The Soyazation of Argentina

An Actor Network Analysis of the Soya Production in the Argentine Provinces of Chaco and Santiago del Estero

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Summary

At present soya, either in the form of oil or meal, is in high demand by fast growing economies like Brazil, China and India. Also the European Union's (EU) economy accounted for over 10 million tonnes of soya oil in 2012. Most of this demand is met by the three biggest producers of soya, The United States (US), Brazil and Argentina (Nassar & Antoniazzi et. al., 2011, p.6). Because of the multitude of interactions between nonhuman and human actors in the network of soya production in Argentina we need an approach that does look at the interaction between these actors, and doesn't treat human or nonhuman actors differently. An approach that doesn't obscure actors and their interrelations by ordering them under dense denominators like "globalization" or belonging to the "local," "global," or "Micro-, Meso-, Macro level". And therefore an approach that keeps us out of the modern ontology of opposing binary positions by positioning the 'subject' opposite the 'object' or in human geography the 'human geography' opposite the 'physical geography'. This approach is found in Actor Network Theory (ANT) which we will use to study the production of genetically modified soya in the Argentine provinces of Chaco and Santiago del Estero and in doing so we will "give evidence that "science" and "society" are both explained more adequately by an analysis of the relations among forces and that they become mutually inexplicable and opaque when made to stand apart" (Latour, 1988, p.7).

In applying this ANT approach this study has revealed some unexpected actants that normally are obscured by approaches like diffusion theory or commodity chain studies. Examples of these unexpected actants are the cells of the soya plant that resist the genetic modification by the introduction of foreign genes that makes them resistant to glyphosate. In addition it has revealed the process through which the GM soya seeds could become mobile and arrive in Argentina where the introduction of the GM soya seeds by Nidera, not Monsanto, was far from linear. And how the farmers actively participated through their representative organizations to obtain their right to save their seeds. The need for a translation of knowledge became visible in the importance of the agricultural engineer that had to translate the cultivation of this relative new crop to the Argentine farmers and how their problematization of soil degradation introduced fertilizers, herbicides and no-tillage systems to the GM soya actor network making it discriminating to farmers with small plots. This discrimination is being enhanced by the export fee of 35% that the Argentine government has put on the export of GM soya. Finally it has revealed that the introduction of these new actants resisted their domination by other actants, in the form of glyphosat resistant weeds, resistance by farmers concerning the high export fee and it caused unwanted associations in relation to the people, animals and trees surrounding the fields in the form of health problems.

Taking the principle of ANT that an actor never acts alone, but always embedded in an actor network in which the actors are shaped and constituted by each other we could show how the GM soya actor network literally shaped the communities of the indigenous farmers in Santiago del Estero. Because of this we could study the interaction between the GM soya actor network and the cotton actor network in Chaco and Santiago del Estro we revealed how the agricultural engineers again could problematize the problems and offer the solutions in adapting combines in such a way that they can harvest cotton to make the production of cotton more profitable, but also redefining the cotton actor network in such a way that it discriminates against the small scale farmers.

By studying the different forms of visibility used by the actors involved and the way that the SRA, the FAA, the CRA and the ConInAgro and MOCASE-VC and MNCI use their magazines to define the other

actants involved and how the GM actor network should work we revealed again the imbalance in power within the GM soya actor network in which some actors are more visible and are asking for better access to technology, knowledge and money while other have to make themselves visible in order to have access to the lands they lived on for years.

To conclude this study has brought to the fore the fluidity of the GM soya in the form of different identities within the actor network. GM soya ensures high revenues by selling it on the world market, but not for farmers with plots of 25, 50 or 100 hectares. GM soya also generates high revenues for seed companies like Monsanto and Nidera, but not for the farmers that have to buy them. GM soya redefined as bio-diesel lowers the CO^2 emission in the EU, but contaminates the air of the people living near the fields, it feeds pigs in China making their meat available for more people, but it doesn't feed hungry people. As argued before the GM soya production might be successful in the wet climate of the provinces of Buenos Aires and Santa Fe, but not in the dry climate of Chaco and Santiago del Estero, GM soya might generate higher income for the Argentine state, but not for the producing farmers. These identities might be categorised to political ways of reasoning, GM soya as tax instrument, environmental ways of reasoning, CO^2 emission reduction and herbicide contamination, economic ways of reasoning, GM soya as an high revenue generating crop for farmers and seed companies and these identities also have a moral connotation, GM soya feeds pigs in China, but not the hungry people elsewhere in the world. By formulating these identities in this way, by presenting them as binary oppositions it might be possible to just answer the question if GM soy is successful with a simple 'yes' or 'no'. But what this study has tried to show is that all these identities exist within the same actor network and therefore the solutions should be sought by taking this heterogeneity into account. This way of viewing the world has both ontological and epistemological consequences and asks for a different way of doing research of which this research gives, although a very modest, example.

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List of abbreviations

- Aapresid — Asociación Argentina de Productores en Siembra Directa (Argentine Asociation of no-tillage Producers)
- ANT — Actor Network Theory
- ARPOV — Asociación Argentina de Protección de las Obtenciones Vegetales
- CEDLA — Centro de Estudios y Documentación Latinoamericanos
- CLOC — Coordinadora Latinoamericana de Organizaciónes del Campo - Coordination of Latin American Farmers Organizations
- ConInAgro — Confederación Intercooperativa Agropecuaria Cooperative Limitada – Intercooperative Confederation of Agrarian Cooperative Limited
- CRA — Confederaciones Rurales de la Argentina (Rural Confederation of Argentina)
- FAA — Federación Agraria de la Argentina (Agricultural Federación of Argentina)

- FAO Food and Agriculture Organization of the United Nations
- FOB Free-On-Board
- GATT General Agreement on Tariffs and Trade
- GMO Genetically Modified Organism
- GM Genetically Modified)
- INASE Instituto Nacional de Semillas (National Institute of Seeds)
- INTA Instituto Nacional de Tecnología Agropecuaria (National Institute of Agricultural Technology)
- MNCI Movimiento Nacional Campesino Indigena - National Idigenous Farmers Movement
- MOCASE Movimiento Campesino de Santiago del Estero - Farmers movement of Santiago del Estero
- MOCASE-VC Movimiento Campesino de Santiago del Estero – Via Campesina -Farmers movements of Santiago del Estero – Via Campesina
- OMA Organización Mundial de Agricultores (World Organization of Farmers)
- OPP Obligatory Passage Point
- PAC Proyecto de Agricultura Conservacionista
- SENASA Servicio Nacional de Sanidad y Calidad Agroalimentaria
- SRA Sociedad Rural Argentina (Rural Society Argentina)
- TRIPS Trade Related Aspects of Intellectual Property Rights
- UPOV International Union for the Protection of New Varieties of Plants

Preface

On writing this thesis I struggled a lot with the academic formulation of the actors involved in the process of soya production in Argentina. I wanted to go beyond the dichotomous formulations of dividing things into wealthy/poor, global/local, urban/rural, central/peripheral, formal economy/informal economy and the underlying hierarchy with the first being valued or privileged and the latter being devalued or marginalised (McPhail, 2008, p.5). These formulations imply that there exist two different spheres/worlds/fields and I was looking for an approach with which I could study the production of soya in Argentina, without having to define which part of it took part in the local and which in the global or what in the urban and what in the rural. I wanted to look at the soya production without imposing these dichotomous structures on what I saw.

At the same time I didn't want to resort to using metanarratives like "globalization" or "capitalism" so charged with meaning, representing so much, that they have lost their meaning all together (Román, 2006, p.1). Something that is also signalled by Zygmunt Bauman:

"'Globalisation' is on everybody's lips; a fad word fast turning into a shibboleth, a magic incantation, a pass-key meant to unlock the gates to all present and future mysteries. (…) For everybody, though, 'globalisation' is the intractable fate of the world, an irreversible process; it is also a process which affects us all in the same measure and in the same way. We are all being 'globalized' (1998, p.1)

What do these terms mean? What do they explain? I found that theories tried to encompass or catch the heterogeneity of the world but in doing so resorted to using terms like 'flows', 'nodes' and 'landscapes' (Appadurai, 1990, p. 295-307-308; Castells, 2009, p.14-15), creating a meta-narrative that supersedes the actual world around us and reduces a lot of specific actors to just one single term in order to explain today's world. Taşan-Kok & Van Weesep (2006) signal the fact that "the notion of globalization consists of a number of distinct but overlapping discourses, suggesting that its meaning is still contested."(p.2). This was what I experienced myself when I was confronted with the subject of this thesis, I found myself trying to find one subject to start out from but by doing this I got further and further away from the production of soya in Argentina. I began by trying to define "globalization", followed by describing the importance of technology in current "society", linking this to farming and the "Green-, and Gene-Revolution" followed by a description of the "Argentine context". But I struggled with combining the multitude of human and nonhuman actors involved in "agriculture":

"It is due not only to differences in factors such as climate, soil, physical distance from centres of consumption, historically-created land-use patterns etc., but above all, to the basic fact that agriculture is social construction, i.e. the way agricultural practice is organised is heavily dependent on the actors involved in it. The strategies used by these actors, the ways in which they link their practices to markets and to technological developments, the specific interaction between farming activities and regional, national and supranational policies and interventions – are all decisive elements in the complex process that makes agricultural practice what it is – a highly diversified whole." (Ploeg, 1994, p.1).

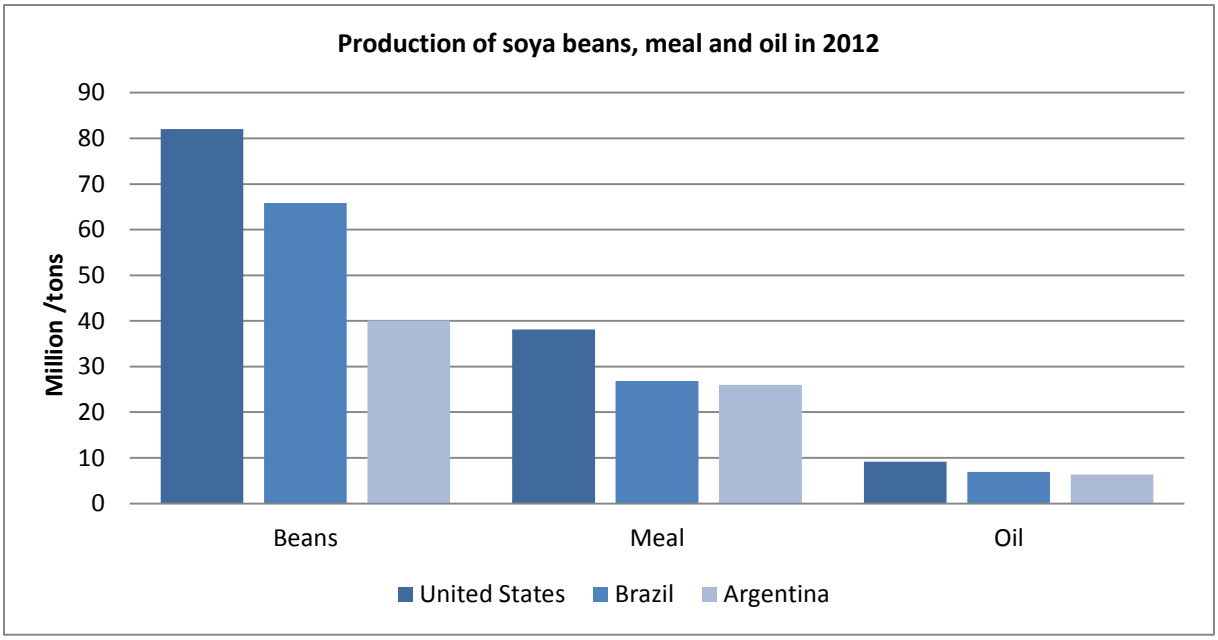
I found that the boundaries, if they did exist, between the laboratories in which genetically modified (GM) soya seeds were developed, the technical and chemical processes to produce fertilizer, the farmers that eventually would sow the seeds with the help of their tractors and no-tillage systems, and eventually sell their harvest on the "global market", were impossible to establish and would lead me to be very creative in connecting all the theoretical bits and pieces on all of these "domains". I found myself stuck in what Nietzsche defines as the intent of man to try and 'equate the unequal':

“Let us especially think about the formation of ideas. Every word becomes at once an idea not by having, as one might presume, to serve as a reminder for the original experience happening but once and absolutely individualised, to which experience such word owes its origin, no, but by having simultaneously to fit innumerable, more or less similar (which really means never equal, therefore altogether unequal) cases. Every idea originates through equating the unequal. As certainly as no one leaf is exactly similar to any other, so certain is it that the idea " leaf" has been formed through an arbitrary omission of these individual differences, through a forgetting of the differentiating qualities, and this idea now awakens the notion that in nature there is, besides the leaves, a something called the "leaf," perhaps a primal form according to which all leaves were woven, drawn, accurately measured, coloured, crinkled, painted, but by unskilled hands, so that no copy had turned out correct and trustworthy as a true copy of the primal form. (…)The disregarding of the individual and real furnishes us with the idea, as it likewise also gives us the form; whereas nature knows of no forms and ideas, and therefore knows no species but only an x, to us inaccessible and indefinable.” (Nietzsche, 1873; In Levy, 1911, p.179)

Eventually I came across Actor Network Theory (ANT) or the ‘sociology of association’(Latour, 1988, p.205), which offered me what I had been looking for in studying the production of soya in Argentina, without having to define all the separately defined domains like - the social, the economical or the political – with which the GM soya production in Argentina was related. This meant however that I had to rewrite my theoretical chapter that had a certain conventional build up with the chapters on “globalization” and “farming” and the “Argentine context” followed by the chapters on theory and methodology. Because I have chosen ANT as an approach to the production of soya in Argentina the way the chapters are ordered might differ from what might be expected from a master thesis. ANT stresses that we don’t impose any hierarchy on the actors, both human and nonhuman, we are about to encounter. We just follow them, wherever they might go which shows a methodology that is very different from conventional ones. So because of this very profound implication the first chapter will immediately set out on explaining ANT, followed by the research aim, research questions and relevance. The second chapter will be about the relation between human and non-human actors, or ‘actants’. In chapter three the ANT approach will be linked to the ethnographical approach of Miller (2010) which will bring us to the methodology used during this research. In the fourth chapter we will follow the GM soya seeds from the laboratories of Monsanto all the way through the sowing, growing and harvesting of the GM soya beans, meeting all the actants involved along the way. After this description of the GM soya actor network the fifth chapter will shortly describe the cotton actor network and then look at how both actor networks interacted and redefined each other. The sixth chapter will be about the methods used by the actors in the GM soya actor network to make themselves visible. Besides it will look at how the actors involved define each other by analysing the magazines they use to transfer their knowledge and opinions. The last chapter will consist of a conclusion in which the main research question will be answered followed by a reflection on the research as a whole.

1. Introduction

At present soya, either in the form of oil or meal, is in high demand by fast growing economies like Brazil, China and India. Also the European Union's (EU) economy accounted for over 10 million tonnes of soya oil in 2012. Most of this demand is met by the three biggest producers of soya (graph 1), The United States (US), Brazil and Argentina (Nassar & Antoniazzi et. al., 2011, p.6). If we want to study the production of soya we see ourselves confronted with what might be characterised as an "overwhelming impression of chaos and disorganization" (Ploeg, 2009, p.1). A wide range of research approaches have tried to order this apparent 'chaos and disorganization'. And without aiming at summarizing the debate within the sociology of agriculture and agri-food research I will shortly take a look at some of the approaches. Agricultural economics tried structuring the developments in the agricultural sector by distinguishing between developments that happened on the global level and how this affected the local level (e.g. Reardon & Barrett, 2000). Diffusion theory has focussed on how technology developed by the sciences diffused into society or the production process (Bisang, 2003), but doesn't look at the interactions between the humans and the nonhumans during this diffusion. Political economy incorporated the Marxist idea of science and technology on the macro level changing society by changing nature (De Sousa & Busch, 1998, p.350), which led FitzSimmons and Goodman (1998) to argue for "nature" to be brought back into social theory (Friedman, 2001, p.92). And the sociology of agriculture came up with the Commodity System Analysis (CSA) (Friedman, 2001; Buttel, 2001) bringing the consumer into their field of study but keeping them divided in scales. Some approaches study production processes through value chain analysis focussing on the "economic value" that is added at different stages. When applied to the soya production in Argentina it starts out form the soya arriving at the harbour or the mill where it will be processed before being exported (López & Ramos & Simkievich, 2008). Commodity chain approaches do take into account the production of soya before it is exported. In respect to the soya production in Argentina and Brazil a commodity chain study was carried out by Berkum, Roza & Pronk (2006) and although they described the production process from the production on the farm to the eventual exportation, it appears to be a more or less linear process in which the multitude of nonhuman actors are treated as passive. The production of GM soya however consists of a wide network of actors in which farmers, sowing machines, investors, pesticides, multinational corporations, airplanes, GM seeds, foreign ministers, trucks, soils, ships, and mills, to name but a few, all take part and (inter)act with each other in all but a linear way. What if we want to bring all of these actors into social theory and research? None of these approaches goes beyond what is called the "modernist ontology" of dichotomizing between key elements in this "field of study" like the social and the natural or the consumer and the producer (Lockie & Kitto, 2000, p.4).



Graph 1: Production of soya beans, meal and oil in 2012 by the three main producers and exporters of soya (FAO, n.d.)

According to Bruno Latour (1992) this way of formulation is due to a 'tug-of-war' (p.278) that has gone on in the social sciences between explaining society from nature or explaining nature from society, by distinguishing between subject and object:

"This tug-of-war is played in one dimension. It is fun to play but after twenty years of it we might shift to other games, especially since it makes incomprehensible the very linkages between Nature and Society we wish to account for. I claim that the only way to go on with our work is to abandon this frame of reference and to set up another standard, all the more so if other scholars go on to make it more subtle, more precise by adding finer divisions and other labels to the same one-dimensional yardstick (Giere, 1988). We do not want finer divisions and new schools of philosophy of science. We want philosophy to do its job and discover the origin of the yardstick in order for us to overcome it." (Latour, 1992, p.278).

Within the field of human geography this 'tug-of-war' exists in the divide between human-, and physical geography. To overcome this dichotomy and to be able to study the interactions between people and their (physical) environment various theoretical approaches have been developed in which the networks play an import role. In urban geography the idea of networks appears almost naturally when we look at the transportation network in the form of highways and railroads. This might have been what made the network approach popular amongst the positivist geographers in the 1960s because this network can be directly observed and measured (Smith, 2003, p.25; Fotheringham, 2006, p.239). With the increasing development of informational technology and a process characterised as "globalization", networks became fashionable again in the mid 1990s after the Marxist critique had dominated the discussion in human geography in the 1980s (Smith, 2003, p. 26). Most notably in respect to the 'return' of networks might be the trilogy of Castells (1996, 1st Edition) on the Information Age of which the first volume is titled: *The rise of the network society, the information Age: Economy, Society, Culture*. The modern ontology of dividing everything into boxes becomes immediately clear from the last three words in the title which shows on which boxes his study will focus, "economy", "society", and "culture". In his trilogy Castells traces the main developments in today's world back to the "flow" of information:

"Advanced services, including finance, insurance, real estate, consulting, legal services, advertising, design, marketing, public relations, security, information gathering, and management of information systems, but also R&D and scientific innovation, are at the core of all economic processes, be it in manufacturing, agriculture, energy, or services of different kinds. They all can be reduced to knowledge generation and information flows." (Castells, 2009, p.409)

The ideas of Castells have been taken up by urban geographers and many has been written since on the network described by Castells in the form of a network of flows in which cities function as nodes, creating a (meta)network that is characterised as a neo-Marxist approach in which capital is global and labour is local (Smith, 2003, p.33). And again we find ourselve trapped in the 'modernist-ontology' of dichotomous divides.

Outside the field of urban geography the network approach has, among others, taken form in social network analysis, but again this concerns the network of the (social) human actors. Because of the multitude of interactions between nonhuman and human actors in the network of soya production in Argentina we need an approach that does look at the interaction between these actors, that doesn't treat human or nonhuman actors differently, an approach that doesn't obscure actors and their interrelations by ordering them under dense denominators like "globalization," "capitalism," "society," "culture," or belonging to the "local," "global," or "Micro-, Meso-, Macro level". In ordering actors under such titles we are imposing a hierarchical structure on the actors involved. Thereby obscuring first of all the actors involved in whatever "society," "globalization," "cultures," or the different "levels" are said to contain, but secondly we are also obscuring the linkages between actors that in this way are being isolated in one of these blocks. In this way of ordering we are defining what actors are in the 'local' and what actors are in the 'global', making all the actors that might cross the boundaries between these blocks inexistent or mute. In short: "We have to give evidence that "science" and "society" are both explained more adequately by an analysis of the relations among forces and that they become mutually inexplicable and opaque when made to stand apart" (Latour, 1988, p.7).

