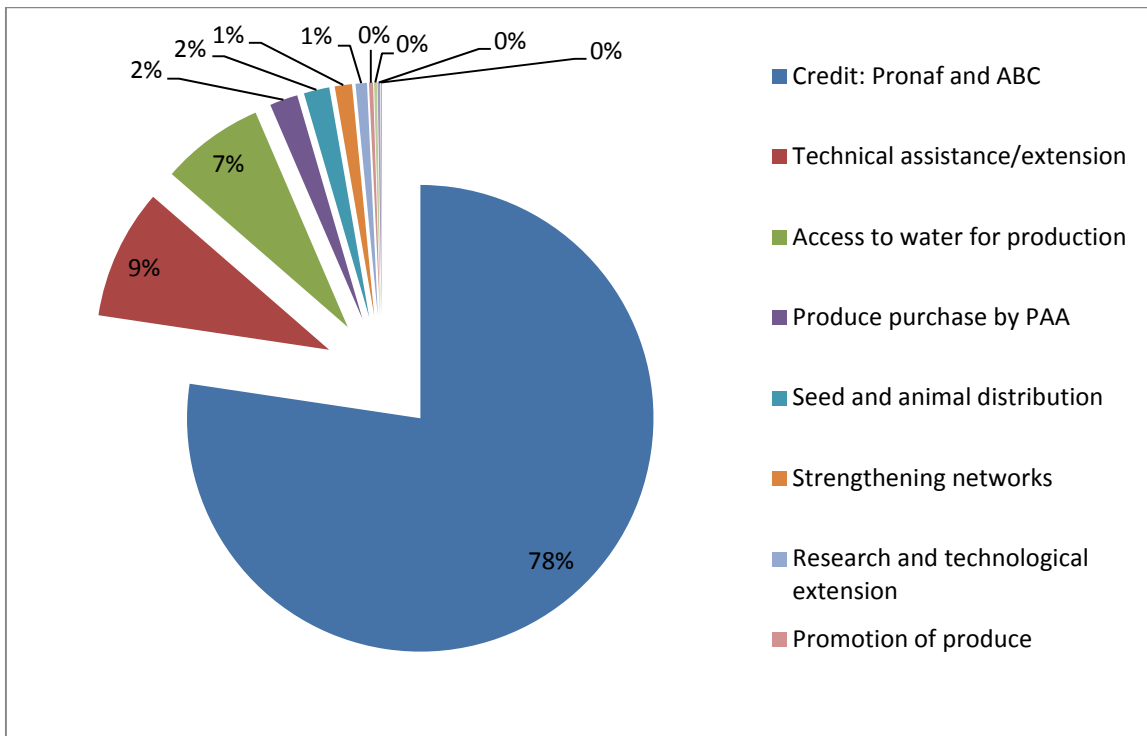


Figure 8: Division of funding announced for PLANAPO (MDA, 2014)

While this plan results from an extremely open and progressive community consultation, the reactions have been mixed from those who were actively pushing for a comprehensive and relevant plan on agro-ecology. While having some reservations, the MST representatives that I spoke with were fairly positive about the plan, especially highlighting the change in focus and funding for organic agriculture. Professor Francisco Caporal was far less impressed, noting the proportion of the funding proposed to go to ProNAF and ABC. In his perception, PLANAPO is largely a plan to scale up organic agriculture rather than agro-ecology. He is critical that this will not advance a more democratic or truly sustainable agenda but will advance organic agriculture within the growth and productivity paradigm.

These two ministries of agriculture and their policies are in many ways representative of the two competing discourses and are both held up internationally as success stories: firstly of modernisation as one of the world's largest agricultural powers thanks to the occupation of vast areas of land by modernized monocrops produced for export, and secondly, being recognized as a bench-mark for actions promoting agro-ecology, family farming, and nutrition and food security. However public sector in Brazilian agriculture is impossible to discuss without looking also at the large scale private sector.

6.2 KEY NON-GOVERNMENT STRUCTURES AND ACTORS IN PERNAMBUCO AGRICULTURE

Agribusiness in Brazil is a highly praised example of modernisation and mechanisation of agriculture. There is a long tradition in export oriented crops, with sugarcane and coffee being prime examples. Until the 1960s, around 55% of Brasils' exports were agricultural (Pereira, Martha, Santana, & Alves, 2012). Even so, Brazil still received significant amounts of food aid until the 1960s and continued to import large amounts of food until the 1980s. From the 1970s onwards, much of the traditional agriculture was transformed into modernised agriculture as a competitive market based on science and technology (Cardoso, 2012).

Industrialisation was prioritised in coastal areas of Pernambuco in the 20th century. Food prices needed to be kept low to avoid pressure on urban salaries, meaning agricultural wages were kept low making the city more appealing to a rural population. Agriculture was identified as a means to export products to accumulate the finances needed to purchase technology and other assets needed to support the industrialisation process. Traditional agriculture on the land base of the time was seen as having reached its limits and so both modernisation and intensification, coupled with expanding agricultural lands was key (Pereira, Martha, Santana, & Alves, 2012).

Of the food products that are currently produced in Pernambuco, most of them will pass through a centralized distribution point in Recife called *Centro de Abastecimento e Logística de Pernambuco* (CEASA: Pernambuco Supply and Logistics Centre) that was created amongst administrative reforms in 2004 by the state Secretariat of Agriculture and Agrarian Reform. CEASA has a monthly turnover of around 80 000 tonnes of products, totalling around BRL190 million per month (EUR63 million) and sees approximately 55 000 visitors daily (CEASA Pernambuco, 2014).

Through these processes of centralisation and market concentration, many family farmers have now left their lands as they do not represent a means of survival, one of the factors in the significant rate of urbanisation over the last 50 years. Rural poor who leave their lands tend to move to cities and live in precarious situations and experience clear social exclusion (FAO, 2009). While the proportion of rural population has decreased significantly in Pernambuco over the last five decades, there are still many family farms and smallholders in the rural areas, particularly in the *agreste* region. Social movements are extremely active, with MST commencing 16 new

occupations in Pernambuco in the first half of 2014. Agro-ecology is limited mainly to technical training of youth while there is little continuing tradition of practicing organic agriculture. Most family farmers attempt to replicate modern agriculture on a small scale and this has historically and still currently been supported by public policies that will be discussed later. Organic agriculture is driven mainly by consumer demand and by education carried out by NGOs and social movements among farmers with messages that agro-chemicals are making them ill.



Figure 9: Examples of anti-agro-chemical advertising (MPA, 2011)

About 60% of family farms across Brazil are in the north-east, and in Pernambuco they produce various crops, depending on the climatic zone, contributing primarily to the national food supply (Cardoso, 2012). Family farming has been supported for some decades by various social movements and by methods of organisation such as cooperatives. According to agro-ecology representatives, the cooperative culture is more prevalent in the southern and south eastern states of Brazil while in the north east it is relatively weak. The larger proportion of family farmers in Pernambuco are individualized and sell their produce to wholesalers, which will generally pass through CEASA. There is a very small percentage of family farmers engaged in organic practices, according to all sources I spoke with, although research has not been conducted to this end. Given the processes of industrialization and the historical prioritization of competitive and scientific farming for export, family farmers have been excluded from much of the agricultural development spotlight and have developed a reputation both amongst urban and rural populations as being “poor, illiterate and ugly” especially the north easterners of Brazil as described by youths in Olinda. Given the number of farms in Brazil and the proportion of family farms, this is

a very significant part of the population and food supply that seems to have internalized the oppression that they have experienced over a long time.

In Brazil, marginalized rural populations have rarely been passive in the face of repression and denial of rights, however with the social and political processes happening in recent years, there are several important factors that make this process more politically legitimate and powerful. Among many civil society organisations there has emerged a convergence of ideas around what kinds of changes need to happen to challenge the dominant pattern of land occupation and economic/environmental hegemony: the socio-environmental sustainability of peasant production (Cardoso, 2012). This convergence in ideas by the national leaders of multiple social movements is in conjunction with efforts by family farmers and local organizations to develop alternatives to industrial agriculture. They claim to hold in common innovative ecosystem management strategies and technologies which place high value on local resources, guarantee high levels of autonomy to family economies and preserve the health of the environment, producers and consumers. Secondly, there is a growing national coordination of autonomous local and regional social initiatives that promote technical, organization and economic alternatives for family based farming. These are mainly under the umbrella of three organizations: the *Articulação Nacional de Agroecologia* (ANA: National Agro-ecology Alliance), the *Associação Brasileira de Agroecologia* (ABA: Brazilian Agro-ecology Association – part of ANA) and MST.

This consensus manifests itself in many ways on the ground and particularly amongst the rural population and very poor it is seen as a significant step towards challenging their poverty and the concentration of land amongst the agrarian elite. I spent a few weeks with some regional organisers for MST in one *ocupação* (occupation: land claim with peasants inhabiting the territory and mounting a legal challenge through INCRA) and in one *acampamento* (encampment: legally recognised land devolution through INCRA). All of the organisers and the peasants that I spent time with or interviewed see their situation as a struggle, a battle between rich powers and the numerous poor and powerless. This is also made clear through the MST literature, of which there are regular updates. Poetry, stories and music are rallying points for the MST participants and these are very often about the beauty of the countryside and the warriors who are fighting to have their share of it without the yoke of oppression (particularly slavery).



Figure 10: A community gathering point and school in an MST ocupação (my photo)

MST is a strongly Marxist organisation, also having roots in the progressive Catholic Church existing at the time of its foundation in Brazil. It aggressively tries to catalyse agrarian reform through changing the structure of land ownership and addressing the effects of a capitalist society and economy. Founded in 1985, their stated goals are to fight for the earth, fight for land reform, and to fight for a more just and fraternal society (MST, 2013). The notion of class struggle is present throughout MST literature and actions.

MST organisers and participants will often use the same core group of people to establish a new occupation as it is dangerous and often results in combat with landowners. Sentries are set and sometimes armed with sticks, shovels, axes, bows and arrows and occasionally with rifles. During the occupation it is quite common for physical clashes to occur and this can result in the occupiers being driven from the land. For the MST participant they see this as intimidation while the real battle is legal. The organisers for this region estimate that the average length of occupation can be 9-12 years and even then some occupations are not successful. I visited one occupation that had been present for 15 years, forcefully evicted from the land at least two times, and lived with very few resources in mud huts practicing family farming on occupied land nearby. They felt that they were always in a precarious position but that the freedom to fight was far better for them and better for their children than the alternative i.e. to move to the urban *favelas* (slums). In the *ocupação* they were able to practice agriculture, live

with little crime in their own community and have the hope that their claim would be granted and their future would be brighter. They contrasted this to the prospects of manual labour on sugar cane farms, where the conditions were close to slavery, or the favelas with the high rates of drugs, violence and few prospects.



Figure 11: The MST ocupação in which I spent some weeks (my photo)

While I visited I was able to participate in a community meeting that was held in the composite structure that was really just a corrugated iron roof held up by wooden posts. This structure serves as the church, primary school when a teacher visits, meeting hall and all other communal purposes and it is adorned with flags of the MST movement and of Che Guevara's silhouette. In this meeting the attitude was upbeat as there was news from one of the organisers of an INCRA representative coming to visit that could signal progress towards their claim to that land.

Once a land claim has been granted, which does not give title over the land but gives a long term lease to the *acampamento* on the condition that the land is kept productive, the land is divided up into shares by the occupants. This process can generate lot friction as not all occupants have been there the same amount of time, not all live there full time, not all participate in the occupation with the same veracity. This process of transitioning from *ocupação* to *acampamento* is worrisome for the participants and the regional organisers must participate to regulate the process.

However I spent around a week in an *acampamento* which had won their land claim 7 years prior and had since continued their collective ventures. These include the pooling of agriculture harvests, womens handicraft groups, community church and school constructions, water and road maintenance. Several of the senior members of this *acampamento* with whom I was lodged also participated in the establishment of new *ocupações* and were well known and respected personalities for MST in Pernambuco.

In my interviews MST organisers characterised a normalised view of modernised agriculture as the current mainstream model imposed by the forces of capital and big business which is harmful to people and the environment. In their view it entails the commodification of food and goods of nature to increase corporate profits. It proposes models of agriculture based on organic peasant production for domestic markets with a democratic distribution of land. It promotes diversification of crops and freedom of seeds, while strongly opposing deforestation. I very often heard the examples of the inhuman conditions of labour and health problems arising in large scale sugar cane farms, which are one of MST's main recruiting sources. As befitting a Marxist ideological foundation, MST is strongly critical of the Breton Woods institutions, the World Bank, IMF and the WTO, who it sees as imposing neoliberal policies and free trade agreements which incentivise food produced with industrial chemicals and which are transported around the world for processing and consumption. It sees this as being the antithesis of a sustainable peasant production and also cites the contribution to climate change of these forms of production as being a clear example of the unsustainability of mainstream agricultural systems.