1.1 Why Actor Nework Theory?

Publicly known as the most important soya producer in Argentina, Gustavo Grobocopatel describes the network of actors that consists around the production of soya:

"When one thinks of "the rural" in the city, one thinks of a producer on his land, but in reality the producer is just one piece, one cog in a much diverser, vaster, without limites in which we find who operate the future markets, the websites on internet, the ones that transport the grains by boat, those that bring everything in trucks, those that sell services, those that lean money, those that sell the machinery, the mechanics, those that produce the bags in which the grains can be packed and also the plastic industry or the petrochemicals that permits for bags to be fabricated. To all this you have to add those that sell the agrochemicals and the industry that's behind it, the molecules and those that sell the seeds and also the biotechnology. Within the biotechnology there is the case of plant design, the laboratories, the national scientific system and more the agricultural engineers and other professionals that in one way or another coordinate this and allow the businesses to grow. So to say, behind the rural there is an extremely complicated network. Therefore when one sees a grain or sees the fields in the countryside, in reality there exists something that is much more than only the producer. In one way or another producer is almost like the assembly worker in the car industry, he has a similar role. He is someone who gathers some things, but the level of integration that exists is incredibly vast." (Starosta & Orden, 2013, p.41)

What must become clear from the citation above is that the production of soya in Argentina consists of a vast heterogeneous network of both human and nonhuman actors that occupy places both in what might be defined as "the rural" or "the global" and the actors interact with each other irrelevant of their geographical position. Which makes that we are forced to rethink our conception of geographical scale. Although we know that "the local", "the global," and "the micro-, meso-, macro level," don't exist as such, we should look at them as "points of view on networks that are by nature neither local nor global, but that are more or less long and more or less connected" (Latour, 1993 In: Smith, 2003, p.35). In looking at actor networks this way we can at last go beyond the 'modernistic ontology' of binary opposition and freely move back and forth from the rural to the urban, the local to the global and from the farm to the laboratory. ANT makes this possible not only because of the way it redefines our definitions of scales, but more controversially because it takes both humans and nonhumans into account as actors. Instead of only studying the human actors, or what might be called 'the social' implies that nonhuman actors are mere passive actors completely adaptable for use by humans (De Sousa & Busch, 1998, p.351). But what if a soya seed won't grow, a weed becomes resistant against herbicides designed to kill it, a combine breaks down during harvest? Who is the actant in these cases? Although ANT takes these nonhuman acts seriously, it doesn't assign 'intentionality' and 'freedom' to them the same way we do to humans (Verbeek, 2011, p.4), ANT doesn't attribute purposiveness to "nature" or "technology" (De Sousa & Busch, 1998, p. 350) but it accepts that human and nonhuman actors simply can't be separated. In the same way human and nonhuman actors never act alone, they are always embedded in an actor network (De Sousa & Busch, 1998, p.351). What sets ANT apart from system theories is the view that human and nonhuman actors are constituted and shaped by their involvement, their interaction with each other (Lee & Brown, 1994, p.775). "The actor network is reducible neither to an actor alone, nor to a network." (Callon,1987, p.93).

This irreducibility is the first principle of ANT as developed by Latour. This principle states that "nothing is, by itself, either reducible or irreducible to anything else." (Latour, 1988, p.158). If we should accept the fact that things could contain one another, could be reduced to one another, this implicitly means that things can become bigger than others, because they include these others. "They become impressive, majestic, sacred, intoxicating, dazzling"(Latour, 1988, p.190) They become the "society", the "culture", the "Modern World", or the "globalized world" as mentioned above. This adds to things something more that comes from beyond the facts (Latour, 1988, p.190). So this is where we take off: "nothing is, by itself either reducible or irreducible to anything else." (Latour, 1988, p.158) This means there is no "society", no "culture", no "science", no "theory", no "law", no "economics", no "capitalism", no "globalization", no "nature" (Latour, 1988, p. 201-207). There are only trials, trials of strength or weakness (Latour, 1988, p.158). "As soon as the principle of irreducibility is accepted, it becomes necessary to admit this first reduction: that there is nothing more than trials of weakness." (Latour, 1988, p.191). Instead of 'force' we might talk of 'weakness,' 'entelechies,' or 'actants.' (Latour, 1988, p.159). In this thesis I will use the term 'actants' to refer to both human and nonhuman actors that find themselves in a field of forces.

Within these trials there are winners and losers. Actants do poses the strength to enlist other actants to work for them, they can associate with one another (Latour, 1988, p.160). This explains the name 'sociology of association', in which the role of the researcher is to follow the associations, without "a-priori ideas about what makes a force, for it comes in all shapes and sizes. (…) we should not decide

a-priori what the state of forces will be beforehand or what will count as a force." (Latour, 1988, p.154-155). An actor network is:

"composed of a series of heterogeneous elements, animate and inanimate that have been linked to one another for a certain period of time (…) But the actor network should not, on the other hand, be confused with a network linking in some predictable fashion elements that are perfectly well defined and stable, for the entities it is composed of, whether natural or social, could at any time redefine their identity and mutual relationship in some new way and bring new elements into the network. An actor network is simultaneously an actor who's activity is networking heterogeneous elements and a network that is able to redefine and transform what it is made of." (Callon, 1987, p.93).

To look at the world from an ANT point of view we see a field of forces, "a seamless web of relations in which particular persons are able to speak for institutions, technical objects or natural objects." (De Sousa & Busch, 1998, p.351). In this way we will look at the soya production in Argentina moving freely through the field of forces in which this production takes place without having to confine the human and nonhuman actors to certain 'fields' or 'levels'. If I would confine myself only to what the social sciences define as part of the "social" or "society" I wouldn't be able to do research into the soya production in Argentina because of the fact that the actors involved are all crossing the boundaries of these separated domains that some define as "agricultural", "political", "economical" or "social". So the choice for an ANT approach is not only an expression of my preference as a researcher for this approach, it is also a choice out of necessity and dictated by the actants involved in the production of soya in Argentina.

1.2 Research aim and research question

Human Geography is a good example of a science that crosses different disciplinary fields. It won't reduce itself to only "human geographical" explanations, if such explanations should exist in the first place. It has always borrowed and developed further theories from other disciplines, from sociology, psychology and the political sciences. I want to take this characteristic of human geography a little further by adopting the 'sociology of association'(Latour, 1988, p.205) as developed by Bruno Latour, John Law (1992), Michel Callon (1986) and Annemarie Mol (2002). Therefore I refrain from defining my field of research any more than that it is about the human and nonhuman actors involved in the production of GM soya in the Argentine provinces of Chaco and Santiago del Estero. I therefore don't claim to be exhaustive, but I have tried to be as thorough as possible to trace all the actants involved, however distant, and tried to let them speak for themselves, without a-priory defining or trying to speak for them. In other words the aim of this research is to investigate the production process of GM soya in the Argentine provinces of Chaco and Santiago del Estero by making both the human and nonhuman actros involved, visible and making them speak by following them in their trials of strength and weakness, without reducing, representing or defining them as a researcher, but let them represent and define themselves. Formulated as a question:

Who are the human and non-human actors that make up the GM soya actor network in the Argentine provinces of Chaco and Santiago del Estero, can they be made visible and made to speak, and in what way do they shape and constitute each other?

To arrive at answering this main research question I have formulated the following sub-questions:

- **What actants are mentioned in the literature?**

In order to answer the main research question we set out from the literature to answer this sub-question by looking at the human and nonhuman actors that are mentioned. To be able to make the different actants visible and made to speak we first have to know who the actants are.

- **What actants are mentioned by the interviewees?**

This second sub-question is aimed at the human actors involved in the production of soya in Argentina. These are the people that deal with all the human and nonhuman actors involved on a daily basis and might reveal different actors than mentioned in the literature which therefore are made visible and can be made to speak.

- **What human and nonhuman actors are reduced and therefore made invisible?**

This sub-question is aimed at spotting the human and nonhuman actors involved in the production of soya in Argentina that might be obscured in non-ANT literature and/or by terms used by the human actors in the interviews. In order to make as much actans visible as possible.

- **Which forms of visibility are used by the actants involved?**

This question is aimed at showing different forms or methods used by the actants in the GM soya actor network to make themselves visible.

- **Which actants are allowed to speak for other actants in the GM soya actor network?**

This question is to make visible the actants within the GM soya actor network that are allowed to speak for other actants, and therefore might reduce the heterogeneity of the group of actants they are allowed to speak for.

- **How do the actants define the other actants involved?**

To be able to define the different positions within the GM soya actor network I will look at the definitions of the actants themselves and refrain from defining their positions myself.

- **How do the actants shape and constitute other actants?**

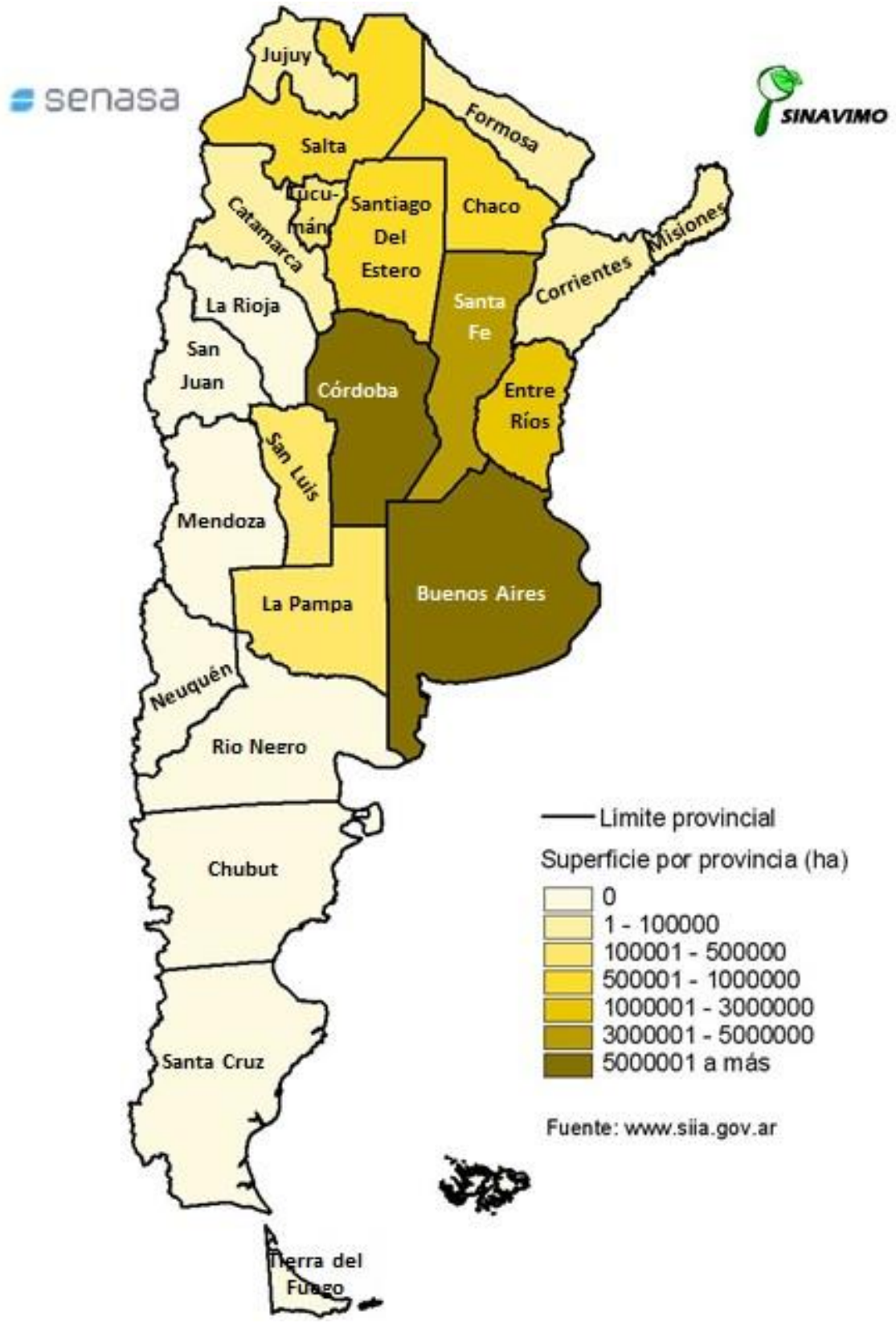
Actants never act alone, they are always embedded in an actor network and are shaped and constituted in relation with the other actants in the GM soya actor network.

1.3 Relevance

The scientific relevance becomes clear from the introduction in the sense that this research offers a new ontology and epistemology to doing research. By adopting the 'sociology of association' (Latour, 1988, p.205), this study will show that theproduction of soya in the Argentine provinces of Chaco and Santiago del Estero is explained better by taking into account the interrelations between the human and nonhuman actors. So it will make the interactions between the heterogeneous actors in this actor network visible and in doing so attribute to close the gap in knowledge left by other approaches, like diffusion theory, political economy, commodity system analysis and commodity chain analysis, because they stayed within the confines of the "modern" ontology of binary oppositions and dense denominators like "globalization", "society" or "culture", or ordering actors according to their geographical "local-global" or "micro, meso, macro" scale.

Above all this research is an exercise in the 'sociology of association'(Latour, 1988, p.205) or Actor-Network Theory and in doing so contributes to the growing body of work done by other ANT scholars in all kinds of disciplines from information system studies (Walshham, 1997) to health (Mol, 2002) all contributing to what Law calls "a sociological treatment of technology" (Law, 1986, p.2) in which artefacts form an integral part of the "social", the "economic", the "political" and all other possible realms of study. At a more profound level its scientific relevance lies in the fact that we might have to reconsider the ontology in sociology in which the non-social, nonhuman, technological artefacts and the natural are made into the 'Other' (Lee & Brown, 1994, p.774). In respect to the field of human geography this shows that we might need to reflect on the notion of scale.

The societal relevance is closely related to the scientific relevance in the sense that this research can attribute to more insight for all the actors involved in the actor network in which GM soya is being produced in the Argentine provinces of Chaco and Santiago del Estero providing these same actors, that among many others include farmers, investors, stock-market brokers, consumers and politicians in Argentina, China, the US and the EU, with more insight in their role in this process. And just like scientist might have to reconsider their ontology, in the same way the human actors involved in the production of GM soya in Argentina might have to reconsider their look on the nonhuman actors that surround and resist them and interact with them in every stage of the production process.



Map 1: The soya producing provinces in Argentina (www.sinavimo.gov.ar)

2. Making trees speak

As mentioned in the preface and the introduction to this thesis the production of GM soya in Argentina involves a multitude of heterogeneous actants. We might set out by defining farming as an interaction between (nonhuman) nature – consisting of for example soil, trees, and animals – on which human actors act in order to produce all kind of food products – for example milk, cheese, wheat, corn and soya. Castells (2009) takes this definition a little further by starting out from 'matter':

"Matter includes nature, human-modified nature, human-produced matter, and human nature itself, the labors of history forcing us to move away from the classic distinction between humankind and nature, since milleniums of human action have incorporated the natural society into society, making us, materially and symbolically, an inseparable part of this environment. The relationship between labor and matter in the process of work involves the use of means of production to act upon matter on the basis of energy, knowledge, and information." (Castells, p.15)

The reason for quoting Castells here is twofold. Firstly he shows us what we have to do if we stick to making distinctions between human and non-human actors, which is the need to specify matter into: 'nature', 'human-modified-nature', 'human-produced matter' and 'human nature'. What do all these differentiations entail? What is part of 'human-produced matter' and how is it different from 'human-modified-nature'? This asks only for more clarifications, resulting in more definitions and more reductions. The second point that Castells is making is that 'the natural society' is incorporated into 'society', again what does this 'natural society' entail, how is it different from 'society' and how are they both related to each other?

If we approach this subject from an ANT point of view we can conclude that:

"It is not a question of nature (…). Try to make sense of these series: sunspots, thalwegs, antibodies, carbon spectra; fish, trimmed hedges, desert scenery; "le petit pan de mur jaune," mountain landscapes in India ink, a forest of transepts; lions that the night turns into men, mother goddesses in ivory, totems of ebony. See? We cannot reduce the number of heterogeneity of alliances in this way. Natures mingle with one another and with "us" so thoroughly that we cannot hope to separate them and discover clear, unique origins to their powers." (Latour, 1988, p.205-206).

This point was also made by Friedrich Nietzsche (1873) by defining and naming things or events through our language we are always talking in metaphors and we don't realise this and build whole construction on the truth of "nature" and the world around us while never getting to the 'things-in-themselves':

"Through this feeling of being obliged to designate one thing as "red," another as "cold," a third one as "dumb," awakes a moral emotion relating to truth. (…). Now as a "rational" being submit his actions to the sway of abstractions; he no longer suffers himself to be carried away by sudden impressions, by sensations, he first generalises all these impressions into paler, cooler ideas, in order to attach to them the ship of his life and actions. Everything which makes man stand out in bold relief against the animal depends on this faculty of volatilising the concrete metaphors into a schema, and therefore resolving a perception into an idea. For within the range of those schemata a something becomes possible that never could succeed under the first perceptual impressions: to build up a pyramidal order with castes and grades, to create a new world of laws, privileges, sub-orders, delimitations, which now stands opposite the other perceptual world of first impressions and assumes the appearance of being the more fixed, general, known, human of the two and therefore the

regulating and imperative one. Whereas every metaphor of perception is individual and without its equal and therefore knows how to escape all attempts to classify it" (Nietzsche, 1873; In Levy, 1911, p. 181-182)

In this way we have defined trees, we have given it all kind of names, oak, *Quercus Lepidobalanus* or *Quercus Cyclobalanopsis* and devided into different families, but in itself a tree isn't lacking anything we have given it these names, but it wasn't lacking these names (Latour, 1988, p.193). The tree didn't need us humans to give it its name but in following Nietzsche we might believe that this is the case, because we have constructed this system of metaphors which we might define as the truth. We have this system of ideas and we might have the power to cut trees down and use them as fuel, but this doesn't mean that these trees don't have any influence:

"We cannot deny that it is a force because we are mixed up with trees however far back we look. We have allied ourselves with them in endless ways. We cannot disentangle our bodies, our houses, our memories, our tools, and our myths from their knots, their bark, and their growth rings. You hesitate because I allow this tree to speak? But our language is leafy and we all move from the opera to the grave on planks and in boxes. If you don't want to take account of this, you should not have gotten involved with trees in the first place. You claim that you define de alliance? But this illusion is common to all those who dominate and who colonize. It is shared by idealist of every color and shape. You wave your contract about you and claim that the tree is joined to you in a "pure relationship of exploitation," that it is "mere stock." Pure objects, pure slave, pure creature, the tree, you say, did not enter into a contract. But if you are mixed up with trees, how do you know they are not using you to achieve their dark designs? (Latour, 1988, p.193-194)

So nothing can be reduced to anything else, a tree can't be reduced to the family of *Fagaseae* and the GM soya bean can't be reduced to the family of *Fabaceae* or *Glycine Max (L.) Merr*, which is the name given to them by the science we call biology. The soya bean did already exist before it was given this name, it wasn't discovered, it was there all the time. It was only for all the actants to come together and for the science of biology to start determining and classifying plants and animals into different species and categories which made the GM soya bean and all other species visible in encyclopaedias and other forms of documentations that could be consulted. So the GM soya bean didn't "emerge in nature" it depended on the science of biology to become visible through the determination and classification system set up by biologist to be able to name and differentiate between species (Latour, 1988, p.91-92).

From the reflection on the relation between "humans and nature" we can conclude that we can't differentiate between the two, because they are all interconnected. This is why in this thesis I will talk about actants, meaning both the human and nonhuman actors involved. Now we are left with the 'principle of irreducibilty' (Latour, 1988, p.158) and the fact that there are only 'trials of strength and weakness' (Latour, 1988, p.191) in which actants associate in every way possible and which leaves us researchers with the task of following them.