In the Great Transformation, Polanyi (1944) creates the 'double movement' and 'fictitious commodities' as key concepts to describe the effects and causes of the anti-democratic nature of capitalism. They describe the reaction of society to social dislocation when the economy is separated from the socio-political sphere. Polanyi originally describes this in relation to the changes around the introduction of market economy in England in the 18th and 19th century. Society perceived the separation of the economy and subordination of the social fabric to the laws of the market and there was an emergence of resistance to this phenomenon through social protectionism (Polanyi, 2005)

For Polanyi, one of the fundamental issues of the market economy system is the real demarcation of what he called fictitious commodities: labour, land and money. Commodities are exclusively items that are produced for sale on markets. As labour is the essential productive function of human beings and land is the physical context in which it occurs, the inclusion of these elements into the market economy as items which are produced for sale describes the subordination of both society and nature to the market. Money also cannot be demarcated as it is only a token of purchasing power designed to facilitate exchange (Polanyi, 2005). The non-regulation of the market economy would atomize and destroy the very substance of society; the dignity, interconnectedness, psychological and physical existence of a person. To trade human function and their surrounds without restriction and with an unlimited amount of fictitiously created purchasing power removes all cultural and institutional protections and would destroy all societies who are subjected to this 'satanic mill'. The subjection of labour to a market system means the reorganization of human activity and life itself as an accessory to the market system. The subservience of humans to the market economy means that their productive capacity is only required to create goods or services to trade, and if this is not required the 'surplus labour' is actual individuals without a productive purpose, without one of the primary forms of human integration, and without a means to subsist (Polanyi, 2005).

One MST participant whom I shared a meal with one evening in the *ocupação* had spent more than 25 years on sugar cane farms and had seen many changes over the years. He spoke about the conditions of work and living and the inability to find what he would consider a better life for his family and children, even for his children to go to school. As a cutter, work is highly physical using machetes to cut the canes and then load onto tractors. With the farms increasing mechanisation the need for physical labour reduced, the conditions were worse and he and his family did not want to go to the *favelas* in the city for fear of violence, drugs and unemployment. He had joined this particular MST *ocupação* around 8 years prior and was now able to cultivate his own small plot of land and live in a productive community. He told me that he did not live in fear other than the significant worry that they may all be evicted from the land. This worry was motivating him to continue production and continue to fight for their better life. He saw hope for progress and more freedom in the MST community life and was

very engaged in the political battle although he was unable to express with depth the political ideals and he could not read the literature.



Figure 12: an MST ocupação as viewed from a discussion with some inhabitants (my photo)

While MST is the largest social movement in Brazil, others are also very important to economic democracy and food networks. Experiences of the Green Revolution in Brazil and Latin America in general have provided a space for alternatives to these agricultural technologies to gain momentum (Cardoso, 2012). Agro-ecology in Brazil started as a reaction to the environmental and social problems that were seen as being caused or deepened by the Green Revolution. In the 1970s this led a group of agronomists, farmers and NGOs to form the *Rede de Projetos de Tecnologias Alternativas* (RedePTA: Network of Projects for Alternative Technologies) which lasted until the late 1990s. The social movement was reorganised in 2002 with the formation of the ANA by NGOs, smaller social movements, and scientists.

Agro-ecology in Brazil sees itself as a social movement, a science and a practice (Cardoso, 2012) (Gleissman, 2007). As a social movement, it is made up of many different types of stakeholders such as farmers, NGOs, scientists, politicians etc. As a practice, it focuses on participation and valuation of farmers and their knowledge and of their on-farm experiments. As a science, it encompasses the study, design and management of agro ecosystems which are expansively defined as a global network of production, distribution and consumption. The agro-ecology movement in Brazil promotes an agriculture which is independent of the Green Revolution technologies and which works within an ecosystemic approaches rather than substituting ecosystem services for industrial chemicals. It sets up a division between dependence on biodiversity or a dependence on external inputs (such as chemicals and pesticides). It proposes that the replacement of natural processes such as nutrient cycling, soil

structuring and pest controls by chemical fertiliser, tillage and pesticides for example, is key to understand why modernised agriculture harms biodiversity (Cardoso, 2012).

While spending some weeks with both family farmers and prominent representatives of agro-ecology in Brazil, many challenges were raised and there is a strong correlation between the challenges outlined during my experiences within MST. While my time within the agro-ecology movement in Brazil was spent around education and youth, a significant amount of agro-ecology practice in Pernambuco seems to focus predominantly on this strategy and collaborating with MST for increasing the understanding and practice.

7. MODERNISATION & AGRO-ECOLOGY: ECONOMIC, ENVIRONMENTAL AND SOCIAL IMPLICATIONS

“...relations of extreme or exaggerated subordination: of people to other people, of plants to other plants, of animals to other animals; the entire mass of plant life to the empire of the all-powerful sugarcane; the entire variety of human and animal life to a small group of white men – or officially white men – who owned the sugar plantations, the rich lands, the beautiful women and the thoroughbred horses” (Freyre, 1985)

In Pernambuco sugarcane farming was originally able to deplete and exhaust land, and then move on to new lands by deforesting new areas (Freyre, 1985). The forest is all but gone now and sugarcane cultivation exists on the same lands. Former workers on large farms say that these lands are almost never left fallow; they grow often all year round and work in monoculture with huge amounts of chemical inputs and very little safety protection for the workers. There have been many changes in the process of cultivation and harvesting of sugarcane since the colonial period. According to many interviewees, the mechanisation that took place from the 70s has provided the worst environmental outcomes while still increasing yields and total output. In the end, whether the changes in agriculture are seen as positive progress or as failure really depends on what outcomes are prioritised. However it is clear that human relations to environment and food have changed:

"For more than 99% of human history people obtained their food by hunting, fishing and gathering. Over the past 7000 years that has changed remarkably. Today, only 2% of all human food energy and only 7% of all protein is captured from the wild, and most of this is from water. The rest is produced by agriculture and aquaculture on land" (Clay, 2004, p. 12).

7.1 ECOLOGICAL

Since agriculture was first developed over 10 000 years ago, it has been having an effect on ecosystems and climate. It should not be assumed that greenhouse gas emissions and loss of biodiversity and other effects observed resulting from agriculture are exclusively contemporary issues. Civilisations have risen and fallen based on agriculture and ecosystem management (Indus Valley, Babylonian, Egyptian, Mayan, and others (Clay, 2004)), however there has been a shift in the intensity of these issues in contemporary times. Modernised food production has become linked to an abundance of fossil fuels and the energy that they provide (Gleissman, 2007). Increased population requires a greater quantity of food than ever before, technologies and systems have been developed based upon the easy availability of fuel.

Green Revolution technology replaced many ecosystem processes such as nutrient cycling, pest control and soil microbiology with chemical fertiliser, pesticides and tillage. This is key to understanding why modernised agriculture harms biodiversity instead of promoting it (Vermeulen, Campbell, & Ingram, 2012). Brazil is one of the most biodiverse hotspots in the world, but now so much of it has disappeared and one of the primary reasons is agriculture (Cardoso, 2012). These are inherently political and economic actions. Using soybeans as an example as there has been more significant research into soybean industry, production accounts for 45% of pesticide consumption across Brazil and 35% of the agricultural land use. Most soybeans are GMO and most are exported, for example, 46% go to the Netherlands alone as animal (mainly cow) feed. In the Netherlands, the cows produce milk which is turned into cheese. The cheese is shipped back to Brazil and sold for a cheaper price alongside Brazilian organic cheese of the same type (Cardoso, 2012).



Figure 13: A man using pesticide without correct protection in a MST accampamento (my photo)

Despite obvious examples such as these, inside MST camps there are regular debates and diverging opinions about agricultural practices with a great many family farmers and MST participants preferring replicating modernisation techniques on their small plots. MST and agro-ecology organisers expressed often their frustration at difficulties in changing behaviours and convincing others that agrarian reform should include agro-ecology as a practice as it can prove difficult to prove to them agro-ecology as a science. The main strategy in these cases is to develop some model plots and encourage other small farmers to observe the results. For many farmers with little to no economic resilience to be able to absorb multiple years of financial hardship and extremely depleted lands it may be very difficult to transition from non-organic to organic agriculture. There is no single generally accepted time-frame for a transition from non-organic to organic, it depends very much on local climatic conditions and the condition of the soils (Gleissman, 2007).

“One of the best regions to observe as test ground for our theories is the sugar-producing northeast of Brazil, with its typical natural environment. The life of its soil, water, plants and even its climate has changed because of the unbalancing and untimely action of colonizers gone blind by greed, always wanting to plant more sugar cane and produce more sugar” (de Castro, Geografia da Fome (Geography of Hunger), 1946)

The question of organic versus non-organic agriculture is obviously huge. Examples of common questions asked are: can organic agriculture feed the world? What about a growing population? It is a difficult debate to wade into and academia has a plethora of pundits expressing different points of view. Are we asking the right questions? (Cardoso, 2012) If the most often asked question is “can organic agriculture feed the world?” then it must also be accompanied with “can modernised agriculture feed the world?” (Bagdley & Perfecto, 2007). Of course this makes for a very simplistic debate and these ideal types are very useful for academia but have less relevance for families who have farm economies to worry about along with environmental and social concerns, or for the extremely poor who think of immediate survival before the origin of their calories and the implications of those agricultural systems.

It is also clear that organic is not necessarily synonymous with sustainable. The adaptation of organic agriculture to factory farming and globalised supply chains as is the case with the entry of Wal-Mart into the organic food supply market shows that it is the entire system within which that production is embedded which is the most relevant. As pointed out by Johnston (2007) organic food can be purely a marketing strategy and convincing consumers to pay more for products related to an ideal equates to “bourgeois piggery”. The question of organic versus non-organic is less important than the management strategy and structure that the entire food network supports.

Ecologically speaking, sustainable agriculture is about soil health (Clay, 2004). Soil health is about the amount of biomass within the soil: plants and animals, wastes, microbes, insects etc. Dead biomass makes up around 90% of the carbon in soil. While undisturbed soil has around 2% carbon content, a 1% gain in soil carbon content can increase yield by around 20%. In early stages of cultivation, carbon content falls to around 1.5% and in severely degraded soil it is around 0.5% or less (Daily, 1995). With the conversion of undisturbed ecosystems to agricultural lands, soil erosion increases in virtually every circumstance. The best protection for soil is permanent cover. Dense and multistorey forests provide the best protection while annual crops which account globally for approximately 90% of land under cultivation, including sugarcane in north east Brazil, leave the soil exposed and vulnerable to erosion and organic matter depletion. Rebuilding soil health starts with increasing soil fertility: organic matter, nutrients, water retention, soil structure, microbiological activity etc., keeping biomass in the fields, manure or compost, making swales along the contour lines, poly-cropping,

symbiotic relationships (Henaio & Banaante, 2006). Using leguminous cover crop as green manure, enough N could be fixed into soil to replace the current use of synthetic fertilisers (Bagdley & Perfecto, 2007). Soil health is also the key element to reducing greenhouse gas emissions from agriculture (Smith, et al., 2008).

At a larger scale, organic agriculture is important especially for economic democracy and environmental reasons. One of the key aspects of a successful sustainable agriculture is for it to exist within the limitations of biogeochemical processes. Non-organic agriculture involves the use of chemical fertilisers and pesticides to increase yields and decrease losses, including with poor soils. To focus on the fertilisers, they consist generally of varying proportions of the three main elements required for plants to thrive: nitrogen (N), phosphorous (P) and potassium (K). Each of these elements has always existed naturally within its own cycle. Industrial fertilisers bring these elements into a private market, undergoing the same process of privatisation which allows for the transfer of capital to the elite class. Of the 3 main nutrients essential for agriculture and used in industrial fertiliser application, Brazil imports around 70% of N, 50% of P and 90% of K (Cardoso, 2012). The effectiveness of fertilizer application diminishes over time for various reasons. For example, application of N to soils changes the balance of micro-organisms in the soil towards N consuming organisms, reducing N fixing organisms and over cycles of application, while also reducing carbon in the soil, dependency on this type of external input is created. Efficiency decreases over time, for example in the United States in 1980, 1 metric ton of N applied could produce a yield of 15-20 metric tons of corn. In 1999, the same amount of N could only produce 5-10 metric tons of yield (Gleissman, 2007).

7.2 SOCIAL & ECONOMIC DEMOCRACY

While comparing and contrasting the implications of the two proposed ideal types of discourses, sustainable modernisation and agro-ecology, differences in socio-economic opportunity should also be differentiated. In rich countries we could exemplify these two discourses as such: firstly, the idea that it is sufficient to clean up current practices, reduce emissions and produce 'greener' products. Alternatively, the need to re-evaluate affluent and material lifestyles, or more bluntly, to redefine our 'needs' (Seyfang, 2006). In 'developing' countries, or countries where there is a large proportion of low-political-power and low-resource-owning humans, the luxury of this moral choice is not available to many people. The difference between these discourses

becomes necessity and building a more resilient future for family units and communities. Information and options may not be freely available. Sustainability in agriculture can only come from understanding the implications of the interactions in the whole system, including paying as much attention to the people in a network as to the ecological and economic conditions (Gleissman, 2007).



Figure 14: Students learning about solar technology in SERTA - sertão campus (my picture)

In Pernambuco, social relations and outcomes are changing and evolving rapidly, as they have been for decades. Urbanisation, economic and infrastructure growth, industrialisation, for example have all affected social outcomes for general population. Social outcomes are perhaps harder to measure than standard economic outcomes however it is clear to see the social divide is also based upon economic lines. All research participants acknowledge that health and education opportunities and outcomes across the state are extremely unequal, access and infrastructure in the rural areas is limited contributing to the perception that the city is a better place to live. In SERTA, a Pernambucan agro-ecology advocacy and education NGO, so many of the students talk about their families and friends wanting the rural youth to move to the city for educational opportunities and employment options, however the young people themselves studying at SERTA expressed very different opinions and were quite happy to be in the minority of those who wanted to stay on the land and practice family farm based agro-ecology. Many of them said the difference was about community, that they felt lonelier in the city and preferred to stay on their land. They hoped especially for

improved access to technology and education in the rural areas as they thought that this would especially keep the youth positively interested in continuing a rural lifestyle.