2.1 Making visible

An example of how things can become obscured by trying to define and classify them is given by Van der Ploeg (2009) in relation to "peasant studies". I have to make clear that Van der Ploeg in his extensive work on "farming" doesn't use an ANT approach, far from it, he tries to define, name and classify different ways of farming, distinguishing between "peasant", "entrepreneurial" and "capitalist" ways of "farming". In this I won't follow Van Der Ploeg, but he makes however very good observations, describing the human as well as the nonhuman actors in his field of study. So I will take

some of his observations and definitions in order to strengthen my argument that in order to be able to do research into the production of GM soya in Argentina, I have to use an ANT approach.

"[P]easant-like ways of farming often exist as practices without theoretical representation. (…) Hence they cannot be properly understood, which normally fuels the conclusion that they do not exist or that they are, at best, some irrelevant anomaly. And even when their existence is recognized (as in developing countries), such peasant realities are perceived as a hindrance to change – a hindrance that can only be removed by reshaping peasants into entrepreneurs" (…) [W]herever entrepreneurial farming deviated from the model as specified in modernization theories, such deviations are seen as temporary imperfections having no theoretical significance whatsoever. (...) In turn the problem of misunderstood changes blinds many of those involved (whether they are scientists, politicians, farmers or farm union leaders). Since these changes (actively organized as modernization) were, by definition, understood as adieu to the assumed economic irrationality and backwardness of the peasant, current patterns of behaviour (individual or collective) can only be understood in terms of 'rational decision making' – which evidently leads to chains of interrelated misunderstandings and fictions." (Van Der Ploeg, 2009, p.19)

With this observation Van Der Ploeg makes clear that peasants seem inexistent within peasant studies, due to the lack of theoretical representation. So by defining and classifying actants we are not only reducing them or adding to them things that go beyond them, we are also obscuring many actants, simply by not defining and classifying them. As long as an actant has no theoretical representation, it is invisible, it doesn't exist. The peasant doesn't exist without academics like Van der Ploeg that will give them a theoretical representation. Just like an oak didn't existed before we classified it as part of the family of *Fagaseae* or the GM soya bean before it became known as *Glycine Max (L.) Merr*. So what the human actors involved might define, with the help of all kind of theoretical frameworks, as "peasants" was already there and they are still there. To make them visible we don't need more constructs or more theoretical representations, because this will always leave some of them out. To turn to Nietzsche ones more:

"If somebody hides a thing behind a bush, seeks it again and finds it in the selfsame place, then there is not much to boast of, respecting this seeking and finding ; thus, however, matters stand with the seeking and finding of "truth" within the realm of reason. If I make the definition of the mammal and then declare after inspecting a camel, " Behold a mammal," then no doubt a truth is brought to light thereby, but it is of very limited value, I mean it is anthropomorphic through and through, and does not contain one single point which is " true-in-itself," real and universally valid, apart from man. The seeker after such truths seeks at the bottom only the metamorphosis of the world in man, he strives for an understanding of the world as a human-like thing and by his battling gains at best the feeling of an assimilation. (…) His procedure is to apply man as the measure of all things, whereby he starts from the error of believing that he has these things immediately before him as pure objects. He therefore forgets that the original metaphors of perception are metaphors, and takes them for the things themselves." (Nietzsche, 1873; In Levy, 1911, p.183)

So therefore this research won't be about defining what is a "peasant" or a "capitalist farmer", it will be about the actants, human and nonhuman, we will follow them through the field of forces in which GM soya is being produced in the Argentine provinces of Chaco and Santiago del Estero and we will look at how they define each other, how they define a "peasant" or a "capitalist".

The part above is about theoretical visibility. But we can also look at how technologies in today's world can make things visible that would have stayed obscured for the naked eye if the actants hadn't associated in such a way for new technologies to make other actants visible to us. For example Pasteur needed microscopes to make the microbes visible. Other examples are infrared

cameras, thermometers and obstetric ultrasound equipment, all actants that make something visible to us. But in doing this these actants aren't neutral. In the first paragraph of this chapter we already mentioned the role that trees play in our lives and how they can be made to speak. The obstetric ultrasound is taken as an example by Peter-Paul Verbeek (2011) to show the role that technology plays in our moral decision making by mediating our perception of things:

"obstetric ultrasound. This technology is not simply a functional means to make visible an unborn child in the womb. It actively helps to shape the way the unborn child is humanly experienced, and in doing so it informs the choices his or her expecting parents make. Because of its ability to make visible the fetus in terms of medical norms, for instance, it constitutes the fetus as a possible patient and, in some cases, its parents as makers of decisions about the life of their unborn child. (…) A thermometer, for instance, establishes a relationship between humans and reality in terms of temperature. Reading a thermometer does not result in a direct sensation of heat or cold but gives a value that requires interpretation in order to tell something about reality. (…) Mediating technologies amplify specific aspects of reality while reducing other aspects. When one is looking at a three through an infrared camera, for instance, most aspects of the three that are visible to the naked eye get lost, but at the same time a new aspect of the three becomes visible: one can now see whether it is healthy or not"" (Verbeek, 2011, p.6-9)

This example shows us the interrelation between us human actors and our nonhuman surroundings. By inventing the obstetric ultrasound technology, we humans are confronted with a whole spectrum of moral issues with which we otherwise wouldn't have to deal with. And the nonhuman actor, in this case the obstetric ultrasound, takes on all kind of different identities, in one case it can save a childs life because its development can be monitored, but it can also cause the life of the unborn child to end when it shows the child has a mortal defect. At the same time the human actors, in this case the parents are forced into the role of deciding over the life of their unborn child. So the nonhuman actors are acting upon us, they are forcing us into a role, an identity, to do something, to respond. Before we take this point a little further let us first look at another example of human and nonhuman interaction.

2.2 Making the translation

The second paragraph was about how actants could become visible in encyclopaedias by giving them names and order them into categories. For this these actants have first to be "discovered", with the help of all kind of actants, like the microscope, thermometer or obstetric ultrasound technology for example. This is often how revolutions are presented, for example the "discovery" of the microbe by Pasteur "revolutionised" the whole of France and then the world. At the first place, as argued before, things aren't discovered and secondly they don't just "change" the world, before they can do that they have to be translated.

"To discover the microbe is not a matter of revealing at last the "true agent" under all the other, now "false" ones. In order to discover the "true" agent, it is necessary in addition to show that the new translation also includes all the manifestations of the earlier agents and to put an end to the argument of those who want to find it other names. It is not enough to say simply to the Académie, "Here's a new agent." It must be said throughout France, in the court as well as in town and country (…) Then and only then, bypassing the laboratory becomes impossible. To discover is not to lift the veil. It is to construct, to relate, and then to "place under." (Latour, 1988, p.81)

Technological instruments can make actants visible that weren't visible before. In paragraph 2.2 the thermometer, the infrared camera and the obstetric ultrasound technology were mentioned. But

these kind of instruments ask for interpretation, they ask for a skilled human user. This shows how nonhuman actants aren't neutral or inanimate objects that lack agency. A good example of this relation between human and nonhuman actors is offered by Law (1986) in his article on the navigation of Portuguese vessels to India. To be able to navigate beyond the European waters the captains and seaman had to be trained by astronomers to teach them to indicate their position in open, unfamiliar seas. Therefore a commission of astronomers was summoned to equip the Portuguese seaman with tools and the knowledge on how to use them:

"When it created a table the commission was therefore creating a kind of surrogate astronomer. It was not necessary to take along Jose Vizinho or Abraham Zacuto in person. Their force, and the work of their predecessors, was being borrowed, converted into a highly trans-portable and indefinitely reproducible form, and being put to work on every ship. The production of tables of solar declination for the purpose of navigation may thus be seen as a way of reducing the relevant aspects of a weighty astronomical tradition to a form that, in the context of the vessel, was more mobile and durable than the original. (…)But the *Regimento* was not sufficient by itself. Navigation also demanded astrolabes or quadrants. In short, it demanded instru-ments. Like the *Regimento* itself, these were transportable and relatively durable on board ship. (…) The right documents, the right devices, the right people properly drilled - put together they would create a structured envelope for one another that, ensured their durability and fidelity." (p.20-22).

So these nonhuman navigational instruments asked for trained and skilled human users. Both the human and nonhuman actants needed each other to be able to do their task. In the same way the introduction of agricultural technology in the GM soya production in Argentina the farmers needed to be trained to know how to deal with this new crop and the machines, fertilizers and herbicides that come with it. A translation had to be made for the farmers to be able to use the technology that was available to them. On top of that farmers in Argentina had very little experience with the GM soya crop when it was first introduced. This paved the way for a whole new actor in the production process in the form of the agricultural engineer, that took over many of the farmers tasks. We will come back to this in chapter four. For now we will take a closer look at the way in which human and nonhuman actors interact. Latour (1992) gives the simple example of a spring that is attached to a door to keep the cold from entering the building. These springs can be very powerful and at times slams the door shut which calls upon the humans using the door to do it in such a way that the door doesn't slam in their face and causes a bloody nose.

"The interesting thing with such impolite doors is this: if they slam shut so violently, it means that you, the visitor, have to be very quick in passing through and that you should not be at someone else's heels, otherwise your nose will get shorter and bloody. An unskilled nonhuman groom thus presupposes a skilled human user. It is always a trade-off. I will call, after Madeleine Akrich's paper (Akrich 1992), the behavior imposed back onto the human by nonhuman delegates rescription. Prescription is the moral and ethical dimension of mechanisms. In spite of the constant weeping of moralists, no human is as relentlessly moral as a machine, especially if it is (she is, he is, they are) as ''user friendly'' as my Macintosh computer. We have been able to delegate to nonhumans not only force as we have known it for centuries but also values, duties, and ethics. It is because of this morality that we, humans, behave so ethically, no matter how weak and wicked we feel we are. The sum of morality does not only remain stable but increases enormously with the population of nonhumans. It is at this time, funnily enough, that moralists who focus on isolated socialized humans despair of us—us meaning of course humans and their retinue of nonhumans. (Latour, 1992, p.157)

Peter-Paul Verbeek (2011) in following Latour explains that to be able to do ethics in this day and age we can't simply cast all the nonhuman actors aside. We can't however assign 'intentionality' and 'freedom' to them, the same way we do to humans. So we have to find a new way of doing ethics that does leave room for the role and agency of nonhumans, although this might be a different kind of agency:

"The central focus of ethics is to make sure that technology does not have detrimental effects in the human realm and that human beings control the technological realm in morally justifiable ways. What remains out of sight in this externalist approach is the fundamental intertwining of these two domains. The two simply cannot be separated. Humans are technological beings, just as technologies are social entities. Technologies after all, play a constitutive role in our daily lives. They help to shape our actions and experiences, they inform our moral decisions, and they affect the quality of our lives." (Verbeek, 2011, p. 4)

This moral dimension becomes clear for example in the access that the human actors involved in the soya production in Argentina have to nonhuman actors, like no-tillage sowing machines, fumigation installations and combines. The knowledge of the production that is concentrated by agricultural engineers and the use of herbicides and pesticides that are needed in the production of GM soya and have led to cases of pollution of not only the environment, but also humans living near the GM soya fields (Bravo et al., 2010). But it is important to understand that although ANT is not treating human and nonhuman actants involved in the production of GM soya in Argentina differently in respect to the morality of the actants it isn't attributing the same intentionality and freedom on the nonhuman as on the human actors. To make this absolutely clear I quote Verbeek (2011) here at length:

"Without denying the importance of human responsibility in any way, we can conclude that when a person is shot, agency should not be located exclusively in either the gun or the person shooting, but in the assembly of both. The English language even has a specific "amodern" word for this example: *gunman*, as a hybrid of human and nonhuman elements. The gun and the man form a new entity, and this entity does the shooting.

The example illustrates (…) [that] in order to understand the moral significance of technology, we need to develop a new account of moral agency. The example does not suggest that artifacts can "have" intentionality and freedom, just as humans are supposed to have. Rather, it shows that (1) intentionality is hardly ever a purely human affair – most often it is a matter of human-technology associations; and (2) freedom should not be understood as the absence of "external" influences on agents but as a practise of *dealing* with such influences or mediations." (Verbeek, 2011, p.65)

2.3 Making time

In the doing research into the production of GM soya in Argentina I came across many articles that mentioned the so-called "Green-, and Gene-Revolution" (Parayil, 2003; Domínguez & Sabatino, 2010; Davies, 2003). From an ANT point of view it is difficult to speak of "revolutions", because they impose a framework on history in which the "revolution" was the turning point in history after which everything that happened before is condemned, as being outdated. It wasn't just the genius of Pasteur in his laboratory that "prevented people from spitting, dig drains, get vaccinated or to create serotherapy." (Latour, 1988, p.14), we can't reduce all this only to Pasteur himself. And we can't reduce the 'Green Revolution' only to "The Rockefeller Foundation" that increased the yields of rice all over the world. It was the actor network and the way the human and nonhuman actors in it associated at that time. So it is about the looking at these moments in time in accepting that "there are only actors which take their capacity to make time and history from other actors and thereby pass the others by and make them passé (…) There is no last moment to condemn all those that came before." (Latour, 1988, p.165). In this way we can stop explaining the movement of actants by

describing the times and dates of their movement, instead we will follow the agents to be able to explain the construction of time as it is translated and periodised by the actants themselves (Latour, 1988, p.51).

This is not to downplay the role that Pasteur played in the making microbes visible and neither do I want to downplay the "Green-, and Gene-revolution" I only want to put them back into the field of forces in which they emerged, in which they associated with other actants that put them into a position to be able to make time and history. Again in doing so I don't claim to be exhaustive, but I will refrain from adding something that comes from beyond the actants that I have encountered and the actants that I have spoken to and spend time with, therefore refraining from making them 'majestic', 'impressive' or 'sacred' (Latour, 1988, p.190).

Up till now we have established that nothing can be reduced, there are only trials of strength and weakness. And we have clearly established that actants do have agency in the sense that at times they mediate between us humans and the world around us and that we have to learn skills to relate to them and to handle them and that this makes them play an important part in our moral decision making. And there is no point in time on which all that came before can be condemned. The actants make their own time, they don't need us to put them in a historical framework. But how does all this work in practice? How can we as "social scientists" enter the laboratory and then return to the farm with the animals and the farmer's family? In the following paragraph I will take an example out of the book of Bruno Latour (1988) on "The pasteurization of France" in which he offers some good examples on how we can "cross the boundaries" of the sciences. Meanwhile this will also serve as an introduction into this research' methodological approach to actants involved in the production of GM soya in Argentina.

2.4 Growing microbes, rearing cows and sowing soya

The production of GM soya in Argentina involves actants ranging from fertilizer plants, soils, tractors, rain, laboratories and GM seeds. How can we, geographers, sociologists and even political scientists, just follow this heterogeneous collection of actants just wherever they might lead us? The answer to this question has been given in the former chapter. In order to eventually reach the methodology that this research will use we will start with an example given by Bruno Latour (1988) in his book on the actor network in which Pasteur made the microbe visible, turning the balance of power in the favour of humans. Latour sets out by lamenting the fact that sociology, when it is confronted with the exact sciences, it loses its grounding and becomes "feeble" (Latour, 1988, p.38). Because "sociology" is grounded on the belief that they can explain everything in social terms, exact sciences included. But with this belief as a ground rule a sociologist can't enter Pasteur's laboratory or a laboratory of Monsanto, so for a sociologist the research would end right there, because he can't explain it (Latour, 1988, p.73). ANT offers us a possibility to enter not only the laboratories but also the farm yard and the plant that produces fertilizer and then come back to the farm again.

As we have seen in the former paragraphs and in the first chapter ANT sets out from two very important principles, 'the principle of irreducibility' and the principle 'that there are only trials of strength and weakness' (Latour, 1988, p.158). Among these trials of strength and weakness the Pasteurians brought the microbe into their laboratory where they could have complete control over it, hereby reversing the power ratio. They retranslated and simplified the microbe in such a way that they were able to control it. Where outside the laboratory the microbe was able to dominate

mankind, by bringing it into the laboratory and breaking it down and growing it in Petri dishes, the Pasteurians were able to dominate the microbe (Latour, 1988, p.74). The way in which the laboratory made a difference is beautifully explained by Latour, therefore I quote him at large:

"[F]or to learn is simple enough. It means to note the culturing, number the Petri dishes, record times, look things up in the archives, transfer from one page to the other of laboratory logbooks the answers given by the tortured or, if a less harsh word is preferred, "tested" or, an even gentler word, "experimented on" objects. In inscribing the answers in homogeneous terms, alphabets, and numbers, we would benefit from the essential technical advantage of the laboratory: we would be able to see at a glance a large number of tests written in the same language. We would be able to show them to colleagues at once. (…) Although the laboratory is constituted only by displacement and transfer, it makes an enormous difference in the end. On the farm there are calves, cows, clutches of eggs, Perette and her milk jug and the willows beside the pond. It is difficult to locate Rosette's disease or to compare it with another. It is difficult to see anything at all if what we are looking for is a microbe. So we are doomed to argue endlessly about the disease. In the laboratory, the researchers have colony no. 5, no. 7, no. 8, with control colonies no. 12, no.13, no. 15. A double-entry with crosses and spots. That's all. We have only be able to read records. The argument (if it is about these spots) will end. A lot of things may be learned on the farm, but not how to define microbes, which can be learned in the laboratory. The issue is not that the first has an ontological superiority over the second; it is simply that the laboratory draws on everything – not milk, eggs, firewood, and the hand of the farmer's daughter, but sheets of paper that can be easily moved and placed on top of one another and can be argued about at leisure as if we were "on top of the question." (Latour, 1988, p.83)

In this way knowledge is transformed into a commodity, it is transformed from a mutable immobile, that existed in the individual countless heterogeneous experiences with the microbe all over France, into an immutable mobile, because it is "knowledge that [is], drawn, mobilized, gathered, transported, archived, recalculated and displayed as to be ready for use by networks." (De Sousa & Busch, 1998, p.352). If we wouldn't have entered the laboratory and have continued to admire Pasteur because of his white coat, we would never been able to explain the role that the laboratory played in the retranslation of the microbe and all the actants – Petri dishes, numbered colonies, sheets of paper, logbooks, microbes – involved. We could not have explained why it was the laboratory and not the farm in which the balance of power was being reversed which made the domination of the microbe possible. And it is this reversal of the power ratio that is admirable, not the fact that it was done by people in white coats that mystically would have the power to dominate the microbe just by wearing this white coat (Latour, 1988, p.84). The translation of the microbe was not intellectual or linguistic,

"it is found entirely in the skill. Taking blood is no more abstract, more rational, more rigorous, more ideal, than milking a cow. Moving from the farm to the laboratory, we do not move from the social to the scientific or from the material to the intellectual. The difference comes from the fact that the world of the pipette, the culture medium, and the guinea pig is a world-to-grow-the-microbe, just as that of the farm is a world-to-rear-cows. Indeed, the laboratory itself is constructed only out of the movement and displacement of other places and skills." (Latour, 1988, p.81)

This is also the case with the development of GM seeds. Genetic engineering is a controlled process of direct manipulation by adding or removing specific genes, while "traditional" plant breeding is a process of trial and error in which also unwanted genes are being transferred by the breeding (Parayil, 2003, p.981; Celec et al., 2005, p.531; Cellini et al., 2004, p.1091) leading to heterogeneous outcomes. Genetic engineering is far more specific and therefore much faster. There are two

techniques within genetic engineering, molecular markers and genetically engineering transgenic crops. Molecular marker is about the screening of DNA of plants to look for genes that are resistant to diseases which plant breeders can use to create new varieties of plants much faster (Parayil, 2003, p.981). With genetic engineering first the characteristics that a crop needs to have are determined, for example resistant to pests and drought or higher nutrition value and then they search for genes in animals or other crops to provide these characteristics, these genes are decoded and sometimes redesigned and then put into the targeted crop (Parayil, 2003, p.981). By breeding plants in a field you are not able to control the other seeds or pollen that is distributed by the wind or bees and might interfere with the plant you are looking to breed. By bringing the plants into the laboratory and breaking them down to their DNA which can be marked or even broken down to their individual genes, they can be dominated. The balance of power is being reversed in such a way that the plants, seeds, and DNA's can be dominated.

3. Methodology

Now the reasons for choosing ANT as the philosophical approach to my investigation have become clear, remains the question how this translates into a methodology. Because of its radical philosophical stand the very ontology and epistemolog are being altered significantly. The way it changes the ontology of research has been dealth with in the former chapter. In this we will set out with a reflection on the consequences for the epistemology of the research methods used for this investigation will be presented and will end with a reflection on both the choice for ANT and the methods used.