Figure 15: Some examples of alternative technology and recycling taught at SERTA (my photos)

One key focus of agro-ecology in Pernambuco is the creation of links and establishment of a sense of community around food production and consumption. Here, some key concepts challenge the established food and agriculture system. A community based food network changes the relations of production to consumption and the links that may come between. Rather than the industrial supply chain seen in Figure 16 which is relatively standard and may be extended or shortened depended on the product and the amount of storage and processing required, a community based food network may have many different arrangements (U of Michigan, 2009). Each of the same elements as those in an industrial food chain may also be present however the form and arrangement of these elements are very different. There is not a simple diagram would show the different arrangements however there is a constant theme of re-embedding food production in social and environmental relations. This may include direct marketing

strategies such as farmer markets, food vans, farm boxes, or collectivisation such as cooperatives.

I was lucky enough to conduct the first interview for this research and continue a series of informal meetings with Clovis Cavalcanti, honorary president of the Brazilian Ecological Economics Society and professor at Federal University of Pernambuco's *Fundação Joaquim Nabuco*. During our meetings we discussed in particular local food networks and his family's implication in creating the first modern farmers markets in the state. The theory and practice relied significantly on the promotion of direct marketing that would create relationships between producers and consumers. Creating community can transcend the imperative of producing for the lowest cost possible and place trade relations in the social sphere rather than purely an economic interaction. Social, economic and environmental effects of community based food networks are many and varied. Socially, a community based food network allows consumers and local farmers, to support and work with diverse members of their own community with whom they have interpersonal relations. Interpersonal relations are a huge step to eliminating the invisibility or the 'otherness' of producers to consumers and vice versa. Traditions and local culture are established and maintained which are centred on interdependence rather than individualisation. Environmental benefits beyond reduction in greenhouse gas emissions from transport depends upon the agricultural system used and the capacity of the network to internalise pollution and waste without using resources beyond what is consistently produced and reproduced within the network. Economic benefits of a community based food network are extremely dependent upon the economic perspective drawn upon. From a perspective of economic democratisation, community based food networks provide huge scope for positive action and movement towards control of the agricultural economic sphere and to re-embed the food economy within social and environmental interactions.

Community based food networks are used to contrast globalised food networks. A food network means more than just the links in the chain of food supply to humans, generally only considered from farm to consumer but it could be expanded to include pre-farm inputs, waste, other relations and interactions which are usually considered externalities (U of Michigan, 2009). Community based as a term is intentionally used rather than local. What the 'local' in local food network means is in the eye of the beholder. Is food from 30km away local? Is food from 100km away local? Is a national

food network considered local? (Edwards-Jones, et al., 2008) Again there is no one clear answer but a concept to use a contrast to what currently exists. What could be considered community based food network must depend on the ecosystem that supports it and the population that lives there. Community based food networks should not be measured in ‘food miles’ as this provides a poor indicator of the environmental and societal impacts of the network hence community based. Community based means connecting food production with economic and community development. It implicates the consumers of the food in the food network, rather than purely as end users of a product. It aims to ensure that “everyone has financial and physical access to culturally appropriate, affordable, nutritious food that was grown and transported without degrading the natural environment, and in which the general population understands nutrition and the food system in general” (U of Michigan, 2009, p. 23)

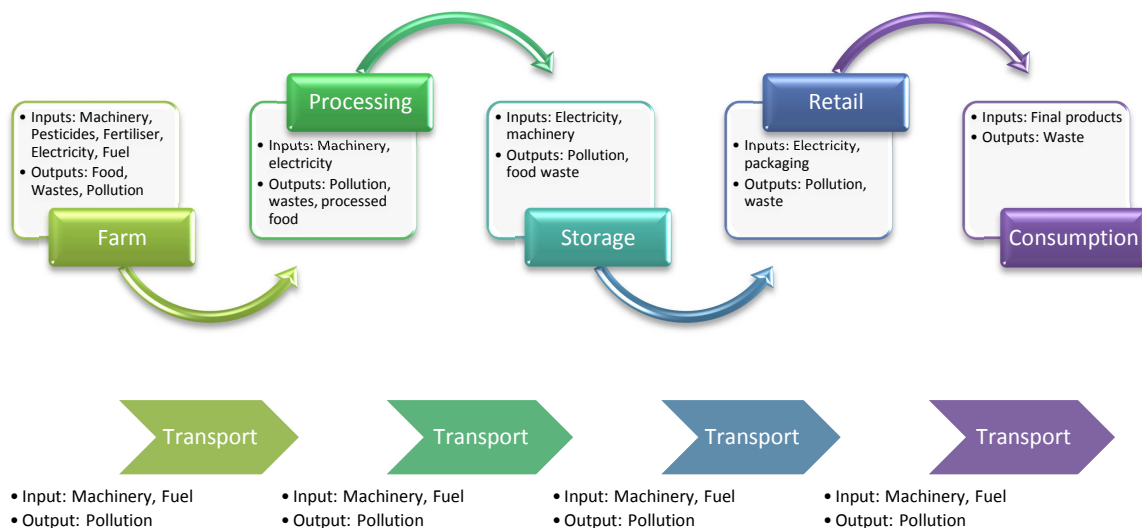


Figure 16: A basic list of emissions to calculate in an industrial food chain (adapted from Edwards Jones et al, 2008)

A significant trend towards urbanisation has taken place in Pernambuco over the 5 decades (see figure 4), and this is also true of all other regions in Brazil. Focusing on continuing the modernisation of agriculture in Brazil means that farmers will increase the manual labour saving technology that they use on the farm and will farm greater areas. This has been one of the driving forces of the urbanisation trend and will continue to be so. While previously there were significant amounts of manual labour involved in sugar-cane farming, the mechanisation of the cultivation and processing has resulted in their loss of productivity over time. This is an easy example of two of the fictitious commodities developed by Polanyi (2005). Land and labour were subject exclusively to

the needs of the industrial production of sugarcane. When those needs were replaced by machinery, the human productive function was no longer required and the space in which that productive function occurred was no longer available to live on, causing exodus to urban slums where situations of misery were the most common. There is a strong perception amongst the rural population that the city provides more opportunities for youth and it is seen as an attractive place for youth to go and live. There is access to and a higher quality of education, there is much more easily accessible technology such as internet, and there are more opportunities for social interaction. Many youth who would have the opportunity of productive function in the rural areas choose to move to the city to try and take up these attractive images of urban lifestyle.

One of the most interesting and telling perspectives of the interviews conducted was a response from the Pernambuco Secretary of Work, Qualifications and Entrepreneurship. He expressed that poverty is not a significant issue in Pernambuco, and there is no lack of work. The issue is that there is a lack of trained people for the jobs that are available. Therefore people need to be retrained to work in industry. While the history of Pernambuco and the productive function of its inhabitants has been largely sugarcane, agricultural technology means that many of those workers now no longer have a function in the sugarcane industry and must be retrained to do other things. A surplus of labour attracts industry, and there are programs in Pernambuco to qualify people to work in the industries opening up. Essentially, business leads and the population must fit with the needs of the business, and the state can assist to mediate that by providing training and incentives to give people the skills required by the employers. During our interview the key point that he wanted to keep reinforcing is that it is not job creation that was needed but increasing the quality of employment. This is seen as an industry led technical qualification drive, the example given was that the state attracted car manufacturer Fiat to open a factory. Technical courses were made available to provide the training to people needed to fulfil those jobs. People moved to live near the factory to be able to work there. It is a similar story for a huge seaport which is under construction south of Recife which will be the largest in the north-east of Brazil.

The problem identified by social movement leaders with this version of developing a workforce is the economic and social theory that underpins it. The macro perspective of people fitting in with the economy and the needs of business ignores the

fact that they are actual people which are fitting in. The focus is not on the wellbeing of the people, but there is the assumption that employment and income will give a productive function and meaning to a person. The general perception in Pernambuco, and the government position, of a productive function is represented by full time employment, which many research participants do not see as an avenue to economic democracy. Conditions were and still are extremely challenging for many workers on sugar cane farms. Slave labour and child labour were extremely common even after the official abolition of slavery in 1888, and, on a smaller scale, these forms of labour still exist today in the sugar cane industry according to many people that I spent time with both in the agro-ecology movement and MST. While the state government recognises that they exist by implementing programs to combat these forms of labour, the state Secretary for Work, Qualifications and Entrepreneurship denies ever having seen the existence of them. Conversely, MST representatives cite examples of slavery and members of their camps and occupations who had been subject to these forms of labour.

One of the key processes that perpetuates and deepens the lack of democracy in the economic sphere is accumulation by dispossession. Through privatisation, financialisation, crises management/manipulation and state redistributions, public policies ensure the transfer of wealth and land to the elite class (Harvey, 2003). The inclusion of common or public owned goods into the market is privatisation, which generates a means for profit for the capitalist class while excluding further the working class by creating another means for the transfer of wealth from working class to capitalists. The process of proletarianisation and dispossession of agricultural lands is a classic example of results of privatisation and manipulations of financial markets.

“Clearly, we have compiled a record of serious failures in recent technological encounters with the environment. In each case, the new technology was brought into use before the ultimate hazards were known. We have been quick to reap the benefits and slow to comprehend the costs” (Commoner, 1969, p. 4)

As seen in the previous chapter, the vast majority of government support for agriculture in Brazil comes in the form of increasing mechanisation and modernisation, with a focus on increasing yield as an outcome. Using machinery to replace human labour is largely seen as a positive outcome, as has been the case for thousands of years

through inventions such as the plough or the mill. This means that there are less people required to maintain or increase productivity of the land. Alternatively this could mean the same amount of people spending less time working on agriculture and more time to complete other tasks, whether they be work or leisure. Green Revolution technologies have not created adequate conditions for the economic, social or environmental reproduction of family farming (Cardoso, 2012). In fact the opposite: they created technological dependency, ever higher production costs and indebtedness while also degrading ecosystems, reducing biodiversity (Caporal, 2011). Technological solutions have historically been sought to counter agrarian reform movements which have been linked to socialism, and this seems to be the case in Brazil also with agrarian reform being undertaken in a market led productivity paradigm which legitimises the elite discourse and delegitimizes the MST discourse (Woolford, 2005). Agribusiness has taken the economy of scale industrial model of the assembly line and applied it to food production. For family farmers, this is disastrous while for large landowners it is a sensible technocratic business model. While 85% percent of the total farms in Brazil are family farms, they use only 25% of the agricultural lands. Of all the food that reaches Brazilian tables, 70% is produced by these family farmers (Cardoso, 2012). Many family farmers attempt to replicate the industrial system on a small scale by acquiring machinery and using bought seeds, fertilisers and pesticides.

According to particular to agro-ecology representatives, a more robust and long term solution would be to increase the proximity of production to consumption, diversify crops and return to a more labour intensive but less destructive form of agriculture, with more people being involved in useful food production rather than paper-producing wage labour which jeopardises productive function. One of the most important points that Clay (2004) raises is the productivity per hectare being greater in smaller farms compared to larger farms. Would it not make more sense for more people to be involved in smaller scale agriculture with more diverse crops, in regions which can support levels of human activity? Low intensity farming or farming which uses fewer fossil fuels and fewer inputs has been regarded as needing higher amounts of physical labour, meaning more people involved.

The health impacts of different types of agriculture are currently the largest driving force in the urban areas for people who are making 'alternative' choices about food consumption. There have been many campaigns against agro-chemicals and the

effects that they can potentially have on humans. Many interviewees divided food consumers into two broad categories: firstly, those who purchase based on price alone with little regard for or knowledge of nutritional quality or dangers, and secondly, those who were willing and able to pay for more expensive foods which are perceived as being healthier. When questioned further there was generally a more nuanced version of this which was based on ability to pay and availability of health information. The health of those involved in agriculture was also perceived as being different based upon what type of agriculture they were involved in. Family farmers were perceived as poor, uneducated and with low living conditions, while workers on large farms were also perceived as poor and with low standards of living, however the managers and owners of the properties were seen as rich businessmen rather than farmers. People involved in other parts of the food chains were represented by the class of work they fit into, workers or managers mostly.

The changes in consumption habits seemingly have spawned from a variety of sources. There is a traditional picture of how wealthier people eat, there is a huge amount of fast food available, there is the government public health advertising and mass media advertising, and there are the social movements and those affected indirectly. The perceptions of needs and wants in Pernambuco of most of the population is diverse, but the stereotypical image is given off that people want to live in cities and have the luxuries associated with modern life; economic growth has led and is leading to more jobs and more money meaning that consumption is increasing, therefore happiness and health will increase accordingly. It seems overly simplistic but this is the public discourse of the government representatives that I spoke with or interviewed. The divergent examples of this are from the social and activist movements who generally championed rural lifestyle under conditions of agrarian reform and changing dominant styles of agriculture through educating family farmers.

To further any analysis of political economic implications of various agricultural systems, one must discuss elements of growth, distribution and justice. Development and growth are not the same thing. The former implies evolution and change, the latter implies increase and expansion. In Brazil, much of the economic growth has been based on increasing participation in a formal economy as well as increasing industrial productivity according to the Pernambuco Secretary of Work who proposes that growth should be focussed now on increasing productivity rather than inclusion. However, as

growth in the real world is not delineated from natural resource consumption, growth of any kind cannot be seen as perpetual, not in consumption nor production and it must be limited to the finite nature of contemporary bio-geochemical processes (Bartlett, 2004).

Economic growth is a poor indicator of social welfare (van den Bergh, 2010). The dominance of economic growth as an objective is one of the key problematic discourses in standard economic discussions. Growth should not be an objective, but neither should de-growth. The economic focus should be on public policies which would promote well-being. Sugarcane production and progression in Pernambuco exists within the growth discourse. It is focused on technology and specialisation, it is the application of the factory floor to agriculture and the objective is to produce as much sugar as possible with as little expense as possible. The focus is on efficiency and scale to create the optimal conditions for output which will maximise profits. Following the Green Revolution technologies has been highly praised by turning many countries who were had large proportions of populations in hunger into net grain exporters and from food aid receivers to receiving income for national food production, as is the case in Brazil which received food aid until the 1980s (Shiva, *Earth Democracy: Justice, Sustainability and Peace*, 2005). But as is the case in Pernambuco, the rest of Brazil, and other countries, it is clear to see that growth does not increase wellbeing or distribution (Stiglitz, Sen, & Fitoussi, 2013).

To this point, EMBRAPA research grouped Brazilian farmers into rich and poor categories, resulting in poor being closely aligned to family farming and rich being aligned to commercial farming. The simple calculation of gross farm income divided by minimum wage to show how many people a farm should financially support. Roughly 75% of farms support the equivalent of less than 10 minimum wages, and as a subset of these, 60% exist in the north eastern states. When further separated between farms of greater than 100 hectares or less than 100 hectares, the gini coefficient was found to be similar (<100Ha = 0.85, >100Ha = 0.87) (Pereira, Martha, Santana, & Alves, 2012). This coefficient is extremely high, the national gini coefficient in 2009 was 0.54, roughly equivalent with Zambia and Colombia. A gini coefficient of 0.85 is not recorded for any country in the world, with the worst national coefficient measured being the Comoros at 0.66 (World Bank, 2014).

In the economic growth discourse, unintended effects of economic activity are called externalities, which don't reflect the full cost (economic, social or environmental) of an economic interaction (Buchanan & Stubblebine, 1962). Mechanisation and centralisation of production has provided a way to economise on labour costs to save on expenses and increase efficiency. A New Holland T9 tractor has 670 horsepower (Tractor Data, 2015). Actually the power of 670 horses in a machine! Particularly since the 1960s in the sugarcane lands of Pernambuco, the mechanisation of planting and harvesting and processing has removed the productive function of a huge proportion of rural inhabitants. Those working under wage labour who were no longer needed could not sustain rural livelihoods and this is the key push factor for migration to urban settings. The commodified productive function of these humans does not compete with the advances in technology, leaving human labour seemingly uncompetitive and inefficient.

Using standard indicators of growth and productivity, modernised agriculture is likely to provide higher profits for private firms and increase national agricultural exports in the short to medium term. However it will continue to subjugate human and ecological wellbeing to market forces. If indicators of wellbeing are focused on and economic democracy is made a priority, then economic growth will not be the key indicator and other methods of economic organisation and power will develop which will internalise externalities into the economic indicators. According to an interviewee, "the policies and frameworks that social movements and governments should aspire to is not one of a business as usual model". This is generally recognised in research however in broader Pernambucan society the fundamental changes required to move from business as usual have little traction. Certainly in Pernambuco the issues which are discussed in this research are not widely known or discussed outside of specific circles, not because they are secret but because they are not 'in the frame', so to speak. There is little knowledge or emphasis placed on discussing peak oil or climate change, while the focus is much more on economic growth and social justice. In the Presidential elections in Brazil, candidates accuse each other of representing the rich while advertise themselves as being the true representative of the peoples interests. There are simplistic differences drawn between the key candidates: "Marina will be good for the environment but Dilma will be good for the economy" as characterised by an interviewee. Most people have little faith in the government that they are shaping up to

elect. It seems that the general perception amongst the public that I spoke to was that corruption was an essential element of being a politician. On several occasions I heard the same principle expressed: ‘all the politicians are corrupt. Some might do more and some will do less, so I will vote for the corrupt one who will do the most.’ There is also the unverified but common story told that politicians will spend money to purchase votes, with votes in the presidential election being sold for BRL30-50 (EUR10-17). Clearly any effective governance strategy which is led by population or by government must rid itself of systematic corruption. Again, if the drive for change and political responsibility comes from the demos, then corruption would not be an unfortunate expectation but would be a scourge that would be much more actively reduced by public engagement.

Given the assumption that there should be a greater public engagement in the political process, there needs to be clear messages to politics and business associated with these. This is certainly a medium term process given that so few of the population are politically engaged currently. There are some subgroups which express dissent, particularly some youth and student groups. For example, in early 2014 there was a group of people who occupied an abandoned rail area that was planned for demolition and development into high-rise buildings with gated parks around them for residents. This brought a lot of political attention and public support and the occupation was eventually evicted by hundreds of military police in combat gear with tear gas and violence. In mid-2013 there were very large protests in the streets of Recife. These were at the same time as many other protests across Brazil, and they were leaderless and without a unified objective. In Recife there were several hundred thousand people protesting, however people that I spoke to did not give this much significance as a popular movement or political action. It was seen more as a trendy thing for youth to do, to go on to the streets and protest, which while provoking a heavy handed response from the state, also deflated the legitimacy of the protesters both internally and the perception of the protesters.

7.3 BIOFUELS

Brazil has historically been very active in producing and using what are known contemporarily as biofuels. Brazil is the world’s second largest producer of biofuels and these are largely ethanol produced from sugarcane (US EIA, 2014). Particularly the north east, Brazil is described as being the example of production and policy that could

be replicated elsewhere to scale up the industrial production and use of biofuels. There is also a high domestic consumption of industrially produced biofuels. This industry has a long history in Pernambuco, dating back nearly 100 years.

In 1919, the Governor of Pernambuco mandated that all official vehicles run on ethanol. Ethanol production and use increased throughout the second quarter of the 20th century and peaked during WWII, after which time cheaper oil began to assert its market dominance (Kovarik, 2008). Ethanol production was not revived until the oil crises in the 1970s highlighted the dangers of oil dependence. As a response to the first oil crises of the 1970s, Brazil developed the Proálcool program which aimed to offset dependency on fossil fuel imports and utilise the countries experience in sugarcane and ethanol production. Vehicle production has been regulated to ensure production of ethanol capable engines and the national government regulates the blend of ethanol used in fuels based on the sugarcane harvest and availability. The rise of ethanol in Brazil has been linked to the price of oil, and therefore in the 1980s when oil prices fell sharply, so did the industrial economic competitiveness of ethanol and the Proálcool program. In 2003, 'flex fuel' cars, which are able to use both gasoline or ethanol or a blend, were introduced on the market. These have quickly become a very high percentage of cars manufactured and used in Brazil and thus the country currently requires a stable and significant availability of ethanol fuels.

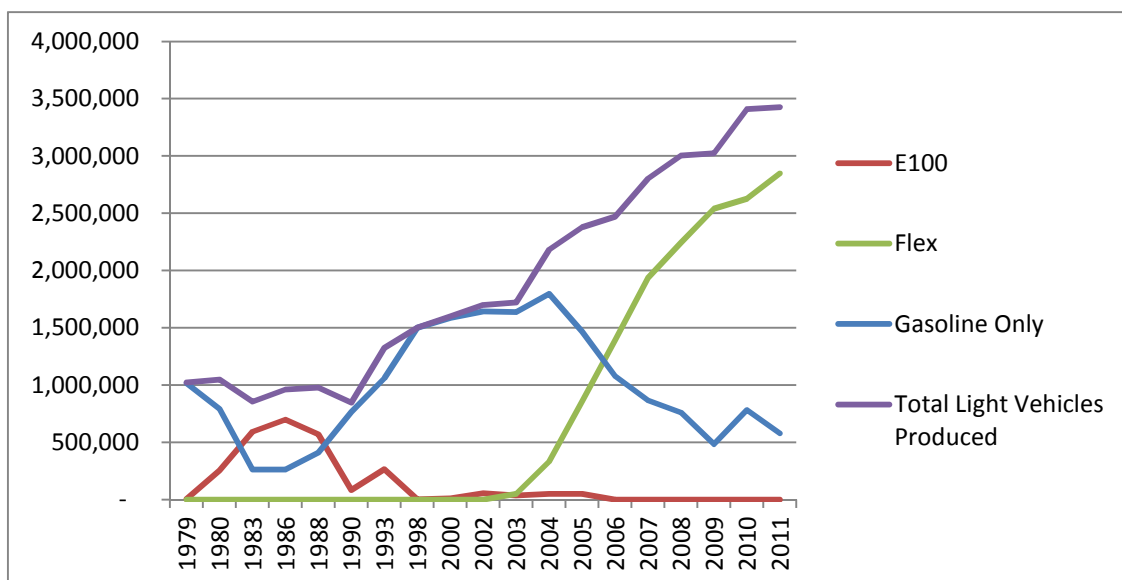


Figure 17: 1979-2011: Proportion of ethanol or ethanol capable light vehicles manufactured in Brazil (Indústria Automobilística Brasileira, 2013)

In the 1970s, the program to replace fossil fuels with ethanol distilled from sugarcane meant that almost the last vestiges of the Atlantic Rainforest were felled to further expand the sugarcane industry. As shown in Figure 18, from the period of 1975-2010, national sugarcane production increased from 89 million tons to 696 million tonnes, sugar from 6.72 million tons to 31.51 million tonnes, and ethanol from 0.6 billion litres to 25.56 billion litres (Pereira, Martha, Santana, & Alves, 2012). The north-east of Brazil, including Pernambuco, is the primary location of sugarcane cultivation in Brazil and has been particularly subject to this intensification including land expansion (both by deforestation and increasing farm size by taking over family farms).

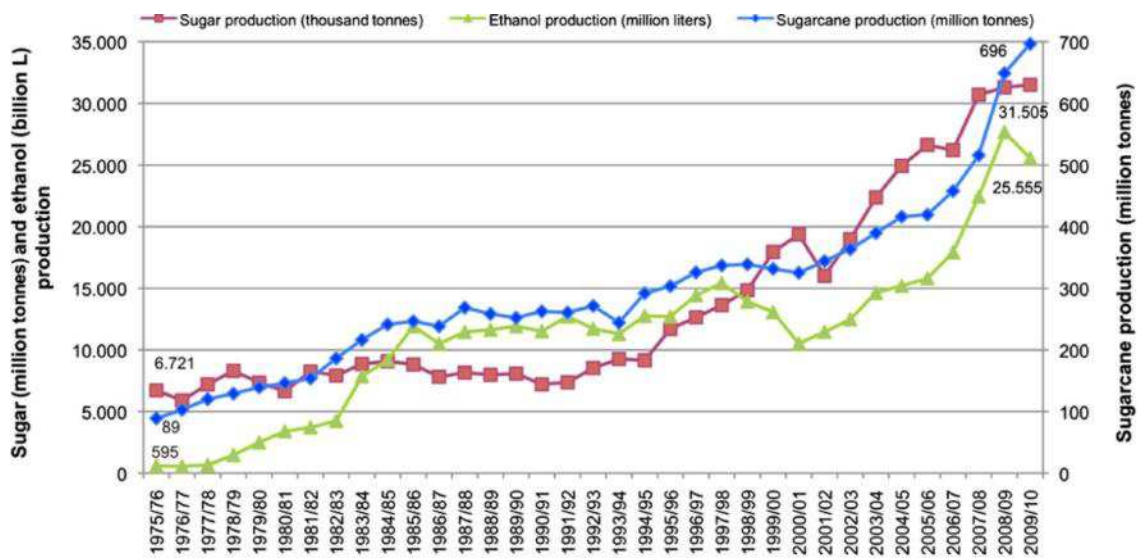


Figure 18: Sugar, Sugarcane and Ethanol Production in Brazil 1975-2010 (Pereira, Martha, Santana, & Alves, 2012)

This thesis will not delve deeply into the biofuel debate due to a need to restrict the scope. However some very broad outlines are needed to provide full context and orientation of the work. There are many debates on the use and future possible usefulness of 'biofuels' as a replacement for fossil fuels. However it is clear that in this research, there is far more at stake than substitution of fossil fuels for lower greenhouse gas replacements. The social, ecological and economic impacts of different forms of agriculture, including those for biofuel production, must be assessed and their ability address the issues faced now and into the future. As such, in Pernambuco and the local sugarcane industry, 'biofuel' production is placed within the business as usual economic growth development paradigm, alongside other forms of high input monoculture agricultures. The agribusiness organisations maintain the political and economic upper

hand with the continuation of a general policy framework prioritising economic growth, natural resource extraction and export oriented development.

8. FUTURE NATIONAL AND REGIONAL SUSTAINABILITY

While I have written much about the competing discourses in agriculture and social and political economic arrangements which exist currently, there are accordingly different visions of methods to achieve sustainability. The modernization side continues to focus on technology, increasing yields of specific crops, maximizing efficiency and controlling/minimizing variations and uncertainty. More mechanization means less people involved and greater invisibility of consumers from social, political-economic and environmental conditions of production. Well known activist Vandana Shiva (Shiva, *Easrth Democracy: Justice, Sustainability and Peace*, 2005) is one of the most vocal critics of this perspective. While conceding that the first Green Revolution technology was both about producing more food and about economic relations, the second Green Revolution is not, it is about profits. Brazilian agronomist Ana Primavesi categorizes GMO crops in Brazil as adaptations to dead soil, something which she sees simply as unnecessary (Serreau, 2010). The Green Revolution technologies are increasingly evidently unsustainable due to their demands for inputs and energy. Mostly, they are considered unsustainable because of the tendency to reduce biodiversity. There is no coincidence that the increasing pace of degradation of Brazilian ecosystems is directly related to the advance of monocultures and the use of chemical inputs. While deforestation began 500 years ago, there is little doubt that the greatest damage has been done since the modernisation process took off in the 1960s (Cavalcanti, 2007).