Just as ANT attacked the ontology of binary oppositions it also attacks the epistemologies that have been developed over time:

"We would like science to be free from war and politics. At least, we would like to make decisions other than through compromise, drift and uncertainty. We would like to feel that somewhere in addition to the chaotic confusion of power relations, there are rational relations. (…). Although epistemologies have varied over time, they have always been war machines defending science against its enemies (…). [But] epistemologists, like generals, are always one war too late. The problem is no longer to defend science against religion, abuses, brownshirts, or devious corporate interests. The problem we now face is to understand that obscure mixture of war and peace in which laboratories are only one source of science and politics among many sources. (…) To understand simultaneously science and society, we have to describe war and peace in different way, without ourselves waging another war or believing once again that science offers a miraculous peace of mind." (Latour, 1988, p.6).

If we look at "knowledge" the ANT scholar would argue that "knowledge" is a product or an effect of an actor network that consists of heterogeneous materials. (Law, 1992, p.2), not as the product of a specific scientific method. And this is how ANT looks at everything else from the family to computing systems and the economy and technologies. So with this theory of knowledge in mind how do we go about gathering our data?

In his work Latour (1988) has made regular references to the methodology of ethnographers. Doing research all over the world forced them to let go of the divisions made by "the sciences" because they didn't apply in other parts of the world and they prohibited to study our "own culture", being the culture in which these sciences and divisions were developed.

"For years ethnographers have said that it is impossible to study "primitive" or ancient peoples if we separate law, economy, religion, technology, and the rest. On the contrary, they have argued that these loosely linked mixtures may be understood only if we look very closely at places, families, circumstances, and networks. But when they talk of their own countries, they are committed to the separation of sphere and levels." (Latour, 1988, p.206)

This point is also taken up by the British anthropologist Daniel Miller (2010) in his book 'Stuff'. He gives the example of Trinidadian women who live in squatters without running water or electricity, but women might have over a dozen pair of shoes (Miller, 2010, p.18).

"Ethnography is a devotion to the particular, what was special about these individual people at this time. Yet to understand one tiny microcosm of this population – why impoverished women had so many shoes – one needed to interrogate a basic philosophical assumption about what it is to be human. I needed to challenge our fundamental theory of ontology, that is, the philosophy of being, to expose the assumptions we make about where being is located and the multiplicity of metaphors and assumptions that flow in all directions from the

presumption that being is deep. We thereby gain an appreciation that what we had assumed to be a universal was itself a particular. That ontology is a cultural construction and not an inherent truth. But demolishing the foundations of Western philosophy in order to understand impoverished Trinidadian women's relationship to their shoes strikes me as entirely worthwhile.(…) The term superficiality and the assumptions we make about where being is located form part of a much larger denigration of material cultural in our own society, where materialism itself is viewed as superficial. Becoming a consumer society is generally seen as symptomatic of a loss of depth in the world. (…) Here though we are embarked on a journey that is intended to rescue, not just clothing, but the whole of material culture and the people who study material cultural from this same accusation of superficiality. To show why people in places such as tribal Papua New Guinea may be resolutely more materialistic than we are" (Miller, 2010, p.22).

So in line with Latour, Miller tries to approach both human and non-human actors without imposing a-priori assumptions like for example that meaning should be something deep or that clothes are superficial, but to look at how the human actors define it themselves. The result of this approach will be demonstrated with an example of an investigation done by Miller on the Sari, worn by women in India. Not only do Latour and Miller meet in denouncing the division between "nature" and "society" or "law" and "economics" or "meaningful" and "superficial", they also share the same concern about the distinction between "object" and "subject" or human and nonhuman. Anthropology has shown us how we are interwoven with the things that surround us and that they bear agency and that they can be made to speak: "Ethnologists have shown us how ashes, curdled milk, smoke, ancestors, or wind may be made to talk." (Latour, 1988, p.195).

A good example of this is the study of Daniel Miller (2010) on the Sari worn by Indian women and how it constitutes a hybrid form that we couldn't investigate if we denied the Sari, the "object", any form of agency. The intention of Miller (2010) was not to show how Indian women wear their Sari, it was exactly the opposite, the intention was to show how the Sari wears the Indian women, how it makes her into what she is. And that this might be very distinctive from a skirt and a t-shirt that are wearing a women (Miller, 2010, p.24). Because of the way that the Sari needs to be worn women feel sensations on their body, for example around the belly where part of the Sari is tucked in (Miller, 2010, p.24). The length of the part that covers the legs of the women determines the length of their strides. The part of the Sari that is worn over the shoulder is called the 'pallu' and it is mostly the most decorated part (Miller, 2010, p.25). This is used by the women in multiple ways: to get hot pots of the stove, wipe a public stool on which they want to sit or to protect their mouth and face from dust or smoke (Miller, 2010, p.25). The relationship that people in India have with the *pallu* already starts in their infant years. Mothers use the cloth to cover the baby when they breastfeed them in public, wipe children's mouths with it, children hold on to the *pallu* when they walk next to their mothers, and in this way the *pallu* becomes "the physical embodiment of their mothers love."(Miller, 2010, p.26).

3.1 Research method

The former chapters and paragraphs have taken us from what might be considered by some a very radical interpretation of philosophy in order to make it able for Latour (1988) to give the microbes back their agency, for Law (1986) to make the navigational tools of the Portuguese speak and for Miller (2010) to show us the hybrid interaction between an Indian woman and her Sari. This research however is about the production of GM soya in the provinces of Chaco and Santiago del Estero and to start our investigation we find ourselves confronted with "a seamless web of relations" (De Sousa & Busch, 1998, p.351). Within this web of actants some human actors are able to speak for natural or

technological objects and some are able to speak for institutions. Because the nonhuman actors lack the freedom and intentionality of the humans within the actor network the entry points of the actor network in which GM soya is being produced was through humans that sometimes spoke for the nonhumans and introduced me to the nonhumans involved. All in order to gather the data needed to answer the main research question and the sub-questions of this investigation. The following research methods were used:

1. Literature study
2. In-depth interviews
3. Field observation
4. Participatory observations
5. Media analysis

I will describe what these methods entailed and comment on them and their relation to the main research question: Who are the human and non-human actors that make up the GM soya actor network in the Argentine provinces of Chaco and Santiago del Estero, can they be made visible and made to speak, and in what way do they shape and constitute each other? To help answer this main question the following sub research questions were formulated:

1. What actants are mentioned in the literature?
2. What actants are mentioned by the interviewees?
3. What human and non-human actors are reduced and therefor made invisible?
4. What forms of visibility are used by the actants involved?
5. Which actors are allowed to speak for other actants in the GM soya actor network?
6. How do the actants define the other actants involved?
7. How do the actants shape and constitute other actants?

Literature study was done on sources like books, research articles, newspapers in print as well as online, websites and magazines. This method was used specifically to answer sub research question one and to a lesser extend sub questions three and four. Besides the literature study helped shape the research. At my intership with the Centro Estudios Alexander von Humboldt they told me that it was hard to maintain contacts over the large distances between the different provinces of Argentina. This implicated that I went to the field with two contacts and the rest I had to establish while being in the field. From an ANT perspective this didn't pose any problems, because 'anything goes' (Latour, 1988, p.182) and I just needed one actor to start with and encounter all the other actors involved along the way. This meant that I went into the field with the following methodological approach, in the words of Latour (1988):

"The method I use does not require us to decide in advance on a list of actors or possible actions. (…) Nor do we have to know in advance what is important and what is negligible and what causes shifts in the battle we observe around us. (…) The analyst does not need to know more then they; he has only to begin at any point by recording what each actor says of the others. He should not try to be reasonable and to impose some pre-determined sociology on the sometimes bizarre interdefinitions offered by the writers studied. The only task of the analyst is to follow the transformations that the actors convened in the stories are undergoing. (Latour, 1988, p. 9-10).

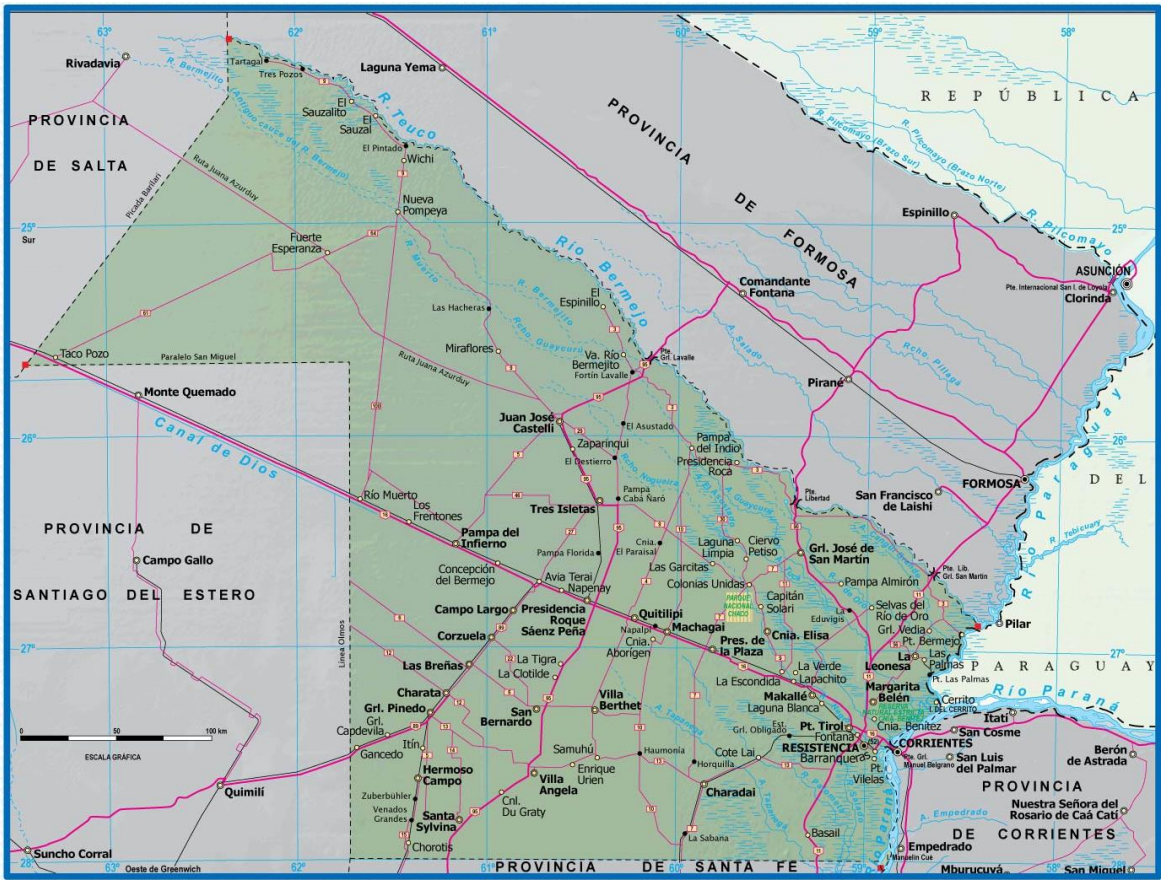
Through my contacts in Buenos Aires I had one contact in Resistencia, the capital of the province of Chaco and this was where I set out to meet the actants. And in line with the methodological

approach mentioned above an ethnographical approach was chosen, defined as “a family of methods involving direct and sustained social contact with agents and of richly writing up the encounter, respecting, recording, representing, at least partly *in its own terms*, the irreducibility of human experience.” (Willis & Trondman, 2000, p.5). In this sense the research consisted of taking in- depth interviews with people, expert interviews to answer sub research question two and six especially. It also involved participatory observations consisting of living with some of the farmers and participating in their daily lives and helping them with their daily tasks, visiting a fertilizer plant and a factory of a corporation in which, among other things, GM soya oil and meal was produced. The in-depth interviews were done sitting outside or inside of the houses, farms, working places or offices of the interviewees. Questions consisted of how many hectares they had and some general questions after which emphasis was put on earlier times, before GM soya was planted and the changes they had encountered or not. Emphasis was also put on the nonhuman actors in their stories, but this was always inevitable on the farms where the farmers were surrounded by actants and eager to show me their machines, crops, animals, mills, shacks or water tanks. The interviews were recorded with a small audio recorder and I used a digital camera to take photos. Interviewees would give me magazines or books of their respective organization which I later used for conducting media analysis in order to answer sub research questions three, four, five and six. Another technique used to get into contact with the nonhuman actors involved, and to help answer the former sub research questions was to ask at the end of an interview with a farmer to show me around his farm which made it able for me to observe and make photos of all the actants presented to me by the farmers. The media analysis was conducted on the magazines, books and websites of the Movimiento Campesino de Santiago del Estero – Via Campesina (MOCASE-VC), the Movimiento Nacional Campesino Indigena (MNCI), the Sociedad Rural Argentina (SRA), the Confederaciónes Rurales Argentinas (CRA) Confederación Intercooperativa Agropecuaria Cooperative Limitada (ConInAgro) and Federación Agraria de la Argentina (FAA). This method was used to help answer sub questions one, three, five and especially four and six.

Field observations existed of observations done during all of my field research and they were collected in a field notebook or documented in the form of photos. This research method was adopted to observe the nonhuman actors involved and the participatory observations were done to get involved with the nonhuman actors. The observations existed of general observations concerning the places I visited. The field observations could easily go over into more participatory observations in which I would assist in feeding animals or baking bread with the family or farmer I stayed with. Visiting the fertilizer plant of Bunge is an example of a mostly observatory gathering of data on a nonhuman actor by which I listened to the explanations given by the guides that showed us around the plant, which I put down in my note book and I made photos of the (mostly) nonhuman actors while we were driven around the plant. Other observatory fieldwork consisted of a visit to a factory of a corporation in Sàenz-Peña in which they produced soya oil and flower and which also functioned as a warehouse to store cotton. These observations were conducted in order to gather data concerning sub research questions three, four and five. Sub research question seven was formulated to help look at the interrelations between the actants within the GM soya actor network. All the applied methods were needed in order to be able to answer this last sub research question.

The research could have begun anywhere, with any actor, which we could have followed and by doing so we would have encountered all kinds of other actants on our way. But to choose one actor I had to read about the production of GM soya. The most obvious to start with was of course the

country Argentina. This confronts us with one of the negative sides of the ANT approach in the sense that the field to study is infinite and so are its entry points. To keep the financial costs in check and to be able to finish this research before the end of 2014 the focus of the research was narrowed down to two provinces. This was done on the basis of the literature that stated that they were at the edge of the agricultural frontier (Pengue, 2005, p.314; Bisang, 2003, p.1; Nassar & Antoniazzi et. al., 2011, p.4), meaning that soya until recently started to change the actor network present in these provinces. In Chaco and Santiago del Estero an actor network existed for many years around the cotton crop (Grau & Aide & Gasparri, 2005, p.265; Tomei et al. 2010, p.378; Valenzuela & Scavo, 2009). For to enter the actor networks in both provinces different points of entry were chosen. In the province of Chaco contact was sought with the Instituto Nacional de Tecnología Agropecuaria (INTA) that was able to speak for many nonhumans amongst which was GM soya.



Map 2: The province of Chaco (Instituto Geográfica Nacional República Argentina)

In Santiago del Estero the entry point was through the Movimiento Campesino de Santiago del Estero – Vía Campesina (MOCASE-VC) a movement that was able to speak for the indigenous farmers in the province to resist the expansion of the GM soya production in their province (García-López & Arizpe, 2010, p.196; Wald & Hill, 2011; Giarracca & Tueba & Pérez, 2001, p.50). Other provinces might have been more of an obvious choice based on the quantity of soya produced in for example the province of Santa Fe, Buenos Aires or Córdoba. But the choice was made reasoning that by choosing provinces in which the actor network of GM soya was relatively new this might offer a more interesting or, if you will, more extreme network to study. Both the choice for the province of Santiago del Estero and the MOCASE-VC movement are based on a-priori assumptions that appear to be in conflict with my ANT approach, that characterises itself to be non-hierarchical. The field had to

be narrowed down however due to limited time and (financial) resources. Therefore MOCASE-VC was chosen on the basis of the same literature study mentioned before which mentioned that the GM soya production acted upon the life of the indigenous farmers. So without following all the other actants that might eventually have brought me to the indigenous farmers in de end MOCASE-VC was chosen as a direct entry point into the GM soya actor network, just like the INTA was used as an entry point to the actor network in Chaco. These were the only a-priory choices made concerning the methodology during the fieldwork. To illustrate this point, the Sociedad Rural Argentina (SRA) was not a-priory selected. The SRA was mentioned and defined by the actors in Santiago del Estero and Chaco, which made me decide to follow this actant and that's the reason that the SRA is also part of this study. To be clear, this research wasn't set up like a traditional case study but was forced to be narrowed down by the resources available. In the analysis of the data gathered the ANT approach will become much more clear, but this point shows however one of the consequences of choosing an ANT approach on which I will reflect in the last paragraph and in the last chapter of this thesis. In the following paragraphs both entry point organizations will be shortly introduced even as the SRA.

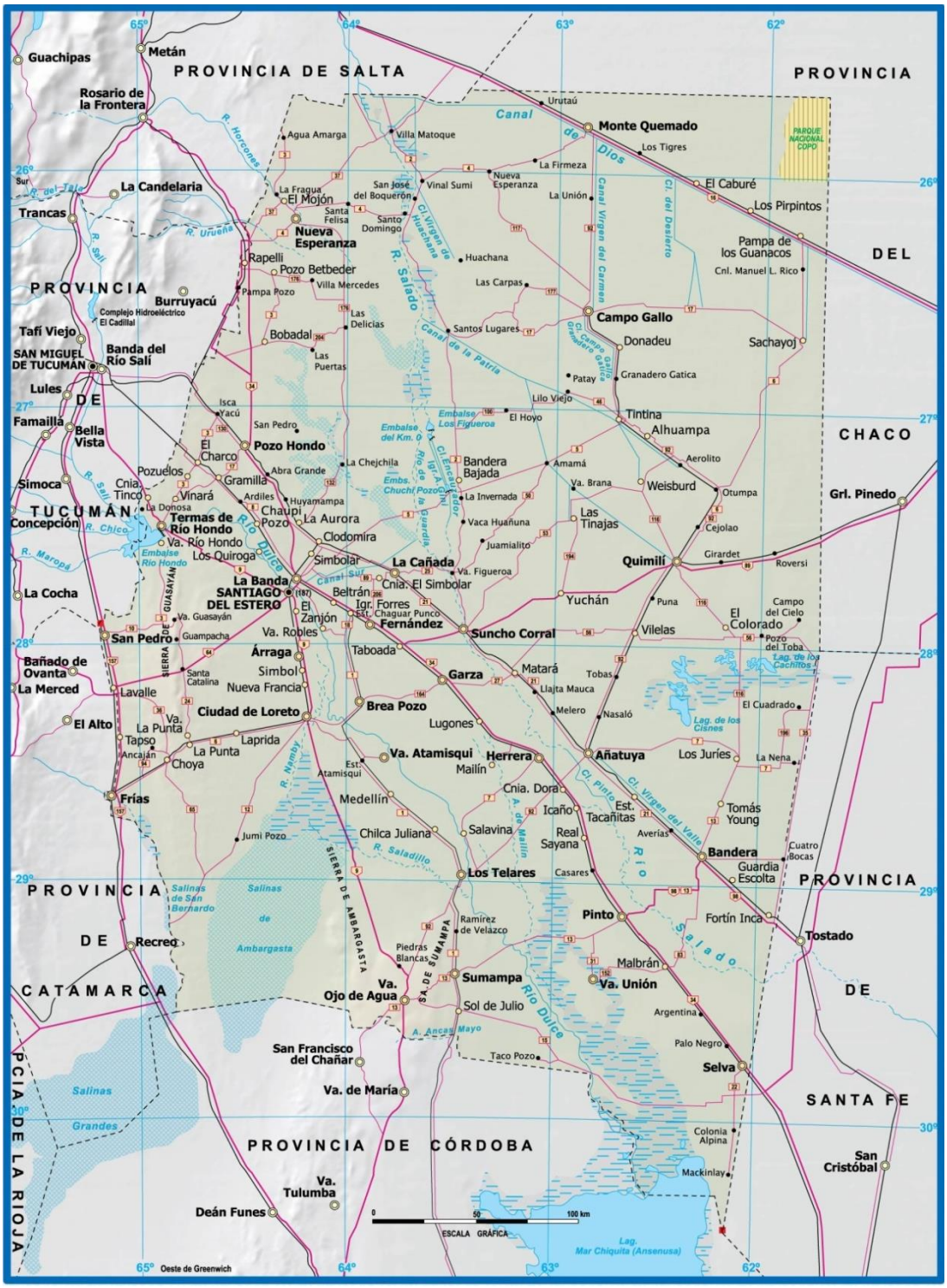
3.1.1 MOCASE-VC

Before we will start with the analysis of the empirical data that was gathered it is necessary to shortly introduce the MOCASE-VC movement here. In the analysis the data gathered in both provinces will be used and for clarity reasons it is good to look at how and why the MOCASE-VC organised itself as a movement.

In Santiago del Estero the indigenous farmers and their families have associated with other farmer families to form a movement named Movimiento Campesino de Santiago del Estero – Via Campesina (MOCASE-VC). They started associating with each other when they still were able to forge an alliance with cotton and they associated with each other to get a better price for their cotton (Juan, personal communication, 5th October 2013). Then their alliance with the lands they lived on was being interrupted by people that came with papers, saying they had to leave their land. Many indigenous farmers did leave their lands. Because of this they started associating with other indigenous communities in the province of Santiago del Estero. The Movimiento Campesino de Santiago del Estero (MOCASE) was being constituted in the town of Quimilí (Bidaseca, 2010, p.262; Gomez, personal communication, 2nd October 2013) on the 4th of August 1990. It started in one community of indigenous farmers that tried to keep their community from eviction of their land and eventually they went to the streets with their cattle bells and bells they use for their goats to know where they are, as miss Gomez, a daughter of one of the founding members of MOCASE explains:

"Carlos Menem [president of Argentina 1989-1999] (...) didn't do anything for the farmers, they started to sell many properties and then the eviction happened very often. People entered with papers and the people left, they sold all of Quimilí and other places, so this is where we started to organise the movement. After that we began to join with other people and started to work with this base and we went to the communities, some historical members went to the people to make it easier to fight for our lands, and for our products to sell and all these kind of things. This was how MOCASe started. After that we organized a very big march here, which was the first big march of MOCASE which was named 'Marcha del cencerro' (the march of the cattle bell) for which we mobilised 2000 farmers and this was the most historic that happened in our country" (Gomez, personal communication, 4th October 2013)

This march of the cattle bell is a good example of how they used a nonhuman actor, the cattle bell, to make themselves visible and make themselves heard. I will came back to this concept of visibility in chapter six.



Map 3: The province of Santiago del Estero (Instituto Geográfica Nacional República Argentina)

In 2001 the movement split up and one part went on under the name MOCASE, while the other part was renamed MOCASE-VC. Cause of the split was a disagreement on the power structure. The MOCASE movement started out with a vertical organization with a president and a treasurer, this led

to the split in which MOCASE-VC continued with a more horizontal organization and MOCASE continued with a more institutional internal organization (Gomez, personal communication, 2nd October 2013). Although they differ in their internal organization, the aim of both movements stayed the same "securing land tenure and improving standards of living for their communities." (Wald & Hill, 2011, p.5). And the two movements still work together in achieving this goal, there is no lasting rivalry between them (Gomez, personal communication, 2nd October 2013).

As mentioned above the MOCASE-VC didn't want to have a vertical organization with a president and a treasurer, but they wanted a horizontal democratic structure in which everybody could have their say. They work with *'secretarías'* each of which covers a different theme, for example health, education, production, formation or territory. These *secretarías* have meetings every three weeks and they discuss ideas and problems which they put on the agenda for the assembly in which they will talk until everybody agrees (Gomez, personal communication, 2nd October 2013). The communities all have their own dynamics and when they have agreed on something it will be passed on to the *secretarías* after which it will be passed on to other levels, but they make sure that everybody agrees with the ultimate decision which is always taken in a central plenary assembly.

The positive side of this, according to Miss Gomez, a daughter of one of the founders of the MOCASE movement, is that decisions that are taken and that turn out to be bad are always a result of a decision taken by the whole movement together. The process of passing on the decisions from the communities, to the *secretarías*, to the assemblies and eventually the plenary assembly takes a lot of time so decision are never taken in a hurry (Gomez, personal communication, 2nd October 2013). In Argentina the people of Santiago del Estero are famous for their very long siestas (three to four hours) this is due to the fact that during the summer it is impossible to work in the sun on the land, so the farmers do their work in the very early morning and in the late evening (Oscar, personal communication, 4th October 2013). But besides the horizontal structure and the decision making in assemblies the organization has a *secretaría operativa* which consists of thirty chosen members from all parts of Argentina and of all the organizations in which MOCASE-VC is participating and they take decisions that need to be taken quickly. They have the mandate of the movement to take quick decisions (Gomez, personal communication, 2nd October 2013).

The members of MOCASE-VC have to pay ten pesos for the lawyers. MOCASE-VC forged an alliance with legal professionals to be able to continue and re-establish their alliances with the land they live on, sometimes for many generations, again miss Gomez explains:

"Yes, now one lives on his own land. The mayority lives in communities in which everything, the forest, the water, everything belongs to the community. Everyone has their own animals, but the lands are of the communities, there are no papers, no titles, all are fiscal lands but they are ancestral lands also so there are people that live many, many generacións on these lands. The problem is that people come that say they have bought the land, but they didn't according to the cadastre but the farmers didn't know that and so the problems started. Before MOCASE the farmers believed the people with ties and papers that said they were the owner of their lands, but with MOCASE this doesn't happen anymore, they don't enter anymore." (Gomez, persona communication, 4th October 2013)

The rest of the activities are financed by forging alliances with subsidies and funds from other countries and through projects (Gomez, personal communication, 2nd October 2013). It is not needed to be of indigenous descend also a lot of *Porteños*, people from Buenos Aires, joined the movement

and live in the rural communities. The mayority of the indigenous campesinos are of Lule Vilela descend.

As a social movement MOCASE-VC has forged alliances with the internationally organised Vía Campesina. As a social movement MOCASE-VC is also organised on the national level under the name Movimiento Nacional Campesino Indigena (MNCI). And finally MOCASE-VC is also forged an alliance on the continental level in Coordinadora Latinoamericana de Organizaciónes del Campo (CLOC), which also brings together peasants, fisher folks and indigenous people on subjects ranging from mining, deforestation and contamination by agrochemicals.

3.1.2 INTA

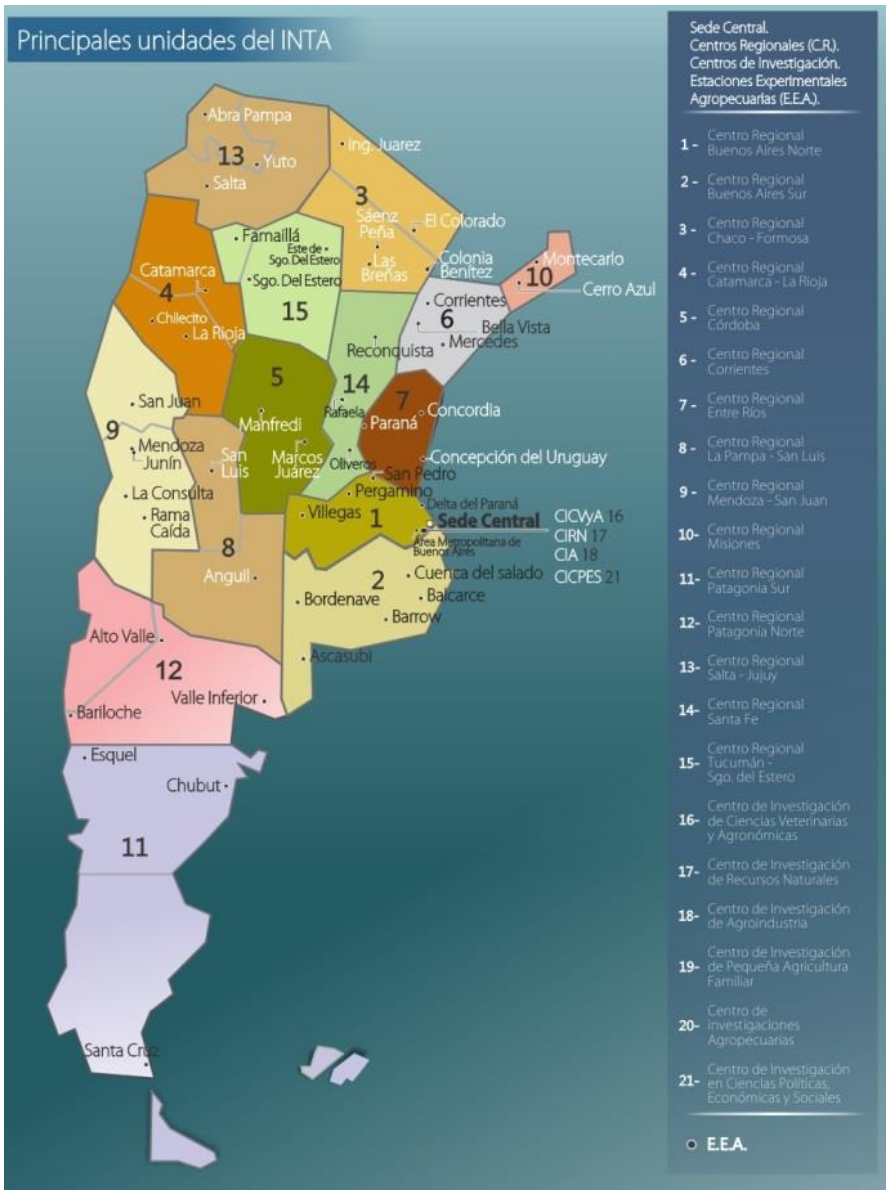
In the city of Sàenz Peña and the town of Las Breñas in the province of Chaco cooperation with the Intstituto Nacional de Tecnología Agropecuaria (INTA) was sought in order to be introduced to the farmers. The INTA was founded by governmental decreed (Law No. 21.680/56) in 1956 in order to "propel, encourage, and coordinate the development of agricultural investigation and extension, and to accelerate (…) the technological bettering of the agricultural enterprises and the rural life." (INTA, n.d.). The institution focusses on innovation as the motor of developments and to put their technology and information to use by making it available for farmers. An example of this was the development of a mechanical cotton harvester that could be pulled behind a tractor for small scale farmers to use (Bustos, personal communication, 15th November, 2013 Buenos Aires).

The INTA can make its technology and information available through the 15 regional centres, 5 investication stations, 50 experimental stations, 16 institutes and 300 extension units spread all over the country, as can be seen in map 4 (INTA, n.d.).

From its foundation the role of the INTA was to make argricultural technology available for the farmers in Argentina. This also led eventually to the founding of two private institutions in 1993, Intea S.A. and Fundación ArgenINTA that together form Grupo INTA (INTA, n.d.). The INTA was involved in various programs initiated by the government that aimed at small scale and middle scale producers and specifically at food production for the poorest part of the population. The investigations of the INTA form the basis of the Plan Estratégico Institutional (PEI) of the Argentine government and the Plan Estratégico Agroalimentario y Agroindustrial (PEA). According to the PEA of the current government the aim is to increase the production of soya with 35% in 2020, from 52,7 million tons in 2010 to 71 million tons in 2020 (Ministerio de Agricultura, Ganadería y Pesca Argentina, 2010, p.97). Besides the INTA provides regional plans concerning agricultural technology. The INTA is involved in almost all the agricultural production in Argentina from cattle, goats and sheeps, to soya, cotton, tabaco, vegetables and marmalade working together with the local producers and this can be either considered a good thing:

"completely positive, because of the fact that the government puts a lot of money in the INTA. Because of that they can do a lot of investigations, have new computers, new buildings. To me the INTA is very positive the only problem they have is that they have to do what the government is ordering them to do." (Bustos, personal communication, 15th November 2013).

But to different members of MOCASE-VC, the INTA is only working with the big producers and not with them, the indigenous farmers (Carrizo, personal communication, 4th October 2013; Beco, personal communication, 4th October 2013).



Map 4: The provinces, cities and towns in which INTA is present.

3.1.3 The Sociedad Rural Argentina

After my fieldwork in Chaco and Santiago del Estero I organised an interview with the Sociedad Rural Argentina (SRA) in Buenos Aires who I will introduce shortly. The SRA was founded in 1866 and focussed on stockbreading, because Argentina at that time didn't yet established the alliance with wheat, which would be established much later. At that time Argentina forged alliances with other countries for the import of wheat because the lands served as grazing lands for cattle's and sheep's, which would later become redefined for cultivating crop, but at that moment this alliance was being interrupted by the access to water and the lack of infrastructure (Urricariet, personal communication, 22nd November, 2013 Buenos Aires). The founders of the SRA forged alliances with different cattle breads from England which they kept documented in a book to monitor the genealogy of all the breads in Argentina. Miss Urricariet of the SRA explains:

"The aim of the founders of the SRA was to try and form and reach better livestock, in order to do this they imported breeds, mostly from England, Angus, Hereford, Shorton, were the breeds they imported most. But to ensure the improvement of the livestock they needed to establish a geneolagical register, which till this day

exists, to select the best animals to be used for reproduction. So this is basically how the SRA was started. (…) The SRA still keeps record of the cattle breeds, but in reality it doesn't owns a genetic bank, but we keep the register which today is kept according to DNA (…)the objective of the SRA, or the motto of the SRA is: "Cultivate the soil is service to the fatherland", it's a very old motto from 1866 and actually we still maintain this" (Urricariet, personal communication, 22nd November 2013).

Although their moto holds to this day, the genealogy book is no longer the most important task of the SRA it focusses more on monitoring the market and tries to limit the negative effects that government decisions might have for their 7000 members. One of the main subjects is the export taxes on GM soya, wheat and corn. But also the regulations concerning the production and export of meat is still something with which the SRA is concerned till this day. And the SRA tries to talk to government officials to make their members, and the effect of certain measures on them, visible to the politicians. But this alliance the SRA is trying to establish still hasn't been established. Both the SRA and the government define each other as each other's opponents. The government defines the SRA and the three other institutions for agricultural producers in Argentina, the Confederaciónes Rurales Argentinas (CRA) Confederación Intercooperativa Agropecuaria Cooperative Limitada (ConInAgro) and Federación Agraria de la Argentina (FAA) as oligarchs that are oppressing the poor people in the countryside. How this has come to be is explained by agrarian journalist, mister Bustos:

"[I]n the history of Argentina there existed always a conflict between the city and the countryside. The towns in the countryside in the 1800s used to organise the customs, which allowed them to obtain some income. Buenos Aires was very small in that time, until the Spanish realised that it was much cheaper to bring a ship to Buenos Aires, unload the merchandise and then bring it by cart to the Peru highlands.(…) When they realised this everything went through Buenos Aires who also got to organise the customs and the country side was left with nothing, and this was when the hunger in the countryside started. So the leaders of the countryside, the *caudillos*, started negociations, but eventually Buenos Aires didn't pay and they came back on horses threatening to kill everone so they were given the money and they went back, but this generated the mutual quarrel between the city and the countryside. Nowadays it isn't like this, but it is this history of the conservatives, the oweners of the estancias in 1800, 1900 that lived in abundance (…) they had a lot of money while the poor didn't have unions, salary, nothing. So they stayed oligarcs, and the oligorsc are the cattle breeders of the Sociedad Rural." (Bustos, personal communication, 15th November 2013)

This idea of the SRA as the big producers with a lot of money is also the way in which MOCASE-VC defines the SRA, the ConInAgro, the CRA and the FAA. The alliance between the SRA and the other agricultural organizations was forged in 2008 when together they blocked the main roads into Buenos Aires with their tractors and trailers. Miss Gomez of MOCASE-VC refers to this event in the following way:

"In 2008 they say that it was the countryside, but it wasn't…it were the big companies that didn't want for the export taxes to be raised (…) and so they went to the streets and they brought the whole country to a stand still" (Gomez, personal communication, 4th October 2013)

The SRA defines its own role as to try and mediate with the government by trying to establish an alliance with governmental officials to try and change the negative aspects of government regulations for its members and the members of ConInAgro, FAA and CRA. Another subject that they try to bring to the fore is compensation for the farmers which lost their harvested because of floods in the province of Buenos Aires in 2013. Again miss Urricariet explains:

"Well the position of the *Sociedad Rural* in general is that the market is to be opened with the remedies that are possible, that the export fees are reduced, because I think this is a very negative tax, the export taxes are

taking money from an efficient sector to be given to another, inefficient sector, this is what we make of it (…) there are better ways of doing the same. (…) We try, in normal times, to ask for interviews with the government to raise our problems (…) for example in the case of the floodings, the emergency agricultural gatherings, but it is very difficult to make progress, so to say the demands of the agro's aren't really heard." (Urricariet, personal communication, 22nd November 2013).

Until today the SRA and the Argentine government aren't talking with each other as the chairman of the SRA, Luis Miguel Etchevehere, recently said in a speech that there is no dialogue between them and the government while the prices of GM soya and corn are falling but the taxes are kept at 35% (www.lanacion.com.ar, 12th July, 2014). The way the actors in the actor network of GM soya production in Argentina define each other will be taken up further in chapter six.

3.2 Analysing the data gathered

While during the fieldwork an ethnographical approach was used to gather the data, in the analysis of the data the ANT approach becomes much more apparent especially in respect to the consequences for the epistemology mentioned at the beginning of this chapter. Where in any other research approaches the data would have been analysed by using qualitative analysing methods like grounded theory or objective hermeneutics, the very principle of ANT doesn't allow for the transcripts to be reduced to codes or any other form of reduction (Latour, 1988, p.158). So where grounded theory and objective hermeneutics derive their validity from their methods, ANT derives its validity from the data itself, from the actor network in which knowledge is being produced. Therefore the analysis of the interview transcripts, field note's, photos, magazines and websites were done following three methodological principles, as formulated and used by Callon (1986) in his research on the scallop fishermen of St. Brieuc Bay:

The first principal makes that, in the analysis of the transcripts, I abstained from censoring the actants when they talk about themselves or any other actant and without judging the way that the actants analyse their situation. None of the views are privileged or censored; the identity of actants is still being negotiated (Callon, 1986, p.3-4)

The second principle is that of symmetry, symmetry in the repertoire used in describing conflicting or controversial viewpoints. So the researcher has to stick to one repertoire to tell the analysis given by the actants.

"We know that the ingredients for controversies are a mixture of considerations concerning both Society and Nature. For this reason we require the observer to use a single repertoire when they are described. The vocabulary chosen for these descriptions and explanations can be left to the discretion of the observer. He can not simply repeat the analysis suggested by the actors he is studying. However an infinite number of repertoires is possible. It is up to the sociologist to choose the one that seems the best adapted to his task and then convince his colleagues that he made the right choice. (…) [W]e know that our narrative is no more, but no less valid than any other." (Callon, 1986, p.4)

As long as the repertoire or register does not change if we move from the "technical" to the "social".

And the last principle concerns free association. The fact that no a-priori structure should be placed on the actants and the relations between them, because these relations are all up for discussion to the actants involved. The researcher follows the actants and how they analyse and define their world (Callon, 1986, p.4).

In other words:

"[W]e would have to accept the lesson that the actors themselves give us. Just as they made their societies they also made their own history. The actors periodize with all their might. They give themselves periods, abolish them, and alter them, redistributing responsibilities, naming the "reactionaries," the "moderns," the "avant-garde," the "forerunners," just like a historian – no better no worse."(Latour, 1988, p.51).

So the analysis existed of selecting the parts in which the actors named all the other actants involved in the production of soya in Chaco and Santiago del Estero, how they are related with one another, how they categorize them, how they valuate them, how they relate to them and all the other associations that they make with one another.

The same approach was used in analysing the magazines, websites or books of the SRA, ConInAgro, CRA, FAA and the MNCI. In relation to the magazines two magazines of each organization were chosen to be analysed. The books and some of the magazines were given to me by the interviewees, others I accessed through the internet sites of the organizations through which I could read their magazines online. The aim was to select the most recent editions of the magazines, but this wasn't always possible. The analysis was done on the complete magazine including the covers, advertisements and articles. The result of this analysis can be found in the chapter on visibility.