To look to the future of agricultural sustainability and the options available, the business as usual approach shows weakness particularly in the areas of climate change and peak oil. The concept of peak oil has been heavily researched and debated, and while the concept itself seems to be unchallenged, one of the greatest challenges and contested points is around the predicted date of the peak. In an evidence review conducted by the UK Energy Research Centre (Sorrell, Speirs, Bentley, Brandt, & Miller, 2010), the future supply of oil will be constrained by three factors. Firstly, individual field production usually rises to a peak or plateau and then declines due to

lowering pressure or the infiltration of water into the field. This usually occurs before half of the recoverable resource has been extracted. Secondly, most oil in a region tends to be in a small number of larger reserves while the rest is in larger numbers of smaller fields. Thirdly, and because of the second point, much of the larger reserves are discovered earlier and exploited first, meaning that following discoveries are smaller, harder to locate and have smaller supplies (Sorrell, Speirs, Bentley, Brandt, & Miller, 2010). The pattern that has been observed in more than a hundred oil regions is that there will be a point where smaller field production will fail to compensate for slowing production in a larger field and the production in a region will peak. Extrapolating this will see the same phenomena occur on a global scale, but the question still remains as to when. In the same 2010 study, the conclusion was that peak oil was extremely likely to occur before 2030 and there is a significant chance of peak oil occurring before 2020.

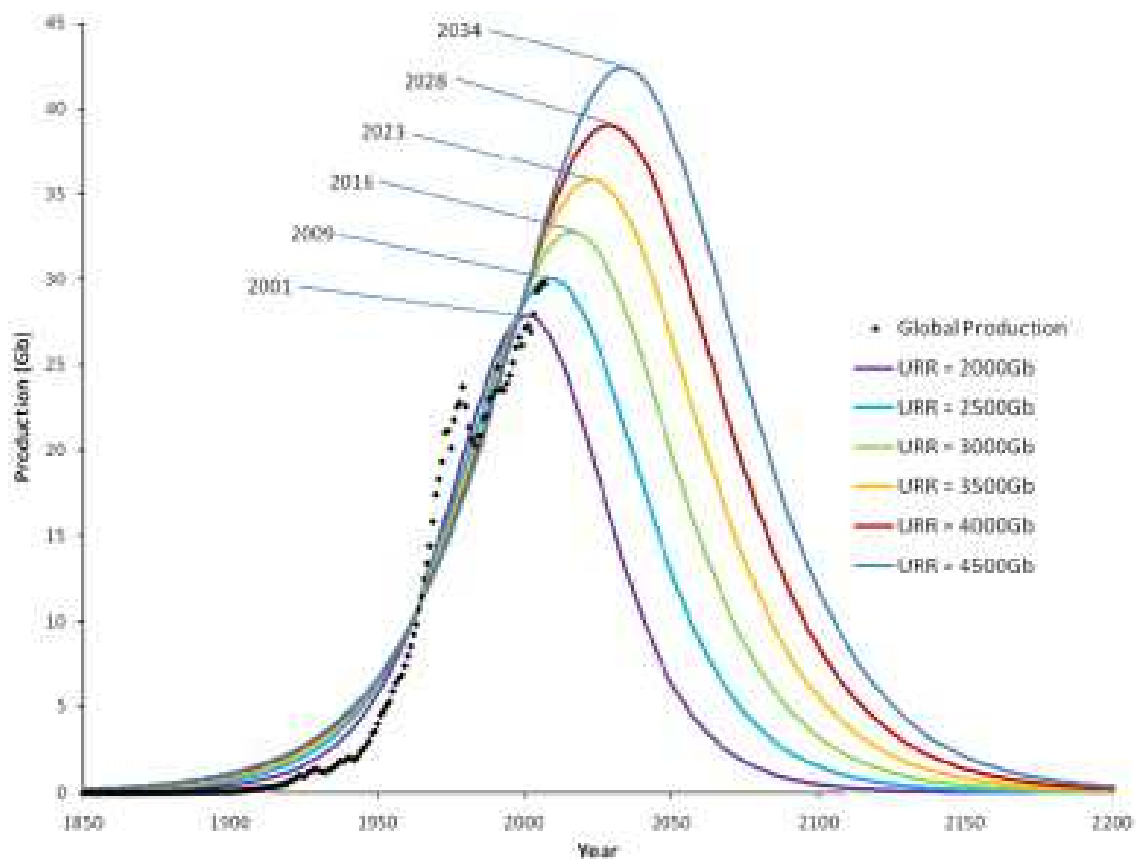


Figure 19: The Hubbert Curve: Predictions of Peak Oil matched with global oil production until 2010 (Sorrell et al, 2010)

This has serious implications for all industries and agriculture is no exception to this. Modernised agriculture is dependent upon the easy availability of hydrocarbon energy. As shown in Figure 16, fossil fuels are used in all stages of the industrial food

chain. Chemical fertilisers and pesticides, fuel for machines, plastics, greenhouses, energy for heating and cooling, transport are all able to exist on an industrial scale because of the availability of oil. This is the foundation of industrial agriculture, the economy of scale.

There are many determining factors as to what happens after global peak oil occurs. The impact of peak oil will hinge upon the level of dependency, rate of the decline and the range of alternative options. Given that it has been the use of hydrocarbon fuels that has been one of the most important factors in changes since the industrial revolution, these in particular are the changes that will be challenged. In Brazil, the context of peak oil means something else than it does for much of the world. It could mean an opportunity to make huge amounts of money for the national economy and private extractive companies. Huge reserves of pre-salt offshore oil are being found in Brazilian territory, doubling or tripling the proven reserves of oil of Brazil (EIA, 2013). In the basic supply and demand context of peak oil, this means that a peaking or dwindling global supply at the same time as an increase in Brazilian production and reserves has the potential to turn Brazil into a much larger player on the fossil fuel market than it already is. On the other hand, it is also clear that the increased national income from oil production does not create a greater level of social justice or equity, nor environmental outcomes (Caselli & Michaels, 2009). Even in oil producing areas of Brazil, the windfalls from oils have not shown to improve the economic or social wellbeing of the poor classes. Royalties from oil production paid to municipalities has increased the wellbeing of those populations very minimally however has increased significantly the level of illegal and corrupt activity, specifically around mayors.

Peak oil is almost an unknown concept in Pernambucan discussions around agriculture and the environment. Very few people that I spoke to or interviewed had heard of the concept or could explain the basic principle. Surprisingly it was not one of the priority areas of discussion or education amongst the agro-ecology proponents and did not feature in the 18 month technical agro-ecology course run by SERTA. Most surprisingly, when I interviewed the Pernambuco Minister for Economy, he had never heard of the concept of peak oil and placed no importance on this preferring to talk about the abundance of sugar for biofuel production and proposing industrial style solutions such as increasing plantation area and attracting manufacturing companies to Pernambuco as solutions to combat climate change and poverty through job creation.

Equally important to the future sustainability of agricultural systems is climate change. Agriculture has contributed significantly to climate change resulting from human activity, totalling around 15-30% of all greenhouse gas emissions (IAASTD, 2009) (Vermeulen, Campbell, & Ingram, 2012). While agriculture occupies 37% of the earth's land surface, it produces 52% of the world's anthropogenic methane (CH₄) emissions and 84% of the world's anthropogenic nitrous oxide (N₂O) emissions (Smith, et al., 2008). Estimations of carbon dioxide (CO₂) emissions from agriculture vary however the combination of land cleared or deforested, fossil fuels used, soil carbon lost, biomass burning, means that it is the most CO₂ producing activity that humans engage in, and this does not include the full range of emissions from transport, processing, retail etc.

Some examples of agriculture's contribution to emissions are CO₂ released from microbial decay or burning of plant litter and soil organic matter. The use of hydrocarbons releases huge amounts of CO₂ into the atmosphere. Slash and burn agriculture releases carbon directly to the atmosphere. CH₄ is produced when organic materials decompose in oxygen-deprived conditions, notably from fermentative digestion by ruminant livestock, stored manures and rice grown under flooded conditions. N₂O is generated by the microbial transformation of N in soils and manures, and is often enhanced where available N exceeds plant requirements, especially under wet conditions (Smith, et al., 2008)

There has been a lot of work done to estimate the impact of agriculture on climate change, primarily through the calculation of greenhouse gas emissions in parts of the food chain. The main greenhouse gasses produced from the food chain include CO₂, CH₄ and N₂O. The greenhouse gas footprint of particular products can be measured in a systematic way by using CO₂ as a common indicator. Therefore converting other greenhouse gas figures into CO₂ equivalents. For example, CH₄ is multiplied by 25 to get its CO₂ equivalent and N₂O is multiplied by 298 to get its CO₂ equivalent (Edwards-Jones, et al., 2008).

The effect of climate change on agriculture is also extremely significant. It is and will alter many ecological process and resource availabilities such as water and temperature regulation (Parris, 2011). Changes in these two factors particularly will affect crop yields in tropical and dry areas through changes in plant productivity (for

example, speeding up sowing to harvest = lower seed weights) and a shortening of growing season. Increased CO₂ in the atmosphere with no temperature change would increase plant productivity through ease of photosynthesis; however the changes in temperatures will be a stronger factor in decreasing overall output, with results varying per crop (Augusto Streck, 2005).

While also equally important to agricultural systems as peak oil, climate science and the concepts of climate change are also equally little known in Pernambuco. In the agro-ecology and MST messages there is little use of climate science preferring instead the much more accepted messages of agrarian reform and social justice. Environmental messages relate much more to destruction of rainforest and natural habitat which is a well-accepted argument considering the significant attention given to Brazilian Amazon and Cerrado destruction. These arguments are also framed in the bounds of indigenous relations and rights based forest management which, coupled with some effective national policies, has lessened particularly the Amazon destruction in recent years (Regnskogfondet, 2012). Despite this, climate change seems to be far from the forefront of debate in Pernambuco around economic democracy and food systems.

One alternative vision to continuing modernization of agriculture promotes community based food networks where more people are involved in production and are involved in closer proximity socio-economic links. It would involve less mechanization and more sharing of resources and physical workload, meaning halting and reversing the trend of urbanization (Gleissman, 2007). Bagdley et al (2006) reviewed global yield data sets for low intensity organic versus 'conventional' crop production methods. The trends were that in the 'developed' world organic: non-organic ratio was generally slightly <1 and in the 'developing' world the ratio was >1. These results were extrapolated to model and infer that the potential output of purely organic agriculture on the current land base could be able to produce sufficient calories to maintain the current world population, and potentially a larger population. PLANAPO in Brazil is a step in the right direction by prioritizing organic agriculture however it fails to address the underlying economic democracy issues which are being challenged by the agrarian reform social movements.

While national politics in Brazil seem to be making tentative moves to address environmental concerns, social movements can also measure themselves by their ability

to tackle and change policies, and this requires challenging power in the political economic zone. Van Den Bergh (2010) makes six recommendations for a policy framework towards governments comprising six components. I would put this policy agenda more in the hands of social movements to challenge their governments with, which if successful would show a significant shift away from growth focused development.

First, there is need for an effective international agreement (for example on climate change) which does not harm a countries competitive position but alters the incentive structure will be more readily socio-politically acceptable: it is possible to overcome the free-rider problem. With failures in Durban, Copenhagen, Doha and now New York to come to any sort of tangible and worthwhile agreement, the next chance for governments to take action on international agreements will be in Paris in 2015. The history of international climate conferences must lead one to be a little cynical about the potential of this forum. Much stronger social knowledge and activism is needed in Brazil, as a member of the BRICS group, to effectively address increasing fossil fuel production and consumption, deforestation, and the social and environmental results of monoculture for export. It is unlikely that Brazil will lead this drive and certain that Brazil won't lead without huge public pressure, which the state has shown a tendency to harshly repress over the last few years. If the world can create a clear and useful international climate agreement then countries can focus on changing the composition of production and consumption, but the pressure has to come from the social movements. The outlook seems difficult for the possibility of community based food networks supported by international agreements given the loudest and richest discourse continues to focus on increasing productivity of all types of farming.

Efforts to include environmental regulation into economic policy are extremely worthwhile; however in isolation these fail to address the social component of the triple bottom line and can reinforce the undemocratic structure of economic relations. An important principle to the triple bottom line in this research is that positive outcomes in one measure should not create net negative outcomes when balanced against the other measures (Henriques & Richardson, 2004) (Elkington, 1998). This means that positive outcomes in an environmental measure may have a negative effect on economic measure or social measure; however the net balance should remain positive and not significantly negative in any of the categories. There is no established protocol for the

indicators to measure success in a triple bottom line, and while the popularity of measuring sustainability is growing, so the methods of measuring are multiplying and thousands of indicators have been developed (Hubbard, 2009). It is more complex because there is no single recognised way, as there has traditionally been for macro-economic performance (growth in trade and profit). While indicators should ideally be context dependant and applicable to each organisation, this would allow those organisations or governments seeking the illusion of sustainability an all too easy way out of true sustainable evaluation, either by choosing poor indicators or by setting targets too low (Henriques & Richardson, 2004). If a one size fits all solution is not available then principles for setting a triple bottom line should be.

Second, create a more flexible job market allowing for time to be spent other than in the pursuit of higher salary and higher consumption. This can leave time for leisure, reduce stress, and reduce the constant increase in purchasing power of luxury items. This recommendation contradicts the opinion of the Pernambuco Secretary of Work, Qualification and Entrepreneurship where the focus is on individuals achieving higher productivity and higher salaries, enabling higher consumption as consumption is perceived as directly correlated to happiness and social wellbeing. It is true that a lack of ability to consume to a basic level can lead to misery, but the inverse is not true, increasing levels of luxury income does not correlate to increases in wellbeing (Stiglitz, Sen, & Fitoussi, 2013). Therefore the indicator is not useful as a goal, only as a minimum standard in conjunction with distribution. Once minimum standards are met then people in Pernambuco should be able to translate productivity improvements into less work-time, whether it be weeks in a year or days per week. This would also allow for a mix of activities and diversification of interaction in economic and social life. It does imply a cultural shift in the competitive nature of salary seeking and expertise which is associated with working long hours. Community based food networks would have the conditions to flourish with this ability.

Third, regulation of advertising and public relations, especially for ‘status goods’, which stimulate dissatisfaction with the range of products that a person owns in comparison to ‘others’. Taxing items which are socially or environmentally destructive goes hand in hand here, considering the bounded rationality of consumer choices (Vatn, 2005). In Pernambuco and Brazil this kind of regulation exists in the public health field only for smoking and, to a limited extent, alcohol advertising. Advertising also

contributes to the status and strive to goods which are required for a favourable comparison of oneself in relation to other citizen/consumers, and especially in the urban areas the status symbols and conspicuous consumption of a growing middle class is evident and is also reflected in the consumption choices of poorer people. In this vein, taxation on status goods which have a significant environmental and social cost should be considered. The goal should not be to de-grow consumption per se, though that may be the effect in certain cases, but the goal should be to reflect the environmental and social cost of consumption.

Fourth, a much more coherent and comprehensive public communications and education strategy is required; schools, media and books focusing on social interactions which can create a useful atmosphere of 'peer pressure' to exhibit conscientious behaviours. Many interviewees saw a lot of information presented on television channels which primarily relates to public health, such as nutritional information for example, however this is one seriously under-utilized medium (in the sense of creating conscientious behaviours) which can have a very high impact on influencing behaviours. Most of the media and interactivity experienced, especially in urban settings, is advertising promoting consumption of this or that 'must have to make you sexy' item. Regulation and paternalistic policies can be effective however communications research suggests that individuals are willing to voluntarily limit or reduce certain types of consumption if the social cues and information are available. This is certainly one topic where Brazilian social movements should be leading governments however in the world of advertising and economic growth, it is challenging to confront the economic power of the business world and the mass consumption discourse.

Fifth, it would be important to stimulate a change in focus from economic growth, as the priority currently assigned to it by politicians, media and economists is misguided. Policies should be set for wellbeing and irrelevant of GDP growth or degrowth. The yoke of international economic reputation that has been put on Brazil as part of the BRICS bloc leads to an expectation of high growth and that anything else will be a disappointment and a failure. The social movements in Brazil are definitely strong enough to challenge this perspective in certain demographics however given the lack of economic democracy; the social base of these arguments would need to be expanded further into the urban areas. In agriculture this certainly applies to the growth

and productivity approach that is favoured by the government and the partial success of the social movements in the creation of PLANAPO. The ongoing marginalization of agrarian reform to a neoliberal agenda means that without more popular support it will be difficult to change the focus of the indicator-makers.

Sixth, policies should allow for flexibility in technology and support research and development of a broad range of technologies, rather than locking in to one system that is the most efficient at the time which might prevent energy technology innovation. For example: the incentive structure could be significantly altered to prioritize small scale technology with targeted schemes such as a modified version of ABC, the low carbon agriculture initiative. This is one area where public may be able to more easily influence government research agenda, given that progress has already been made with PLANAPO.



Figure 20: Community gardening work in MST accampamento

Each of these six policy recommendations relies on social movements being able to influence government as without the social pressure there is no reason for the government to alter its position of focus on economic growth. That pressure exists now in some areas and has resulted in the partial success in the creation of PLANAPO however this plan is unlikely to significantly challenge the economic powers or to stimulate agrarian reform, which was the original goal of the social movements. To have a significant effect on the social and environmental outcomes, a much larger

movement for economic democracy through agriculture must be created and extrapolated to a broader redefinition of production and consumption. On the global agenda we can see climate change has been put there by social movements inspired both by the science of climate change and the total lack of response of governments. Peak oil, however, is conspicuously missing from the discussion and the attitude towards fossil fuels seems to be more along the lines of “it’s ok, we found some more”, or the conversation turns to biofuels. The social movements must work much more at the fringes of their social influence to expand. While pockets of dissent and resistance to the dominant discourse exist, these are marginalized or repressed. A broader base of support for social movements needs to be built particularly in the urban areas of Pernambuco.

9. THE GLOBAL PERSPECTIVE

While looking at the current realities in agriculture and the environment it is important to be both critical and creative. It’s easy to get cynical and see how entrenched capitalism and neoliberal globalisation is and the changes and effects these have on agriculture and the environment, but in reality there is no simple one size fits all recommendations to make. All of the solutions are contextual and regional, depending on the issues on hand, however, there may still be several core principles which could govern the future of agriculture (Gleissman, 2007) (Vermeulen, Campbell, & Ingram, 2012) (Parris, 2011). These should always include promotion of biodiversity and symbiosis, using current available energy rather than fossil energy wherever possible, production and consumption in close proximity. Soil degradation, water quality, climate change, deforestation, these are pressing issues which have resulted from population growth, technological change, capitalism and globalisation. They are not only contemporary faults, however contemporary practices are more problematic than all the cumulative history. If there is to be a chance to feed the predicted 10 billion people in 2050 and to do it sustainably and equitably, then these issues need to be addressed both environmentally and socially on a local, regional and global scale.

It is important not to romanticise 'traditional' agriculture or think that all of the ills and environmental degradation is caused by 'modern' methods (Bagdley & Perfecto, 2007). Clearly the impacts of agriculture on the environment have existed for a very long time. Changes in land use from forested areas to agricultural and grazing lands

have released untold amounts of carbon into the atmosphere. Around 1000 years ago, Britain was already more than 90% deforested (Ruddiman, 2005). Thousands of years of cultivation of rice and livestock have cumulatively released huge amounts of CH₄ into the atmosphere. Agriculture has inherently simplified ecosystems and reduced biodiversity, and this intentionally allowed the prevalence and cultivation of plants and animals that produce food and other items for humans.

Some areas of the world have been successfully farmed for centuries and even millennia. Other ancient (and less ancient) civilisations have suffered or disappeared due to various resource collapses, such as water or soil fertility due to agricultural methods and adverse climate conditions; whether subsistence farmers or large farmers selling 100% to market, all farmers have the potential to damage ecosystems beyond their reproductive capacity.

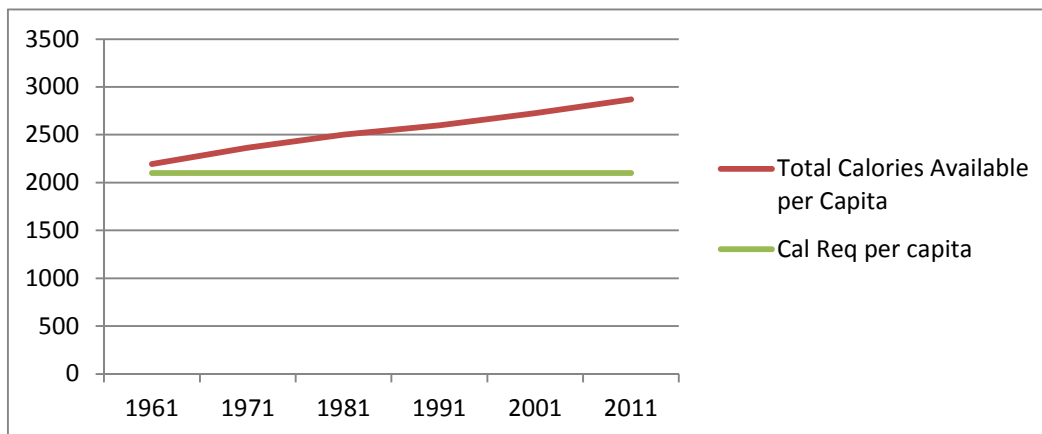


Figure 21: World - 1961-2011: Calories available per capita increases significantly above the basic per capita requirement (FAO, 2013)

Total food available worldwide has grown exponentially (even faster than population growth), along with the exponential growth of production and consumption of fossil fuels and particularly oil. Out of the destruction of World War II, modern industrial agriculture was born. The American war economy was producing huge amounts of chemical compounds for weapons, and after the war these industries were kept going to produce chemicals for fertilizers and pesticides (Shiva, 2001). Previously, agriculture was not a large consumer of products from industry, mainly limited to tractors and tools. In the USA there were incentives towards large farms and production, and specific varieties of crop grown in monoculture. This increased yields and was seen a huge success for industry and agriculture, and this model of agriculture was exported through industrialization and development in what became known as the Green

Revolution. One problem for the rest of the world was the industrialized countries controlled all these products:

“[Supporting industrialization] would certainly be very good for US agricultural exports, because as you help develop them industrially, you will shift their economy to an industrial economy, so that in the end you would create more markets for your agricultural products” W. L. Clayton (US state department: 1944 – 1963)

While the Green Revolution has been significantly criticised for its industrial and economic foundations, it was also very successful in increasing food production globally. In the last 50 or so years, global food production per capita has increased by around 25% while land use for food production per capita has only increased by around 10%. Since 1900, agricultural land has increased by around 33%, however productivity has increased by around 400% meaning that the total output is around 600%. There has been approximately an 8000% increase in external inputs, primarily fossil fuels used for machinery, fuel, and fertilisers (Clay, 2004).

As population grew, the production and consumption of food grew accordingly. Malthusian theory proffers that food supply grows and then population grows, constrained primarily by the availability of food. While it is clear that population cannot significantly outstrip its food supply, the causality of increasing food production to population growth is simplistic (de Castro, 1946). Whether cause or effect of population growth, a global population that uses agriculture rather than harvesting from uncultivated sources will create an agricultural production and wild harvest to roughly match the caloric needs of a population. The caloric needs of that production, however, changes with the method of production and consumption, and with the crop being produced (Clay, 2004). For example: estimates of the net energy used in agriculture in the United States pegs 10 calories of primarily hydrocarbon energy used for every 1 calorie of food produced (Pfeiffer, 2006). Much of the energy used is in processing manufacturing or transportation. While for Malthus, hunger and poverty were at the same time morally deplorable yet inevitable, Pernambucan author José de Castro framed hunger in a different light:

“Hunger is not a product of overpopulation but overpopulation is a product of hunger. Hunger is a social creation not from the lack of food

availability but from the lack of understanding of the biological, social and economic forces that create the conditions of hunger” (de Castro, Geografia da Fome (Geography of Hunger), 1946)

Currently, more food is produced in the world than is required by the total population. Given the standard number of 2100 calories daily as a basic minimum for regular daily activities, global food production has been well over this number for decades (see Figure 14). In 2008, 35% of the global population was considered overweight while 12% were undernourished and 29% were micronutrient deficient (FAO, 2013). Huge amounts of food are wasted in the regular food chain. The global estimation is 1/3 of all food is wasted from production to consumption and post-consumer waste. Waste occurs in rich countries primarily in the retail and post retail phase while in poor countries waste occurs more in the storage, transport and processing phases (FAO, 2013). But this does not mean that less waste in rich countries will lead to more food availability in poor countries. These chunks of information lead often to the first conclusion that the issue is not production but distribution of food, however, this is purely deregulated market thinking. It leaves out of the frame the environmental and socio-political elements of food production and consumption.

The intensification of agriculture through large scale and high input monocrop systems is a relatively new phenomenon, existing on a broad scale only since WWII. About 90% of land under cultivation is planted to annual crops, and the methods of annual crop cultivation reduce soil nutrition and biology if land is not rejuvenated. About 40% of the world’s food is produced on irrigated land, about 16% of the total agricultural land, and 58% of this is for three crops (34% rice, 17% wheat, 7% cotton) (Clay, 2004). These systems intensify environmental issues that had been seen previously in agriculture: loss of biodiversity, soil compaction and erosion, loss of soil health, reduced quality and quantity of water available, plus other new issues such as agrochemical pollution. One side of the food supply debate argues that green (and new green) revolution technologies (high yield varieties, mechanised tillage, synthetic fertilisers and pesticides, and now transgenic crops) are necessary to feed the global population. Another side of this argument is that this is a short term perspective and will compromise the long term environmental sustainability and food supply (Bagdley & Perfecto, 2007).