3.3 Reflection

The choice for an ANT approach brought with it some difficulties that ask for some consideration. The first difficulty was defining the actor network in respect to its size. Every part is accessible, everything is granted the right to be represented (Lee & Brown, 1994, p.778). The actor network is infinite and therefore unable to study in its totality given the available resources. Therefore the actor network had to be narrowed down to two provinces, which asked for a-priory decisions to be taken. Here we might conclude that the very radical stance taken by ANT in viewing the world as an actor network is causing difficulty in the sense that some sort of border had to be imposed which in this case took form in the borders of both provinces, while the actor network associations did transcend these borders. So without implying that the actor network on the GM soya production in Chaco and Santiago del Estero ends at the border of the province, the area in which the fieldwork took place was narrowed down to these two provinces and only some of the actors were followed to the city of Buenos Aires.

In Chaco cooperation was sought with the INTA, a governmental institution that I knew from my literature study and it was an actor frequently mentioned by other actants I met. The affiliation with this governmental body poses questions in relation to the objectivity of my research as does my contact with the MOCASE-VC movement in Santiago del Estero, this is however part of applying an ANT approach by which you encounter actants that bring with them their own political orientation. "Science and technology are dramatic 'stories' in which the identity of the actors is one of the issues at hand. The observer who disregards these uncertainties risks writing a slanted story which ignores the fact that the identities of actors are problematic." (Callon, 1986, p.3) Besides this shows the very point made by ANT concerning epistemology in the sense that we "would like to feel that somewhere, in addition to the chaotic confusion of power relations, there are rational relations." (Latour, 1988, p.6). The fact that contact was sought with these organizations was also being determined by the fact that without an institution or someone familiar to the farmers that could introduce me, I wouldn't have been able to conduct my interviews. From researchers and my courses at the Centro de Estudios y Documentación Latinoamericanos (CEDLA) in Amsterdam and my internship at the Centro von Humboldt in Buenos Aires I had learned that mistrust to foreigners

might complicate fieldwork in Latin America. So this collaboration was chosen to be introduced to my actants. The selection of the human actors therefore consisted of what can be defined as a 'snowballing' approach (Verschuren & Doorewaard, 2007, p.209). By contacting agricultural engineers at an INTA office in the cities or towns I went to I would be introduced to other human actors and through them to the nonhumans as well. Moreover it was also out of necessity, while I didn't have the means to drive a car and get out into the fields, so I depended on the agricultural engineers of the INTA and their cars, to drive me around and introduce me to the people involved in the production of GM soya in the province of Chaco. In Santiago del Estero I depended, for the same reasons on the people of MOCASE-VC to drive me around and to introduce me to the farmers with whom I spoke and stayed.

In the middle of my fieldwork I couldn't access my bank account and didn't have other possibilities to obtain money another way, therefore my fieldwork period in Chaco and Santiago del Estero was shorter than I had planned and therefore I couldn't visit other parts of Chaco and Santiago del Estero, so caution needs to be taken by translating the conclusions to the whole of both provinces.

Moreover this was the first time that I as a researcher adopted ANT and because of its profound view in seeing the world as a field of forces I was struggling to find the vocabulary to describe this thesis in that fashion. Besides ANT posed some difficulty in formulating a clear method to analysing data. I found it difficult to find literature on ANT methodology and methods of analysis. This is due to the fact that ANT itself is the methodology, the way ANT sees the world is the methodology, because it determines every methodological part of the research, the literature study, the observations and analysis. And the methodology of ANT is still being developed in projects like 'An Iquiry Into Modes of Existence' (AIME, n.d.) which tries to offer an alternative project to the modern project that has been roled out over the world not long ago (AIME, n.d.). So it took some time for the methodology to take form eventually. These are all aspects of the field of forces in which this research was conducted.

4. Putting GM soya in the field of forces

Up till now we have explained the ANT approach and how this translates into a methodology. This chapter will be about the actor network in which GM soya is being produced in the Argentine provinces of Chaco and Santiago del Estero. We will enter this actor network through the soya seeds and we will follow them from their sowing through their growing until the harvesting of the soya bean.

4.1 Seeds

Almost all the soya produced in Argentina is genetically modified (Bravo, 2010, p.9; Bisang, 2003, p.1), so this research will be about the production of GM soya as opposed to soya that hasn't been modified to become resistant to glyphosate based herbicides. As mentioned in chapter two genetic engineering is different from "traditional" plant breeding in the sense that it is process of direct manipulation by adding or removing specific genes without the side effects of unwanted genes being transferred which make it a process of trial and error (Parayil, 2003, p.981; Celec et al., 2005, p.531; Cellini et al., 2004, p.1091) leading to heterogeneous outcomes. By breeding plants in open fields the control or domination over the plants is limited and so is the control over the outcomes. So the plants have to be brought into the laboratory to be able to be fully dominated by breaking them down to their DNA and their individual genes. Therefore genetic engineering is faster because it is more specific. The balance of power is being reversed in such a way that the plants, seeds, and DNA's can be dominated. Within genetic engineering there are two techniques, molecular markers and genetically engineering transgenic crops. Molecular marker is about the screening of DNA of plants to look for genes that are resistant to diseases which plant breeders can use to create new varieties of plants much faster (Parayil, 2003, p.981). With genetic engineering first the characteristics needed to modify a crop is being determined, for example resistant to pests and drought or higher nutrition value and then they search for genes in animals or other crops to provide these characteristics, these genes are decoded and sometimes redesigned and then put into the targeted crop (Parayil, 2003, p.981). This sound like a linear process in which the genes and cells can be manipulated without difficulty. This is where ANT shows its strength by being able to enter the laboratory, but also by being able to zoom in onto the actual process of genetic engineering and look at the actants involved. When the gene with the preferred characteristic, in this case resistance to herbicides based on glyphosate, has been selected it is being transferred using the recombinant DNA technique to another organism. But the gene with the desired characteristic is being transferred together with a selective marker gene. These are genes which present resistance to a selective agent, most often an antibiotic (Celec et al., 2005, p.533). This is done to be able to select the GM organisms from the unmodified. So the ability of the gene to act, in conferring resistance to an antibiotic, is used to select GM organisms, because the resistance to the antibiotic makes only the GM organism visible, the non GM organisms will die.

For the modified genetic material to enter a cell, in this case the cells of plants, the cell wall poses a formidable barrier to overcome (Sanford et al., 1987, p.27). The cell resists the entry of genetic material, the cell acts by not allowing foreign genes to enter. Therefore different techniques have been developed of which the bacterium transformation and microballistic impregnation are the most widely used with GM crops. With the former technique the preferred gene together with the marker gene is introduced in a cell using an agrobacterium *tumefaciens* enzyme that provides for the genes to enter the cell (Celec et al., 2005, p.533). The microballistic impregnation is done by using a gene

gun that fires minute particle of gold or tungsten coated with the desired gene and selective marker gene, through the cell wall into the living cell, without killing it (Sanford et al., 1987, p. 27; Celec et al., 2005, p.533). After the transfer the organisms can be grown in a culture containing antibiotics (or another substance to which the selective marker gene is resistant). The GMO's become visible because the unmodified organisms will die. So the soya seeds, by being dominated in the laboratory have been redefined as GM soya seeds and more specifically in the case of Monsanto they have literally been redefined by being named RoundUp Ready (RR) soya seeds, named after the herbicide based on glyphosate which is also produced by Monsanto under the name RoundUp (Bravo, 2010, p.18; Filomeno, 2013, p.37).

This chain of actions can be described as interessement, which is the group of actions taken by an actant, in this case Monsanto, to impose and stabilize the identity of other actants (Callon, 1986, p.8), in this case the GM soya seeds. Monsanto problematized the problem of agriculture in the sense that the weeds are a danger to the soya plants and obliged the farmers to work very hard to get rid of so by making the GM soya plants resistant to RoundUp herbicide, all the weeds die except for the GM soya plants, making the work of the farmers much easier (Filomeno, 2013, p.37). So by problematizing agriculture in this way Monsanto has extracted the soya seeds from its context. By genetically modifying the seeds they have taken away the danger of weeds that can act on them. At the same time they force the other actants involved, the farmers for example to adopt their form of production and by claiming the patents on the GM soya seeds, Monsanto tries to disassociate other actants.

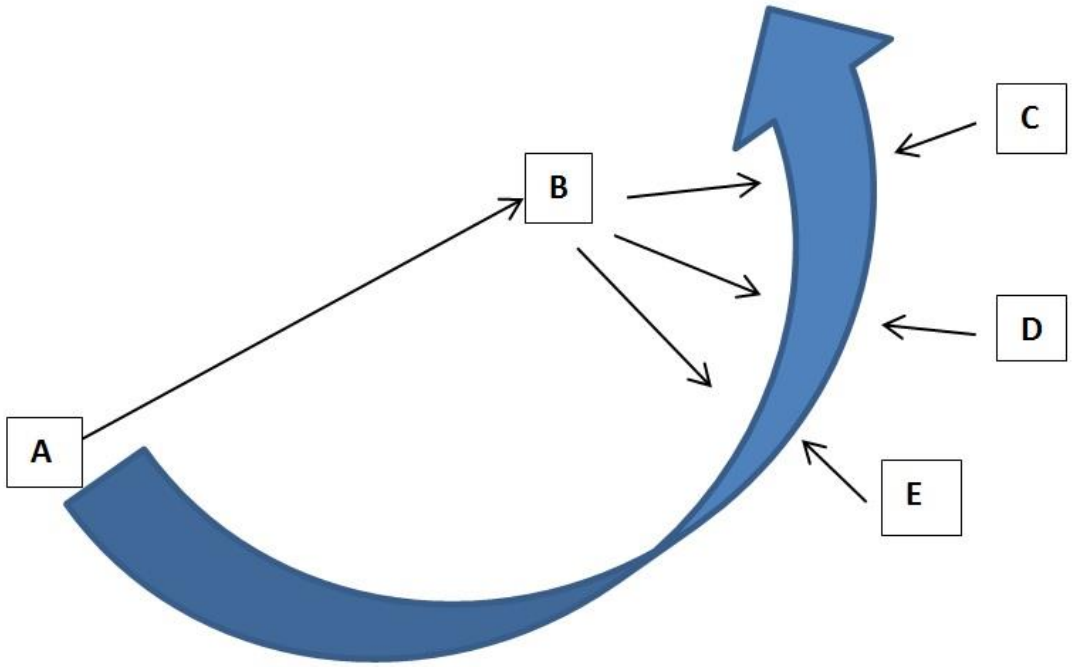


Figure 1: The process of disassociation the Monsanto established between the GM RR soya seeds and the other actants. (Taken and adapted from Callon, 1986, p.12)

Let's say that 'A' is the GM soya seed produced by Monsanto and 'B' is the GM soya seed, by genetically modifying and claiming the patent on the GM soya seeds Monsanto consolidates and redefines the identity of 'B' by naming them RR soya seeds, on which they have the patent

(Filomeno, 2013, p.37) and in this process of interessement, it cuts off all the other associations that might redefine the identity of 'B' in another way (Callon, 1986, p.9). These other actants might be 'C', the farmers that have a different way of selecting and producing the seeds they want to sow the next year, but it could also be 'D', another company that develops seeds for the market, for example Dow (Pengue, 2005, p.317) And 'E' could be the weeds that are unable to act on the GM RR soya seeds. In this way Monsanto changes the balance of power in its favour.

Monsanto, as one of the actants in this trial of strength and weakness is dominating the seeds by taking them into their laboratories, where they have the upper hand and are able to dominate the seeds, experiment with them and changing their genetic structure (Latour, 1988, p.83). This process of domination makes the soya seeds into an immutable mobile (De Sousa & Busch, 1998, p.352). The seeds have been broken down to their germplasm, put in petridishes, coded to be stored and archived in a seed bank. The International Union for the Protection of New Varieties of Plants (UPOV) established in 1991, and the agreement on Trade-Related Aspects of Intellectual Property Rights of the World Trade Organization (WTO) in 1994 (Filomeno, 2013, p.36) provide for this immutable mobile to be sold in other parts of the world, by protecting the patented RR soya seeds. Through this process of interessement, Monsanto has enrolled the GM soya seeds, meaning that they accept the role or the identity as defined and consolidated by other actors (Callon, 1986, p.10). Just as Monsanto has enroled the glyphosate based herbicide RoundUp

Both these enrolments however are far from stable or given. In both cases the actants involves are far from passive. With the enrolment of the GM soya seeds Monsanto also redefines and tries to consolidate its alliance with the farmers. By obtaining the patent on their seeds, Monsanto forces an alliance with the farmers to buy their seeds. The patenting is again a form of interessement, it redefines the identity of the farmers and their alliance with seeds. The farmers used to own the seeds they produced, they used to keep part of their harvest to use as seeds for the next campaign, or they might sell or trade them with other farmers to obtain the best seeds for sowing (Filomeno, 2013, p.37; Bustos, personal communication, 15th November 2013). Monsanto sells GM soya seeds that are resistant to RoundUp, and the farmers have to pay for the seeds, the herbicides and the costs for the intellectual property that Monsanto has on GM RR soya seeds and the RoundUp herbicide. This interessment, if successful, might lead to the enrolment of the farmers in that they accept the new role they have been given as consumers, instead of owners, of the GM soya seeds and herbicides of Monsanto.

With the RR soya seeds of Monsanto becoming immutable mobile, they can be sold by Monsanto to other seed companies. Asgrow was one of these companies to which Monsanto sold its germplasm needed to produce the RR soya seeds. Asgrow was taken over by seed company Nidera that eventually was granted the distribution and commercialization of the first RR soya seeds in Argentina in 1996 (Filomeno, 2013, p.44). So it wasn't Monsanto that introduced their GM soya seeds in Argentina, but Nidera. At that time Europe did allow for 18 GM products, including crops, flowers and vaccins, to be introduced into its market, but with the outbreak of BSE or "mad cow disease" confidence in food safety plummeted in the EU and although the BSE had no direct connection with GM crops, people were suspicious of the possible dangers of GM crops (Praalberg, 2001, p.5). Argentina became the first country in Latin America to allow for GM crops to be produced on its territory (Praalberg, 2001, p.4). Without the patent being obtained the farmers could purchase the RR soya seeds relatively cheap and they were allowed by law to trade and save some of their harvest

for the next campaign. The Argentine state protected the Argentine farmers by state law No. 20.247 which states the limits in which Argentine farmers are allowed to save seeds from their land:

"Nowadays in Chaco the production of seeds is monopolised and the genetic patent belongs to Monsanto. So the only one that has the original seeds is patented and to obtain them the corporation has to pay a royalty and therefore we can have these seeds. The things is that nowadays there exists a monopoly, they set the prices and those are very high, logically they sell their genetics, they sell their investigation but it is exaggerated for the small producer to obtain these seeds, seriously an invalid price. So what they do is prostitute the sowing of the producers. (…) But a national ley facilitates for the producers to keep his own seeds always when he won't sell them to others. (…) This is protected by national law 2247 de SENASA [Servicio Nacional de Sanidad y Calidad Agroalimentaria]. (…) In the past, almost thirty years ago, you had what they called identified seeds. An expert went to the field and identified the plot and decided the seeds of this plot we are going to use for the next champagne. That is what you call identified seeds. But genetically speaking they have a potencial that is much lower than the first seeds or the original." (Cogno, personal communication, 1st October, 2013 Chaco).

Currently this process of identification that mister Cogno, director of Coorporativa Unión mentions is done by the Instituto Nacional de Semillas (INASE). That was part of the same law No. 20.247 which not only provides for farmers to save an amount of their harvest to use as seeds, it also provides for the protection of intellectual property. In order to apply this law a governmental body was created, this is the INASE that acts on the seeds, before they can be sown. Its objective is to "promote an efficient activity of the production and commercialization of seeds, to secure the identity and quality of the seeds to the agricultural producer and acquire and protect intellectual property on genetically modified crops" (INASE, n.d.). So in order to apply the law No. 20.247, INASE literally identifies the seeds in order to guarantee the quality of the seeds. So INASE becomes an obligatory passage point (OPP) (Callon, 1986, p. 7-8) in the sense that the seeds have to be inspected, identified and certified by the technicians of INASE before they can be sold. In the laboratories of INASE the GM soya seeds are subjected to test to establish, among other things, their purity, their capacity to sprout, their viability through biochemical methods, and detect viruses that can influence the quality of the seeds (INASE, n.d.) So INASE has regulations and has to subject the seeds to testing to be able to guarantee their quality, therefore redefining the identity of the seeds and dividing them in seeds of good or bad quality. So in this way INASE makes it only possible for the farmers to make alliances with the seeds that they define as of good quality according to their standards.

Mister Cogno defines the alliance that Monsanto has forged with the farmers and with his corporation, who has to pay a royalty to be able to sell the GM soya seeds to their members, as too expensive for the small producers and he even calls it prostitution by the hands of Monsanto. This position is also being voiced by the different agricultural associations that are allowed to speak for the farmers that formulate their message through their magazines, websites and also through scientific report they made by associating with universities (Filomeno, 2013, p.46). The agricultural associations partaking in the discussion surrounding the patents on RR soya seeds are the organizations mentioned before, the Federación Agraria de la Argentina (FAA), Confederación Intercooperativa Agropecuaria Cooperative Limitada (ConInAgro), Confederaciones Rurales de la Argentina (CRA) and the Sociedad Rural Argentina (SRA). All are allowed to speak for different actors. The FAA speaks for the small and medium producers (FAA, n.d.), the CRA represents the interests of the small, medium and large producers throughout Argentina (CRA, n.d.), ConInAgro represents small and medium sized corporations of producers (ConInAgro, n.d.) and the SRA says to represent the rural sector as a whole (Urricariet, personal communication, 22nd November 2013). In respect to

the patents on RR soya seeds they always defended the right of the farmers to save their seeds through publication of articles in their magazines and other media in order to influence the Argentine minister of agriculture in his decision. I will come back to this way of representation and making visible in chapter six.

So besides the FAA, CRA, ConInAgro, the SRA and the state interrupting the alliance that, Nidera and other seed companies tried to forge with the farmers, some other companies establish alliances outside the law, by trading illegally on what they call the '*bolsa blanca'* (Bustos, personal communication, 11th November 2013), which is the black market for seeds. But it is not only big corporation like Nidera that sell less GM seeds because of the law No. 20.247 and the *'balso blanca'*, also smaller retailers that sell GM seeds, herbicides and pesticides see their alliances they try to establish with the farmers interrupted by this law:

"In cuantity we? No, there aren't much changes from a commercial point of view, because the mayority of the producers save their soya seeds and wheat seeds which actually make up for the mayority of the hectares is sown with soya and there sowing more and more soya everytime because of the economy and the producer saves his seeds and that isn't good for us, because one time or another they are going to generate in time, but it is true that today from the point of view concerning the seeds we keep selling more or less the same proportions, GM sunflower we sell more when the climate is favourable, after that a bit of corn, followed by sorghum and soya is what we sell least when the mayority of the hectares are sown with it and also wheat we sell very little when its sown in great mayority." (Julio, personal communication, 1st October 2013).

Seeds companies like Nidera however try to restore their alliance with their patented seeds by participating in a private royalty collection system based on individual contracts with producers. This system was created by the Asociación Argentina de Protección de las Obtenciones Vegetales (ARPOV) in 1999 (Filomeno, 2013, p.45) which allows the participating seed companies to conduct inspections on the seeds saved by farmers. Monsanto at the same time tried to restore its alliance by prosecuting in countries that imported Argentine GM soya and did recognize its patent, but their claims were rejected. At the moment Monsanto, just like the ARPOV is applying a systems that works with individual contracts between them and the farmers purchasing their seeds (Filomeno, 2013, p.47). And the ultimate step taken by Monsanto is obtaining the patent on their newest generation of GM RR soya seeds, which they redefined as INTACTA RR2 Pro (Monsanto, n.d.) and has been developed especially for South-America. By this Monsanto is continuing to try and consolidate their alliance with the farmers, forcing them into paying for their seeds every time they want to sow them. In this way again redefining and enrolling the GM soya seeds.