Resilience from and contributions to climate change is a key topic in global agriculture and especially in Brazil. According to Smith et al. (2008), opportunities for mitigating greenhouse gas emissions in agriculture fall into 3 general categories; reducing emissions, enhancing removal, avoiding (or displacing) emissions. The specific actions for each of these mitigation options are dependent on local conditions. For example, reducing emissions could focus on efficient management of carbon and nitrogen flows, or animal waste management that reduces CH₄ production. Enhancing removals is very simply achieved by building more organic matter above and especially below ground. Plants sequester atmospheric carbon through photosynthesis and when a plant dies or is harvested, the rest of the biomass which is left in the soil will decompose, releasing some carbon into the atmosphere and retaining much of the carbon in the soil itself. Avoiding or displacing emissions means avoiding growth into new lands by way of deforestation. The discussion around mitigation methods refers to mitigation within any agriculture framework however generally the methods of mitigation proposed apply primarily to modernised agriculture. By using different cropland management strategies, emissions may be reduced (Gleissman, 2007). These strategies could include using perennial crop varieties, extending rotations, reducing or avoiding the use of bare fallow. Emissions could be avoided by using less intensive cropping systems (and using leguminous crops in a rotation) and therefore reducing reliance on external inputs. Thirdly using cover crops between agricultural crops adds C to soil and reduces 'excess' N unused by previous crops, reducing N runoff and N₂O emissions.

Globally, modern agriculture has a large impact on environmental outcomes: greenhouse gas emissions, soil degradation/erosion, water quality/availability, air quality, loss of biodiversity, mineral exhaustion (Clay, 2004) (Daily, 1995) (Nelson, 2010) (Parris, 2011) (Ruddiman, 2005). There are clear and large scale cases which exemplify the extent to which the issues which are intensified through high input monocrop agriculture decrease ecosystem complexity and resilience, leading to strongly negative social and economic outcomes. Hurricane Mitch, which devastated parts of Nicaragua, Honduras and Guatemala, caused 10 000 human deaths in 1998 and around USD5.5B damage to local economies (Franks, 2006). High input monoculture farms typically showed 60-80% more damage from crop loss, soil erosion and other water caused losses than farms practicing more typically ecologically friendly agriculture

(Clay, 2004). Of course this kind of extreme weather event is thankfully not commonplace however it is a useful characterisation of ongoing more subtle changes to social, environmental and economic resilience. Ecosystems that are not even related to agriculture also suffer from some methods of production, such as dead zones in the Gulf of Mexico and Baltic Sea, and threats to the Great Barrier Reef from agro chemical effluents. The huge increase in the amount of N and P available in some ecosystems creates issues like eutrophication. Clay (2004) points to the accumulation of toxins in water and air, deforestation, soil compaction, mineral exhaustion are all consequences of agriculture that are intensified by the modernisation of agriculture.

With a notion of 'ecological citizenship', consumers will feel a sense of responsibility on a global scale and will make decisions that will not impact negatively on others or on the environment (Seyfang, 2006). This group or personal identity of citizenship is a method to lead towards sustainable consumption. In all types of sustainability scenarios, consumers are required to 'do their bit' to change the patterns of production and consumption. Put in the democratic market terms, to vote with their wallets. Changing behaviour of consumers is a key area of concern for researchers and policy makers who are genuinely concerned with long term sustainability options. However there can be contradicting frameworks such as an agricultural sector which focuses primarily on creating viable livelihoods above long term environmental concerns. However, while sustainable consumption is a notion for the high consuming community, it does not suffice for the large part of the global community, including Pernambuco.



Figure 22: an MST ocupação inhabitant

While millions face hunger, food has become a market good (seen as a set of commodities) and citizens have become consumers. Profits determine the distribution and production of food and ethical considerations are left behind (Caporal, 2011). The lack of economic democracy equates to control over resources and income based on politico-economic and military power, with the benefits ending in the hands of few. In 2007-2008 the spike in global food prices corresponded to the spike in global oil prices. This effectively pushed more people into hunger and a lack of fulfilling basic necessities as many groups of people living on the edge of hunger have a lesser capacity to absorb fluctuation in prices (Vail, 2010). The exposure of food traded as a commodity and its reliance on fossil fuels had never been clearer and this was one of the causal factors for unrest in multiple countries. There were food riots in West Africa, a government change in Haiti, violent protests in Mexico and Pakistan, while many people had stopped growing their own food and were instead purchasing food on the market with cash. When oil prices spiked, the cost of transport, fertilisers and on farm production rose significantly. At the same time, the global stockpiles were small and this caused speculation on ‘commodity’ markets. Within the global food system, if oil production decreases or does not meet demand, the possibilities and effects of rising oil prices can be disastrous.

10. CONCLUSIONS

"Even if it makes the task more complex, we have to find a way of addressing global hunger, climate change, and the depletion of natural resources, all at the same time. Anything short of this would be an exercise in futility" Olivier De Schutter – UN Special Rapporteur on the Right to Food: 2008 – present

While there are positive signs in Brazil for participatory policy making with PLANAPO, there is a long road to travel for a fuller democratic participation in economy and pluralistic development possibilities. The classic development discourse of increasing material wealth and modernising is largely internalised in Pernambuco, however there are significant formal social movements mainly in the rural areas, and less formalised social movements of youth in urban areas, that challenge this discourse. The convergence of ideas between national social movements has been able to create a response from the national government through a consultative process, of which PLANAPO is the result. However while addressing some important issues for agriculture, it does not address the foundational problems created by the mechanisation process, the lack of economic democracy or agrarian justice, rather the key outcome seems to be the promotion of organic agriculture within a scientific productivity framework, especially considering that 75% of the total program funding is for credit focused on modernising production and very little is for organising local forms of production and marketing.

In the north east of Brazil there is very little organisation of cooperatives and outside of social movements, family farming is individualised and replicates large farms on a small scale. Communities and social movements must take the lead and work to create alternative economic arrangements, and focus their actions on rural urban relations to remove the invisibility that exists between urban consumers and rural producers. Community based food networks are an effective import substitution strategy which challenges the industrial food system by re-embedding the political economic zone within the regional social and environmental boundaries. In Pernambuco this does exist in some small but symbolic forms, such as early morning organic farmers markets in urban areas, with farmers from the *zona da mata*, however the share of this form of organisation against the industrialised food commerce is extremely small.

Social movements need to expand the discussion of what is at stake. Currently the discussion points which are coherent in the rural areas relate to agrarian reform, such as access to land and a battle against the imposition of agricultural chemicals and seeds. There is rudimentary discussion at best of two of the key challenges facing the world: peak oil and climate change, in fact very few people I met in Pernambuco, including all government representatives, had any clear idea of either of these concepts. Social movements, especially rural focused movements can link much more strongly with urban areas to challenge political and economic powers through community based organic food systems by understanding and promoting that this intentionally different form of economic organisation addresses two key challenges faced by the world: peak oil and climate change.

Decades after scientific consensus on many environmental and climatic risks emanating from anthropogenic ecological impacts and misery and social dislocation arising from colonization, slavery, decolonization, conflicts and economic growth focused development, it seems that powerful economic and political structures will not engage sufficiently in the task of creating a just and sustainable society. Within this task, scaling up agro-ecology as a mainstream ideal is a significant challenge and to do that there needs to be a technically and politically legitimate governance strategy which creates an enabling environment for agro-ecology to flourish. This has to take economic incentives away from large agribusiness, address legal issues such as land occupation and water controls, and focus on re-embedding a local and regional food network within a symbiotic human / nature relationship. If a solution to issues raised in this thesis is to create a more sustainable and resilient agriculture, it is unlikely that it will be led by large companies or powerful governments, the large part of the cultural shift needs to come from changes in the way that communities interact with the economy, their communities and their ecosystems. Through social movement and cultural progression away from individualised consumers, democratic movements will be able to hold governments accountable for their policies and will be more able to take control of the economic domain.

Policy frameworks need to support the creation of triple bottom lines that represent a sustainable economy. Policy frameworks with effective legal instruments are what protect certain interests in the case of conflict. The creation of these successful legal frameworks will most likely only be possible within a democratic economy.

Legitimate policies including prohibitions, concessions and prescriptions must be created both to incentivise a democratic economy and because a democratic economy exists, hence the legitimacy. It should not, however, be set aside that there are several contradicting arguments between universal definitions of success and contextual pluralistic definitions, each of these having their own strengths and weaknesses. It is extremely important to note that a sustainable economy is not focused on sustainable growth. The notion of perpetual growth should be considered outdated and incompatible with sustainability. As Al Bartlett (ND) puts it in his famous lecture on sustainability and arithmetic,

“The greatest shortcoming of the human race is our inability to understand the exponential function”.

The success of collaborative social efforts to pressure governments can be recognised in the policy output (or lack thereof) of governments. Moves to regulate, at the very least, a triple bottom line approach to measuring success should include: effective international agreements which alter incentive structures for resource consumption and pollution; flexibility in work-time so that increases in efficiency and productivity allow for diversification of activities and increased social and leisure time rather than pursuit of higher salary and higher consumption capability; regulation of items for purchase based on social and environmental outcomes to disincentivise socially or environmentally destructive consumption patterns and status dissatisfaction; re-assign the importance given to economic growth to other portfolios which promote wellbeing and economic democracy; promote a diversity of research, particularly in energy conservation and production using current available energy.

Positive action on multiple scales can be taken by social networks to impact upon the social, economic and environmental outcomes that will occur over the next generation. These actions have a possibility in Pernambuco to address social and economic inequality and the relations between the economy and the environment. Indeed it would be difficult yet possible for Pernambuco to take significant action without a national trend however the close geographical link of the population makes rural and urban collaborative movements a strong possibility. Significant challenges remain to increase access to opportunity (education, health, technology) in the rural areas. The perception amongst both rural and urban youth remains that urban areas are

better places to live and the urbanisation trend continues. Collaboration between rural social movements and urban groups can provide a strong platform for reintegrating economic relations within a social framework.

Community based food networks and rural/social linked social movements can provide a strong basis for challenging political and economic power concentration and bring the politico-economy realm back within the control of the demos. Given the historic and current actions of governments in Brazil and Pernambuco, pressure applied by social movements can be effective and have in the past created tangible outcomes. To create durable change outcomes in economic democracy and food networks the influence must be led by the demos.



Figure 23: some future agents of the demos from an MST ocupação

11. REFERENCES

- Augusto Streck, N. (2005). Mudança climática e agroecossistemas: efeito do aumento de CO₂ atmosférico e temperatura sobre o crescimento, desenvolvimento e rendimento das culturas. *Ciência Rural*, 35(3), 73-740.
- Bagdley, C., & Perfecto, I. (2007). Can organic agriculture feed the world? *Renewable Agriculture and Food Systems*: 22(2); 80–85, pp. 80-82.
- Banco Central do Brasil. (2014). *FAQ - Programa Nacional de Fortalecimento da Agricultura Familiar - Pronaf*. Retrieved September 6, 2014, from Banco Central do Brasil: <http://www.bcb.gov.br/?PRONAFFAQ>
- Bartlett, A. (ND). *English Transcript of Arithmetic, Population and Energy*. Retrieved November 24, 2013, from Al Bartlett: http://www.albartlett.org/presentations/arithmetic_population_energy_transcript_english.html
- Buchanan, J., & Stubblebine, W. (1962). Externality. *Economica* 29:116, 371-384.
- Caporal, F. (2011, June). Opinion. *Farming Matters*, p. 17.
- Cardoso, I. (2012). *From Alternative Agriculture to the Brazilian Policy on Agroecology*. Viçosa, Minas Gerais: Federal University of Viçosa.
- Caselli, F., & Michaels, G. (2009). *Do Oil Windfalls Improve Living Standards? Evidence from Brazil*. London: Centre for Economic Performance - London School of Economics.
- Cavalcanti, C. (2007). Plant Opulence, Insatiable Greed, and the Enthronement of Entropy: A view of the socio-environmental history of the Atlantic Rainforest. In J. Alves Filho, & E. Leme, *Fragments of the Atlantic Forest of Northeast Brazil: Biodiversity, Conservation and the Bromeliads* (pp. 13-45). Rio de Janeiro: Andrea Jakobsson Estúdio.
- CEASA Pernambuco. (2014). *CEASA em números*. Retrieved August 20, 2014, from CEASA Pernambuco: <http://www.ceasape.org.br/ceasaemnumeros.php>

- Clay, J. (2004). *World Agriculture and the Environment: A Commodity-By-Commodity Guide To Impacts And Practices*. Island Press.
- Commoner, B. (1969). Frail Reeds in a Harsh World. *Journal of the American Museum of Natural History* 78:2, 44.
- Cowen, M., & Shenton, R. W. (1996). *Doctrines of Development*. London: Routledge.
- Daily, G. (1995). Restoring Value to the World's Degraded Lands. *Science, New Series* 269:5222, 350-354.
- Dale, G. (2012). Double movements and pendular forces: Polanyian perspectives on the neoliberal age. *Current Sociology* 60:3, 3-27.
- de Castro, J. (1946). *Geografia da Fome (Geography of Hunger)*. Rio de Janeiro: O Cruzeiro.
- de Castro, J. (1967). *Homens e Caranguejos*. Brasilia: Porto.
- Duffield, M. (2007). *Development, Security and Unending War: Governing the World of Peoples*. Polity.
- Edwards-Jones, G., Mila i Canals, L., Hounsome, N., Tuninger, M., Koerber, G., Hounsome, B., et al. (2008). Testing the assertion that 'local food is best': the challenges of an evidence-based approach. *Trends in Food Science and Technology* 19, 265-274.
- EIA. (2013). *Brazil - International Energy Data and Analysis*. US Energy Information Administration.
- Elkington, J. (1998). *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. New Society Publishers.
- Ellis, C., Adams, T., & Bochner, A. (2010). *Autoethnography: An Overview*. Retrieved from Forum Qualitative Sozialforschung / Forum: Qualitative Social Research (Freie Universität Berlin): <http://www.qualitative-research.net/index.php/fqs/article/view/1589/3095#gcit>
- EMBRAPA. (2014). *Plano ABC – Plano Setorial de Mitigação e de Adaptação às Mudanças Climáticas Visando à Consolidação de uma Economia de Baixa*