All these actants show that the introduction of RR soya seeds is far from linear. It wasn't Monsanto alone that just implemented the RR soya seeds in Argentina. It was through an actor network in which the Trade Related Aspects of Intellectual Property Rights (TRIPS) and the International Union for the Protection of New Varieties of Plants (UPOV) treaties, the laboratories of Monsanto, Asgow, Nidera, contracts and the Argentine farmers and their representative institutions like the FAA, CRA, SRA and ConInAgro who all interacted with each other and tried to define the situation in such a way that the balance of power would change in their favour. The introduction of GM crops is not as powerfull as it sometimes is being portrayed. This is also shown by Herring (2007) concerning the introduction of Bt cotton in India, where the farmers produced their own Bt seeds, which Herring redefined as 'stealth seeds' (p.135) whithout paying royalties to Monsanto. And it might just be the

interruption of the relation that Nidera and Monsanto tried to establish with the Argentine farmers through the patent on their seeds, that the GM soya could spread so rapidly through Argnetina.

We have already seen some nonhuman actants play their role in the trial of strength and weakness portrayed above, like the TRIPS and UPOV and contracts, but also weeds have resisted domination by developing resistance to the glyphosate based RoundUp herbicide of Monsanto:

"In Argentina there are around ten weeds that are resistant to glyphosate. (…) What soya did was in the first place make place for glyphosate (…) managing soya is glyphosate, glyphosate was like the water of the world, easy to gain access to and cheap (…) for 50 million dollars you can have a transgenic plant, but a new herbicide costs 200 million dollars, so it is much easier to create a GM plant resistant to an old herbicide that is so cheap and old than to a new herbicide. So there we go, soya is resistant to Dicamba, 2.4-D and glyphosate, all the products of 30, 40 years or more are all glyphosate based, there were no super new herbicides because ten years ago they have stopped investigate herbicides because glyphosate was the best." (Canteros, 1st October 2013)

According to mister Canteros the alliance between GM soya seeds and RoundUp based on glyphosate was forged, because glyphosate was cheap and easy to apply, and it is cheaper to forge an alliance with an already existing herbicide than to develop a new herbicide. So Monsanto successfully disassociated other agrochemicals from associating with the production of GM soya in Argentina and even disassociated the researchers from studying weeds and other agrochemicals for threating the weeds. All these actors changed the balance of power in favour of glyphosate. With the resistant weeds interrupting the effectiveness of the glyphosate, associations with other agrochemicals have to be made to be able to dominate the weeds again and enable the GM soya crop to grow.

4.2 Sowing

The sowing of the GM soya seeds is done through a system that doesn't acquire for the field to be ploughed, it inserts the seeds directly into the ground at the required depth, which limits the disturbance of the soil structure (Trigo et al., 2009, p.1). This system is called no-till, zero-till or, in Spanish, *siembra directa*. The system was developed to prevent or decrease soil erosion. This occurred when the production of oilseed crops was increased and the farmers tried to limit the risk of losing their harvest due to extreme rainfall during the autumn. Soya is sown from November till March and to save time the farmers burned the remnants after the first harvest, so they could immediately sow the next campaign. This intensification of the production caused a decrease in the soil fertility (Trigo et al. 2009, p.2). The no-tillage system was developed within a field of forces in which agricultural engineers of the INTA, fertilizer, farmers, iron discs, metalworkers, universities and many other actants worked together (Trigo et al. 2009, p.4).The agricultural engineers of the INTA made the degradation of the soils visible by investigating it and writing reports about more sustainable ways of cultivation, which was part of the Proyecto de Agricultura Conservacionista (PAC), a conservation program (Trigo et al., 2009, p.4). This was the beginning of the change in balance in favour of the agricultural engineer. The solutions to the problem of soil degradation were defined by the agricultural engineers, based on their own research, but also on information from the US that became an immutable mobile through research and science reports and sometimes through visits of Argentine farmers to the US to see in person the no-tillage systems developed there in practice (Trigo et al., 2009, p.5). Solutions were sought in the use of fertilizer, crop rotation systems and vertical tillage of the soil. The agricultural engineers of the INTA could also make their time and

change the balance in their favour because of the way they moved and positioned themselves. The INTA established experimental stations throughout Argentina (map 4). These stations were close to the farmers so the agricultural engineers could learn from the farmers themselves and see the problems the farmers experienced with their own eyes. The experimental stations of the INTA therefore played an important role in developing the no-tillage systems further and adjusting it to local circumstances, for which it worked in close relation with the farm machinery industry (Trigo et al., 2009, p.5). For the no-tillage system to be used as defined by the developers another actor had to arrive first: the herbicide. We will continue on the development of the no-tillage sowing in paragraph 4.4. First we will look at the role of the agricultural engineer.

4.3 The agricultural engineer

Both in the literature and some of my interviewees defined Argentina as "lacking behind to the rest of the world in the adoption of fertilizer, hybrid seeds and the wider process of mechanization between 1950 and 1980." (Bisang, 2003, p.2), lacking technological innovation (Trigo, 2009, p.2) and "Argentina lost pace with the rest of the world" (Urricariet, personal communication, 22nd November 2013). However this idea of what has been named the "green revolution" followed by the "gene revolution" doesn't apply in a world of forces and actor networks where actors make their own time (Latour, 1988, p.49). The agricultural engineers in the INTA were making their time by translating their knowledge into conservation programs that introduced fertilizers and crop rotation systems, which in turn asked for the expertise of the agricultural engineer to plan the sowing of the different crops and determine the amounts of fertilizer that needs to be applied in relation with the nutrients present in the soil. The introduction of GM soya as a cultivation crop in Argentina allowed for the position the agricultural engineers as translators of knowledge within the actor network:

"In every form the Argentine agriculture changed dramatically with the introduction of soya, why? Because no-one knew what to do with the soya when it arrived, no one knew and so many agricultural engineers they took the crop further with the date[of sowing], what to do, what products to apply, when, how and in what condiciones, there are many agricultural experts that are behind the crop, in respect to how it was done before when the Argentine producers were much more familiar with wheat and corn, but practically didn't know soya" Urricariet, personal communication, 22nd November 2013).

When soya arrived in Argentina the farmers didn't know what to do with it. Until then farmers had been mainly producing wheat or corn. So GM soya demanded for the farmers to learn how to cultivate this unknown crop (Trigo et al. 2009, p.2). The GM soya required an actor that could translate this GM crop and its alliance with herbicides and fertilizers. This left room for agricultural engineers to make time and forge an alliance with the crop. In doing so they redefined the alliance between the farmer and the GM soya and changed the balance of power in their favour. The agricultural engineer became an obligatory point of passage (OPP) for the farmers to be able to sow GM soya. From this moment onwards, farmers depended on the knowledge of the agricultural engineers like mister Canteros who describes what is job entails:

"basically we plan the year, where we are, what we are going to sow on his plot and to arrive at a date when we complete the production, after which I help with the commercialization, buying the supplies (…)interpreting the soil is also part of our job." (Canteros, personal communication, 1st October 2013)

Analysis of the soil is needed to establish how much and which kind of fertilizer is needed for the soya to grow, the kind of weed present in the field has to be determined for the selection of the most

effective herbicide. And to keep the soil fertility from degrading the crops with which to rotate the GM soya have to be selected. All these actants have to be dealt with by the agricultural engineer after which sowing can begin. Determining the nutrients that are needed in the ground is based on how the agricultural engineers define a GM soya plant. An example of such a redefinition is:

"The crops have specific and absolute requirements which have to be met to reach high outputs. Radiation, water, time of growth and nutrition are the principal requirements to be covered. In case of soya, the objective is develop a crop with an ideal flowring state (R1-2 acoording Fehr & Caviness, 1977) which permit for efficient interception of the incidental radiation and maximization of the accumulation rate of dry material in the period of the filling of the grains (Vasilas et al., 1995). To reach this objective, among other factors, the crop needs to cover his necessary nutricions." (García, 2000, p.1)

This definition is the result of taking samples of the soil, plant, grains and seeds and bring them into the laboratory to dominate them and to be able to subject them to experiments to determine the amount of the nutrients present in the soil, plant, grains and seeds so they can be translated in numbers and tables which can be printed on papers making this information mobile and the agricultural engineer only has to read to calculate the amount of fertilizer that is needed per hectare. The following table shows the amount of nutrients that is needed to produce one ton of soya, corn, wheat, sunflower or cotton:

		Required totals to produce 1 ton of soya/corn/wheat/cotton Kg/t			
Nutrients	**Soya (grain)**	**Corn (grain)**	**Wheat (grain)**	**Sunflower (grain)**	**Cotton (fibre)**
Nitrogen (N)	75	22	30	40	150
Phosphor (P)	7	4	5	11	25
Potassium (K)	39	19	19	29	100
Calcium (Ca)	16	3	3	18	102
Magnesium (Mg)	9	3	3	11	24
Sulphur (S)	4.5	4	4.5	5	25
Boron (B)	0.025	0.020	0.025	0.165	0.268
Chlorine (Cl)	0.237	0.444			
Copper (Cu)	0.025	0.013	0.010	0.019	0.121
Iron (Fe)	0.300	0.125	0.137	0.261	0.814
Manganese (Mn)	0.150	0.189	0.070	0.055	0.408
Molybdenum (Mo)	0.005	0.001		0.029	0.004
Zinc (Zn)	0.060	0.053	0.052	0.099	0.645

Table 1: Required totals of nutrients to produce 1 ton of GM soya, corn, wheat, sunflower or cotton (García & Correndo, 2013)

In Chaco for example the soil contains a high amount of potassium, so a fertilizer should be chosen that doesn't contain potassium (Cogno, personal communication, 1st October 2013).

So to conclude we have seen that the agricultural engineers of the INTA have consolidate their position within the GM soya actor network by moving their laboratories to the provinces (map 4), close to the farmers and the production areas to which they translated their knowledge and where

they could witness the problems the farmers encountered with their own eyes and could define the problems and the solutions based on their own research, knowledge and experience.

4.3.1 Fertilizer

After having problematized the degradation of the soil the agricultural engineers introduced fertilizer into the actor network of the GM soya production in Argentina. The fabrication of fertilizer is a process in which an alliance is forged between the nutrients mentioned in table 1: nitrogen, phosphorus, potassium, calcium, magnesium, sulphur, boron, chorine, copper, iron, manganese, molybdenum and zinc. For this alliance to be consolidated an industrial plant is needed in which an enormous amount of (mostly) nonhuman actors work together to produce the fertilizer. Air, pressure, water and temperature act upon the elements mentioned above or create the elements needed for the alliances to be consolidated. For this research a plant of Bunge SA was visited. Bunge SA is an Argentine multinational that produces fertilizer, but is also one of the mayor traders of GM soya meal and oil and other oilseeds and grains, next to other multinational companies like Cargill and Dreyfuss (Bustos, personal communication, 13th November 2013).

The site of the plant and how it is being designed is being determined by the actants and how they associate with one another. The plant consists of an enormous network of tubes which transport the different actants around the plant. The height of the chimney is being determined by how much time it takes for the particles to rise and cool down. Also the dangers that the production of these kind of chemicals brings with it is determining much of how the plant is being organised. On all buildings there are flags to indicate the direction of the wind, which is very important in the case of a chlorine or ammonia leak. The red pipes in the installations are the ones that contain water or foam to extinguish fires.

Plate 2: The network of tubes, kettles, chimneys that is needed for the production of fertilizer (photographed by the author)

Plate 3: Liquid and solid fertilizer, produced at the plant of Bunge. In the background the computers of the control room are visible (Photographed by the author)

The stability and continuity of the consolidation of the alliance between the elements is very important. Slight differences in temperature or pressure can result in the interruption of the alliances that Bunge SA is seeking to consolidate between the different actants. To control the process the whole plant is being controlled from an office with computer technology that oversees the actants involved in the process and from which the actants can be corrected if they resist and try to redefine the alliances. All the activities on the plant are being translated onto a series of computer screens that can be monitored in the control room (plate 3). In this sense Bunge SA changes the balance of power on its own plant, so it can dominate the consolidation of the alliance between nitrogen, phosphorus, potassium, and all the other actants involved in exactly the way as they defined it.

4.3.2 Herbicides

As described in the first paragraph the no-tillage system was developed in close cooperation between the agricultural engineers of the INTA and farm machine industry and this cooperation eventually led to the establishment of the Argentine Asociation of no-tillage Producers (Asociación Argentina de Productores en Siembra Directa (Aapresid), that are promoting, together with the INTA the use of no-tillage systems as a sustainable way of production (Bisang, 2003, p.10). But for the no-tillage system to be able to do its job as defined by its designers another actor was needed. The system of no-tillage sowing demanded another actor to control the weeds. Instead of tilling the ground and keeping the weeds from growing that way, glyphosate herbicides were introduced to keep the weeds from growing and allowing for the GM soya seeds to be sown by a no-tillage system.

Among the different no-tillage systems developed a distinction can be made between five types:

1. Sowing machines for thick grains which make furrows with 70/52 cm between the rows
2. Sowing machines for thick grains that make furrows with 35/26 cm between the rows
3. Sowing machines for fine grains that put 42/38/35 and 21/19/17,5 cm between the rows
4. Sowing machines for fine grains equipped with plates or applied to sow thick grains which sow at 52/38/35 cm between the rows

5. And sowing machines equipped with a pneumatic or air drill that puts 42/38/35 and 21/19/17,5 cm between the rows (Martinez Peck, 2003, p.61)

The differences in distance are needed to make the intensive rotation of crops possible. The first crop will be sown with larger distances between the rows in order to allow for the second crop to be sown direct after the harvest of the first crop between the rows of residues. But also in order to harvest the crops with a cobine the distance between the rows is needed and corresponds with the front of the combine. To cut through the soil the no-tillage machines can be equipped with a single disc, a double disk or a blade. The discs can be placed vertically or slightly tilted. Which one to use depends much on the type of soil and its humidity (Martinez Peck, 2003, p.64). The rates with which the seeds are being put into the ground depend on the type of dispenser that is used. This will determine the distance between the plants in the row.

Plate 4: A no-tillage system that the brothers Luis and José in Chaco use to sow their GM soya, wheat and cotton (Photographed by the author).

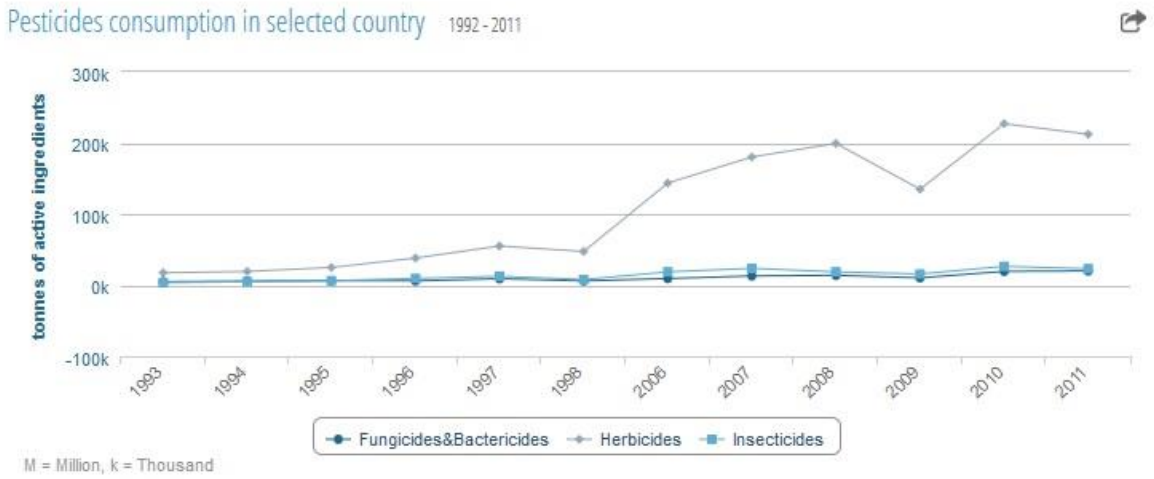
In paragraph 4.1 the relation between the GM soya seeds and the herbicide based on glyphosate has already been mentioned and described. Monsanto redefined both the seeds and the herbicide and forced an alliance between the two, by making the GM soya seeds resistant to glyphosate. Glyphosate has been used as an herbicide for years in Argentina. It was used to keep weeds from growing between the train rails (Bustos, personal communication, 11th November 2013). According to mister Canteros, an agricultural engineer in Chaco, the alliance between GM soya seeds and RoundUp based on glyphosate was forged, because glyphosate was cheap and easy to apply, and

because it is cheaper to forge an alliance with an already existing herbicide than to develop a new herbicide.

The need to use herbicides introduces another chain of actants to the production of GM soya in Argentina. Farmers can do the spraying of the fields themselves for which they have to buy a spraying system that they can put behind their tractor or buy special tractors that are designed only for spraying. They can also choose to hire specialised personnel to fumigate the crops for them. Like mister Mellinger who has 770 hectares to sow in Chaco:

"All the machines are mine, so the sowing machines, (…) the tractors and harvesters also, all are for my own use, the only thing that is done by a third party is the fumigation. They work with fumigation equipment that is exclusively for fumigation. So with a cabin with carbon filters and with airconditioning which before they didn't have, before they worked with tractors and a fumigation system that practically drenched the field with the poison, rightly not anymore, these days the workers work with equipment that has airconditioning and a carbon filter in the cabin so nothing gets to the producer." (Mellinger, personal communication, 30th September, 2013 Chaco).

Sometimes fumigators work with airplanes to spray fields with herbicides. So another actant is added to the alliance between the GM soya seeds, the herbicides and the no-tillage sowing system which is the fumigator. This actor brings with him a whole new chain of actants. The fumigator associates with an airplane or tractor that consists of a cabin with air-conditioning system and carbon filters that act by interrupting the interaction between the herbicide and the fumigator. The carbon filters prevent the alliance between the chauffeur of the tractor and the herbicides from happening. Outside the cabin of the tractor the herbicides can interact with other crops, trees, houses, metal roofs, water and people and animals living around the field.



Graph 2: Herbicides, pesticides and fungicides & bactericides consumption in Argentina between 1991-2011 (FAO, n.d.)

Graph 2 shows the rise in the use of pesticides between 1991 and 2011. A steady rise, with a small dip around 2009, begins around 1998 when farmers in Argentina first forged an alliance with GM soya and in the following years more and more farmers did so which explains the rise in the use of herbicides. This rise has been connected to a rise of health problems in cities and towns surrounding the fields in which GM soya is being produced. Domínguez & Sabatino (2011) registered the cases of

contamination in Paraguay and Argentina between 2002 and 2007 and came to a total of 65 cases, of which 40 occurred in Argentina (p.66). In 72,5 % of the cases it concerned contamination effects on people and in 27,5 % contamination of animals or crops (Domínguez & Sabatino, 2011, p. 67).

Many farmers of MOCASE-VC mentioned cases of malformation in the nearby village, like MOCASE-VC member, Beco:

"They are waiting for an national investigation and we participated in some assemblies in Buenos Aires in which a doctor participated that had done experiments with rats and chickens and the effects of agrochemicals are the same, the contaminated them and here in Colorado there are malformations and children of which some organs are missing. Here not but (…) almost 15 kilometres from here. Here they don't sow because of the animals here, but in Colorado when you pass in a car or on your motor when they are fumigating, everything is poison, and it doesn't bother them because they are businesses, they don't bother." (Beco, personal communication, 4th October, 2013 Santiago del Estero).

Mister Mellinger doesn't believe that people can get cancer of the herbicides used on his fields:

"That is politics because really this system of contamination it could be partly true, but I tell you if someone is living in a town or city and says that he has cancer because they are fumigating on the fields, then I don't understand that the applicator with whom I am working for years is still alive. So I think that this is all a big talking circus. Because when today a fumigator passes in front of my house I can't say that I will get cancer because of that. So no, its okay, I agree that we have to be careful, we are all producers and there are producers that are very offensive and they use many things (…) but this isn't the way, this is the way nowadays with the rentability that this occurs." (Mellinger, personal communication, 30th September 2013).

In the province of Chaco there is a law that provides some kind of restrictions for the use of herbicides:

"There exists a ley in the province to establish limits to the spraying, a regulation especially for the management of agrochemicals and there exists uncertainty in respect to the conditions that need to be taken into account, this is where the contaminations can occur, so application within certain norm that have to be considered and must insure a low risk for the consumption and the environment. In respect to this there are regulations in this province [Chaco]that establishes different standards for the application, which is a good thing because one can talk with a producer and control the application with these regulations and you can prohibit the application or you can sentence a producer for contamination so regulations are necessary" (Marcelo, personal communication, 1st October, 2013 Chaco).