- Emissão de Carbono na Agricultura*. Retrieved September 5, 2014, from Empresa Brasileira de Pesquisa Agropecuária: <https://www.embrapa.br/tema-agricultura-de-baixo-carbono/nota-tecnica>
- EMBRAPA. (2014). *Quem Somos*. Retrieved September 4, 2014, from Empresa Brasileira de Pesquisa Agropecuária: <https://www.embrapa.br/quem-somos>
- Engler, A. (2010). *Economic Democracy: The Working-Class Alternative to Capitalism*. Black Point: Fernwood Publishing.
- Escobar, A. (2011). *Encountering Development: The Making and Unmaking of the Third World*. Princeton University Press.
- FAO. (2009). *Small-Scale Bioenergy Initiatives: Brief description and preliminary lessons on livelihood impacts from case studies in Asia, Latin America and Africa*. Rome: FAO.
- FAO. (2013). *Food wastage footprint. Impacts on natural resources. Summary Report*. Rome: FAO.
- FAO. (2013). *The state of food insecurity in the world 2013: The multiple dimensions of food security*. Rome: FAO.
- Franks, S. (2006). The CARMA Report: Western Media Coverage of Humanitarian Disasters. *The Political Quarterly*, 281-284.
- Freyre, G. (1985). *Nordeste: Aspectos de Influência da can sobre a vida e a paisagem do nordeste do Brasil*. Rio de Janeiro: José Olympio.
- Gleissman, S. (2007). *Agro-ecology: The Ecology of Sustainable Food Systems*. CRC Press.
- Harvey, D. (2003). *The New Imperialism*. Oxford: Oxford University Press.
- Harvey, D. (2006). *The Limits to Capital*. University of California.
- Harvey, D. (2010). *The Enigma of Capital and the Crises of Capitalism*. New York: Oxford University Press.

- Henao, J., & Banaante, C. (2006). *Agricultural Production and Soil Nutrient Mining in Africa: Implications for Resource Conservation and Policy Development*. Retrieved from http://www.eurekalert.org/africasoil/report/Soil_Nutrient_Mining_in_Africa_Report_Fin
- Henriques, A., & Richardson, J. (2004). *The Triple Bottom Line: Does it All Add Up? Assessing the Sustainability of Business and CSR*. London: Earthscan.
- Herrera, C. (1996). *Naturaleza y sociedad en la historia de América Latina*. Panamá: Centro de Estudos Americolatinos Justo Arosemena.
- Hubbard, G. (2009). Measuring organizational performance: beyond the triple bottom line. *Business Strategy and the Environment* 18:3, 177-191.
- IAASTD. (2009). *Agriculture at a Crossroads*. Washington: IAASTD.
- IGBE. (2008). *População residente, por cor ou raça, situação e sexo*. Instituto Brasileiro de Geografia e Estatística.
- IGBE. (2010). *Sinopse do Censo Demográfico*. Instituto Brasileiro de Geografia e Estatística.
- IGBE. (2012). *Regional Accounts*. Instituto Brasileiro de Geografia e Estatística.
- Illich, I. (1970). *Celebration of awareness: a call for institutional revolution*. University of Michigan.
- INCRA. (2014). *O INCRA*. Retrieved September 6, 2014, from Instituto Nacional de Colonização e Reforma Agrária: <http://www.incra.gov.br/content/o-incra>
- Indústria Automobilística Brasileira. (2013). *Anuário da Indústria Automobilística Brasileira*. Indústria Automobilística Brasileira.
- Johnston, J. (2007). Counter-Hegemony or Bourgeois Piggery? In W. Wright, & G. Middendorf, *The Fight Over Food: Producers, Consumers, and Activists Challenge the Global Food System*. Pennsylvania State University Press.
- Kellogg, E. (1849). *Labour and Other Capital*. A M Kelly.

- Kovarik, W. (2008). *Ethanol's First Century*. Radford: Radford University.
- Leonel, M. (2000). O uso do fogo: o manejo indígena e a piromania da monocultura. *Estudos Avançados*, 14(40), 231-251.
- MAPA. (2014). *Ministério*. Retrieved September 5, 2014, from Ministério da Agricultura, Pecuária e Abastecimento : <http://www.agricultura.gov.br/ministerio>
- MDA. (2014). *Missão, Visão e Valores*. Retrieved September 6, 2014, from Ministério do Desenvolvimento Agrário: <http://www.mda.gov.br/sitemda/pagina/miss%C3%A3o-vis%C3%A3o-e-valores>
- MDA. (2014). *Plano Nacional de Agroecologia e Produção Orgânica*. Brasília: Government of Brasil.
- MDA. (2014). *Plano Nacional de Agroecologia e Produção Orgânica*. Retrieved September 6, 2014, from Ministério do Desenvolvimento Agrário: <http://www.mda.gov.br/planapo/>
- MPA. (2011). *Campanha Nacional Contra os Agrotóxicos*. Retrieved September 6, 2014, from Movimento dos Pequenos Agricultores: <https://mpacontraagrototoxicos.wordpress.com/>
- MST. (2013). *Quem Somos*. Retrieved October 2013, from Movimento dos Trabalhadores Rurais Sem Terra : <http://www.mst.org.br/quem-somos/>
- Nelson, G. (2010). *Food security, farming, and climate change to 2050 : scenarios, results, policy options*. Washington: International Food Policy Research Institute.
- Pádua, J. (2002). *Um sopro de destruição: pensamento político e crítica ambiental no Brasil escravista (1786-1888)*. Rio de Janeiro: Jorge Zahar.
- Parris, K. (2011). Impact of Agriculture on Water Pollution in OECD Countries: Recent trends and future prospects. *International Journal of Water Resources Development*, 33-52.
- Peet, R., & Hardwick, E. (2009). *Theories of Development*. Guilford Press.

- Pereira, P., Martha, G., Santana, C., & Alves, E. (2012). The development of Brazilian agriculture: future technological challenges and opportunities. *Agriculture and Food Security*, 1(4).
- Polanyi, K. (1944). *The Great Transformation*. New York: Farrar & Reinhart.
- Polanyi, K. (2005). The Self Regulation Market and Fictitious Commodities. In L. Amoor, *The Global Resistance Reader* (pp. 48-54). New York: Routledge.
- Prado, P. (1931). *Retrato do Brasil: ensaio sobre a tristeza brasileira*. Rio de Janeiro: F. Brigulet & Cia.
- Regnskogfondet. (2012). *Rights-based Rainforest Protection*. Oslo: Regnskogfondet.
- Ruddiman, W. (2005). *Plows, plagues, and petroleum: How humans took control of climate*. Princeton: Princeton University Press.
- Sachs, J. (1988). *Conditionality, Debt Relief, and the Developing Country Debt Crisis*. University of California.
- Schweickart, D. (2011). *After Capitalism*. Rowman & Littlefield Publishers.
- Secretaria de Defesa Social. (2014). *Boletim Trimestrial da Conjuntura Criminal em Pernambuco - Trimestre 1 2014*. Recife: Governo do Pernambuco.
- Sen, A. (2000). *Development as Freedom*. Anchor.
- Serreau, C. (Director). (2010). *Solutions locales pour un désordre global* [Motion Picture].
- Seyfang, G. (2006). Ecological citizenship and sustainable consumption: Examining local organic food networks. *Journal of Rural Studies* 22, 383-395.
- Shiva, V. (2001). *Stolen Harvest: The Hijacking of the Global Food Supply*. Zed Books.
- Shiva, V. (2005). *Easrth Democracy: Justice, Sustainability and Peace*. Zed Books.
- Smith, J. (2005). *Economic Democracy: The Political Struggle for the 21st century*. Radford: Institute for Economic Democracy Press.

- Smith, P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., et al. (2008). Greenhouse gas mitigation in agriculture. *Philosophical Transactions of the Royal Society*, 363, 789-813.
- Sorrell, S., Speirs, J., Bentley, R., Brandt, A., & Miller, R. (2010). Global Oil Depletion: A Review of the Evidence. *Energy Policy* 38, 5290-5295.
- Stiglitz, J., Sen, A., & Fitoussi, J. (2013). *Mismeasuring Our Lives: Why GDP Doesn't Add Up*. The New Press.
- Tractor Data. (2015). *Farm Tractors*. Retrieved October 2015, from Tractor Data: <http://www.tractordata.com/farm-tractors/index.html>
- U of Michigan. (2009). *Building a Community-Based Sustainable Food System*. Michigan: University of Michigan: Capstone Project.
- UNDP. (2013). *Human Development Atlas in Brazil*. United Nations Development Program.
- UNODC. (2013). *Intentional homicide count and rate per 100,000 population, by country/territory (2000-2012)*. UNODC.
- US EIA. (2014). *International Energy Statistics*. Retrieved October 3, 2014, from US Energy Information Administration: <http://www.eia.gov/cfapps/ipdbproject/iedindex3.cfm?tid=79&pid=80&aid=1&cid=regions&syid=2008&eyid=2012&unit=TBPD>
- Vail, J. (2010). Decommodification and Egalitarian Political Economy. *Politics and Society* 38:3, 319-346.
- van den Bergh, J. (2010). Environment versus growth — A criticism of “degrowth” and a plea for “a-growth”. *Ecological Economics*.
- Vatn, A. (2005). *Institutions and the Environment*. Edward Elgar Publishing.
- Vermeulen, S., Campbell, B., & Ingram, J. (2012). Climate change and food systems. *Annual Review of Environmental Resources* 37, 195-222.
- Walvin, J. (2014). *Atlas of Slavery*. Routledge.

Woolford, W. (2005). Agrarian moral economies and neoliberalism in Brazil: competing worldviews and the state in the struggle for land. *Environment and Planning A* 37, 241-261.

World Bank. (2014). *Gini Index*. Retrieved August 20, 2014, from <http://data.worldbank.org/indicator/SI.POV.GINI/countries?display=graph>

ANNEXE 1: SEMI-STRUCTURED INTERVIEW SCHEDULE

Objective: To ask non-leading and open ended questions which will uncover discourses around the future of agriculture in Pernambuco and beyond.

Sample: Key informant and Snowball methods used based on various stakeholders I have previously met and will try to meet. I aim to interview organic and non-organic farmers, local and national government representatives, unions, social movement organizers, academics, food processors, wholesalers and retailers. A minimum of 20 interviews should be conducted.

Questions should be asked in this order, all questions should be asked, but there is freedom for follow up questions and tangential conversations if relevant.

Participants should express informed consent in a written or oral form.

Assistance from a translator may be provided and this will be included in the informed consent and confidentiality statement.

Recording: will be primarily writing notes.

Introduction:

My name is Brian Willett and I am a masters student at the Norwegian University of Life Sciences. As we have previously discussed, we are here to conduct an interview, talking about social issues, agriculture and ecology. It's very straightforward, there are no right or wrong answers, I just want to know your personal opinions, and not what you think I want to hear.

I have some questions that I will ask and you can respond as long or short as you like. If you feel uncomfortable or want to stop the interview you can do that.

Everything that you say will be kept confidential and your name or position will not be published in my final work, unless you give me consent, which is entirely your choice.

Do you give consent for me to use this interview as part of the research for my master thesis?

Do you give consent to use your name or personal details in the final version of the thesis?

Introduction in Portuguese:

Meu nome é Brian Willett, sou estudante de mestrado da Universidade Norueguesa de Ciências Naturais. Como discutimos previamente, estamos aqui para conduzir uma entrevista falando sobre problemas sociais, agricultura e ecologia. A entrevista é bem direta e objetiva, sem respostas certas ou erradas, quero apenas saber suas opiniões pessoais, e não o que você acha que quero ouvir.

Eu tenho algumas questões a ser perguntadas, e você pode respondê-las de forma mais longa ou mais curta, como preferir. Você pode parar a entrevista caso se sinta desconfortável ou por qualquer outro motivo.

Tudo o que for dito por você será mantido confidencial, seu nome ou posição não será publicado em meu trabalho final a não ser que você me conceda, e essa permissão fica à sua escolha.

Você me permite usar esta entrevista como parte da pesquisa para minha tese de mestrado?

Você me permite usar seu nome ou detalhes pessoais na versão final da minha tese?

Questions:

Ok, let's get started:

1. Firstly, I am interested to know how you describe agriculture in Pernambuco.
2. Is it different to the rest of Brazil? (Not just in types of crops but the way it works...)
3. What do you think are the right questions that I should be asking about the future of agriculture in PE?
4. What do large farmers want?
5. What do small farmers want?
6. What do consumers want?
7. What does the government want?
8. When you hear the term social justice, what does it mean to you?
9. Can you briefly explain to me what you know about peak oil?
10. How do you think peak oil will affect agriculture in Pernambuco?
11. What other factors do you think will influence agriculture in Pernambuco in the future?
12. Do you have anything else that you would like to add?

Thanks for your time



Norges miljø- og biovitenskapelig universitet
Noregs miljø- og biovitenskapelige universitet
Norwegian University of Life Sciences

Postboks 5003
NO-1432 Ås
Norway