But legislation doesn't stop the herbicide from collaborating with the heat of the sun that evaporates the herbicides so they form a cloud that is transported by the wind to other parts around the soya fields. Mister Brabo who lives on 25 hectares in Chaco describes the cloud of herbicide above a field:

"I think that both with the 'mosquito' [truck with a spraying system] as with the airplanes they contaminate in the same way, last year they passed two, four times and they didn't leave anything (…). Overt here in front of the tractor there, there were two lines of plants but at the time of the spraying they dried everything out, there is nothing left, nothing is left when the neighbours sprays two to four times and sows corn (…) above the corn hung a cloud of a meter high and they fumigated two, three times which was impossible to fight it (…) the damage that is done is impressive all around the fields, the Durano plants are very delicate and they are the first that are dried out and this is how they dried out the plants of neighbours overthere, overhere in every direction, they dry everything out." (Brabo, personal communication, 30th September 2013).

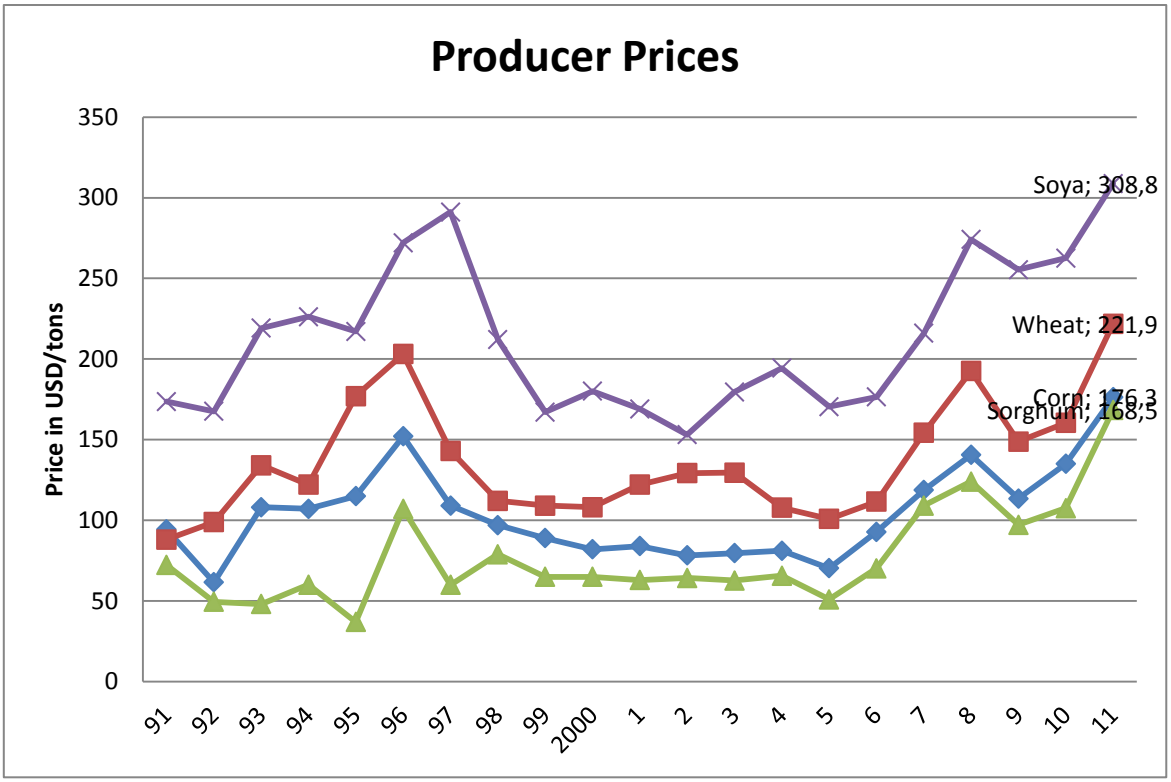
Up till now we have seen how the GM soya seeds arrived in Argentina which asked for the agricultural engineer to make time to translate the knowledge for the farmers to cultivate the GM soya crop which added the use of fertilizer, herbicides and no-tillage systems to the actor networks which in turn acts on the people, their houses, and trees around the fields. These interactions will be again taken up in the following chapters.

4.4 Growing

As shown in the former paragraphs the agricultural engineer, Monsanto, Nidera and Bunge seem to have established the enrolment of the herbicides and the fertilizer needed for the alliances they defined, although these enrolments aren't stable and experience threats from time to time, they have been able to keep the balance of power in their favour. One actor that neither Monsanto, nor the agricultural engineer can enrol is the climate, the intensity and amount of sunshine or rainfall and the intervals between the two. These actants become the most important ones during the time that the seeds develop into plants and the soya plants develop their beans. And put the agricultural engineers to the daunting task to, within this field of forces, to ensure the harvest of the crops, but it also puts people up to the task to organise themselves in securing their access to water. All the people that I spoke with, both in Chaco and in Santiago del Estero talked about the weather and that they were waiting for it to rain. Chaco has a history of both flooding's and droughts (Altamirano, 2013, p.25). During my field research Chaco was experiencing its third year in a row with a very limited amount of rainfall. In 2012 the harvest was very bad with only 254 mm of rain, while normally close to 500 mm of rain is needed for a harvest of 1800 kilos to 2000 kilos per plot. But because of the shortage of rain the harvest was much less in 2013. And the producers only could produce one crop in summer and one in the winter. The drought was in its third year which was almost historical. In 1978 it rained 312 mm and from January until the beginning of Octobre 2013, it had rained only 327 mm (Canteros, personal communication, 1st October 2013).

The drought interrupts the alliances that actants are trying to consolidate. For example the alliance between fertilizer, no-tillage sowing and crop rotation that INTA is trying to consolidate, to keep the soil fertility stabilized, is being interrupted. Especially the alliances with crops other than GM soya, like corn, wheat and sorghum is being interrupted. The shortage of rain at times doesn't allow for more than two campagnes while oilseed crops, like GM soya and sunflower need to be rotated with cereal crops, like corn, wheat and sorghum for the soil to keep its fertility. This is the solution that INTA poses to their problematization of the decrease in soil fertility. This solution is published by the INTA in magazines and it advocates the alliances between the use of fertilizer, no-tillage sowing and rotation of crops as a sustainable agricultural practice (Ferrari, 2010, p.6). This alliance is being threatened by the shortage of rain but also by the difference in price that farmers receive for GM soya beans, GM corn, GM wheat or GM sorghum (graph 3). If farmers can only sow two or three times they prefer forging an alliance with GM soya to ensure the highest financial return. As explained by agricultural engineer, mister Canteros:

"the soil isn't magical, but you can't make a turnover with [prizes] 30 to 10, without rain, with 30 to 10 you can't and this is where the difference in rentability is caused. The correct way is a year soya and a year corn, a year soya and a year corn if you don't want to sow cotton, but the prizes of corn aren't as positive as that of soya, so [they sow] soya, soya, soya, corn, soya, soya, soya, soya, like that" (Canteros, personal communication, 1st October, 2013 Chaco).



Graph 3: International Producer Prices USD/tons for Argentina (FAO, n.d.)

In this way the alliance between GM soya and the rotation crops is being interrupted by the price famers can receive by selling their crop after harvesting. Based on the prices in graph 5, the balance of power is in favour of GM soya beans. But the extreme droughts in Chaco and Santiago del Estero, also influences the GM soya production and might turn the balance in favour of other, more drought resistant crops like cotton. This chain of actants will be taken up in chapter five.

During its history the province of Chaco has experienced both periods of droughts and flooding's. The cause of the drought they were experiencing during my visit was defined by much of the interviewees in different ways. Some redefined the droughts in relation with the canalization of the province that caused for the water to pass more rapidly through the province and therefore can't be detained for when there is a shortage of rainfall (Ferreras, personal communication, 26th September 2013). But mister Ferreras mentioned the fact that almost every ten year Chaco experiences flooding's, with periods of droughts in between, so he was convinced that the floods would return one day. Others, like mister Mellinger, defined the droughts in relation with the geographical position of the provinces and the oceans that interacted with each other:

"They say that we are in a cycle of about thirty years in which the natural temperature, a bit cold in the pacific and the atlantic is a bit more artic and causes humidity at the coast of the atlantic but it doesn't enter the continent, when the humidity arrives at the continent and the pacific needs to have the right temperature for to pass the Andes mountain range for the humidity to enter the continent and produce the normal rainfall, but that doesn't happen in this zone, and until this doesn't happen we don't have rain (…) this is the explication, this are explications at a technical level" (Mellinger, personal communication, 30th September 2013).

In the province of Santiago del Estero the farmers also define a relation with the use of herbicides and the drought. The herbicides that are used are blown into the forests surrounding the field, which

the indigenous farmers use to rear cows, goats, pigs and chickens. They define a relation between the forest and the rain. The forest provides for humidity in the air which culmulate into clouds that provide for it to rain. The herbicides makes the forest dry out and causes the trees to die. With the forest disappearing the relation with the humidity is being interrupted according to indigenous farmer Juan:

"less rain, the climate changed completely. There is no forest, they say that the forest brings water, but there is no forest everytime with the poison and the water in the aquifers is very low, it changed a lot, before it rained and nowadays it doesn't. We never had a register of the rain, but it rained much more before." (Juan, personal communication, 5th October, 2013 Santiago del Estero).

4.4.1 Farmers organise themselves

With the alliance between the heat and the use of herbicides changing the balance of power the farmers in both Chaco and Santiago del Estero associate with all kind of actants to consolidate their access to water and in this way trying to change the balance of power in their favour. Mister Brabo who has 25 hectares, forged an alliance with other farming families and they put money together to be able to hire a lawyer to translate for them his knowledge of finance which allowed them to buy a wind mill to pump water, a water tank and a machine to grind the fodder for the animals:

"we gathered and we have a group of small producers so to say and we started with seven families here, seven families (...) to solve our water problems that we had, we bought a mill [to grind fodder] and we still had some money left so we bought a second hand [water] mill and water hoses, which is behind you. We have water overthere in a well and with 400 meters of waterhose it comes here (…) So with the group we installed these two mills and an older one we send to be repaired and we built a Australian [water] tank all with that money. We are fighting the drought from the beginning and we continue to do so and thanks to the Australian tank and the water mill we have water for the animals. The water mill pumps the water into a tank, we have a tank of 2700 [litres] overthere and when the tank is full we open the tap overhere and then the Australian tank is filled for the animals, so the water arrived directly from over there to here for our consumption and that of the animals, everything (…) we are in the process of joining three groups together with the help of a juridical person we are organizing one commission for the group to be independent, to depend only on ourselves and in which we solve our own problems." (Brabo, personal communication, 30th September 2013).

Mister Brabo mentions the whole chain of actants with which his and the other families forged alliances. They started by associating with other families which made it possible for them to forge alliances with things for the pigs and a grinding mill. Then they went on to forge alliances with water mills, water tanks and water hoses which enabled them to change the balance of power a little bit in their favour by joining together and to be independent and able to solve their own problems.

Plate 5: Some of the nonhumans with which the different families have associated, above the windmills to pump up water, the red mill to grind fodder for the animals and the Australian tank to store the water (Photographed by the author).

In Santiago del Estero the indigenous farmers also sought cooperation with other families which cumulated in the MOCASE-VC and they also associated with wind mills to be able to pump up water for the animals. They also use their metal roofs to gather rainwater to use as drinking water. This alliance is being threatened by the airplanes that spray the fields with herbicides and contaminate the roofs and wells so they can't use the water anymore. This is especially problematic with the public school that is surrounded by fields on which GM soya is cultivated. When an airplane passes over the school the well is contaminated and they have to empty the well and clean the roof for it to be used as defined by the: for collecting rainwater. Juan talks about the experience in his community:

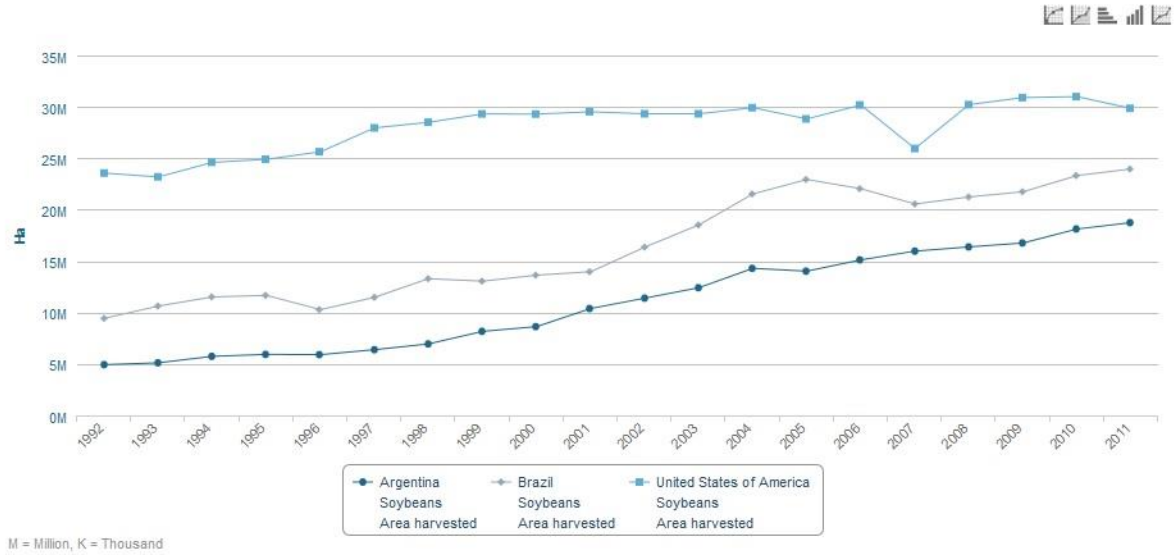
"[our community is]1500 hectares, 1520. Before it was all open fields but with the introduction of soya they buy land and they log the forests to sow more soya, they evict the idigenous farmers and everything to plant soya. So soya encloses the whole forest (…) Because we are organised and we defend our land, but everywhere around us is soya fields, at this side soya, overthere soya.. and the rural schools are in the middle of the soya and when they fumigate, fumigate all over the school, there is no control, they don't respect anything, not the children, it's crazy, it's a struggle against the evictions and the agrochemicals" (Juan, personal communication, 5th October 2013).

Plate 6: A rural school in the middle of acres and acres of soya fields.

4.5 Harvest

When the alliances between the farmer, the GM seeds, the herbicides, the no-tillage machines, the fertilizer, the soil and the sun and the rain aren't interrupted by all the actants mentioned above the GM soya seeds can develop into plants and they can develop their soya beans that can be harvested. Arround 18 million hectares of GM soya beans were harvested in Argentina in 2011 (graph 4). This is done with combines that are designed to harvest the GM soya beans or other grain crops like wheat or corn. The GM soya plant is being cut and then within the combine the plants is being separated from the GM soya beans which are being transported into a trailer driving next to the combine and transport the harvested beans off the field. Then another alliance is made with trucks to transport the GM soya beans to a corporation if the farmer is a member and here the GM soya beans are being redefined into GM soya meal or oil. Other producers might transport their harvest to the city of Rosario and send their harvest by truck to one of the mills around Rosario that will redefine the GM soya beans into meal, oil or biodiesel. The role of Rosario in the GM actor network is explained by agricultural journalist, mister Bustos:

"the big multinationals, Bunge, Cargill, Dreyfus, all of them (...) first set up mills to make soya meal and soya oil and this is all installed in what is called a cordon, the cordon of Rosario, all the ports that are situated around the river Paraná. It is here where the soya is gather from all over Argentina and they make a big investment, a lot of money, a lot of dollars, because after this they transform the soya oil into bio-diesel that they send to Europe" (Bustos, personal communication, 15th November, 2013 Buenos Aires).



Graph 4: Harvested area in Argentina, Brazil and the US (FAO, n.d.)

The importance of Rosario in the soya actor network also becomes visible during the harvesting period on the roads around the city. The amount of trucks needed for the transport of the GM soya beans to the cordon of Rosario is so big that they act on the traffic around the city by causing traffic jams. Through newspapers articles the GM soya harvest becomes even more visible (plate 6). The majority of the GM soya beans, meal or oil is being exported through an alliance with freighters that link the GM soya beans, meal or oil to the biodiesel refineries in Europe or the mills in China.

MARCELO MANERA

Largas colas para descargar la cosecha en Rosario

En las cercanías de los puertos de Rosario, hay largas colas para la descarga de la cosecha. Según datos de la Bolsa de Comercio de Rosario, en los últimos cinco días el promedio de ingreso fue de 4269 camiones. Esto corresponde a las terminales ubicadas entre Timbúes y Arroyo Seco. Respecto de la misma semana del año pasado, la entrada de camiones es un 7% menor, pese a que hay mayor producción. Los ingresos varían según los stocks de las fábricas, la velocidad de molienda y los embarques por realizar. ●

Plate 7: Newspaper article on the traffic jam caused by the amount of trucks used to transport the soya beans to the mills and refineries that are concentrated around the harbour of Rosario. (photo Marcelo Manera, La Nacion, 18th May 2013)

For this investigation a refinery of a corporation in Sàenz-Peña was visited. This was where the members brought their cotton, corn, wheat and GM soya beans and where the latter were being redefined into soya meal and oil. The corporation grinded part of the soya beans to be used as animal fodder (plate 7) and part of it is grinded in such a way that the oil is being extracted that can be redefined further into bio-diesel.

(clockwise) Plate 8: (a) the grinded soya beans redefined as GM soya meal and to be used as animal fodder in a bag, (b) the oil is being separated from the GM soya meal, (c) the grinder that redefines the GM soya beans into soya meal and oil, (d) three silos in which the soya oil is being gathered before it is being transported (Photographed by the author).

4.6 Taxes

Currently the national public debt of Argentina is 195,568,852,459 US dollars (The Economist (n.d.) accessed on 8th August, 2014). Argentina has had to deal with hyperinflation through much of the 70s, 80s and 90s to change the balance of power in their favour and stop the hyperinflation the Argentine government redefined the value of their peso by linking it directly to the US dollar, one peso equalled one Argentine peso. This decision was also supported by the IMF (Stiglitz, 2002, p.2). The only way that the Argentine government could spend beyond its means was to borrow money. Where the US could sustain its trade deficits, because other countries were, and still are, willing to finance this debt, they didn't want to finance the debt of Argentina when the forces outside Argentina were changing the balance of power in disadvantage of Argentina, the currency in Brazil went down and the Euro which made it difficult to compete with Brazil and less money came in

through trade with the EU and finally Argentina couldn't pay the interest on their debts, and therefore couldn't maintain the balance of power anylonger and the Argentine economy defaulted in 2001 (Stiglitz, 2002, p.3). After the crisis the Argentine government forged alliances with all kind of funds that bought state bonds that now have changed the balance in their favour because these bonds are currently worth billions of dollars and they have enrolled the Argentine state as debtors. To be able to pay the interest on its debt the Argentine state as a network 'acted at a distance' (De Sousa & Busch, 1998, p.351) on the GM soya network through resolution No. 125/08 by which they enrol the GM soya farmers or exporters to generate income for the state. When the GM soya is harvested and it arrives at the port of Rosario it will be redefined into an export product on which the Argentine government has imposed a tax to obtain permission to export GM soya, either in the form of beans, oil or meal, to other countries. The resolution doesn't discriminate between producers, every producer has to pay this percentage of the price of the GM soya. In this way the Argentine government has created another obligatory passage point (OPP) (Callon, 1986, p.7-8) for the GM soya that is being transported. For the GM soya to establish a link with countries in the EU or with China it has to pass through the harbour and the export tax has to be paid (Urricariet, personal communication, 22nd November 2013). This resolution interrupts the alliance between farmers that have only 25, 50 or 100 hectares and want to export their GM soya harvest. But the high price that exporters can get by exporting or selling their GM soya beans to an exporter also elevates the value of land on which GM soya can be sown. Some small farmers therefore choose to rent their lands to producers that do have the machinery or the money to hire the machinery necessary for sowing those fields. This changes the actor network in which GM soya is produced towards an actor network that is defined by the interviewees as an actor network without farmers (Bustos, personal communication, 11th November 2013; Mellinger, personal communication, 30th September 2013; Ferreras, personal communication, 26th September 2013). The costs are too high to pay for farmers with small plots, so in not discriminating between farmers it does discriminate against farmers with small plots.

On its introduction the resolution No. 125/08 set the export fee on 10% of the price of the amount of GM soya that was being exported. This percentage rose within four months from 17%, 23%, 28% and eventually to 35% in March of 2008 (Bustos, personal communication, 11th November 2013). The height of the taxes was directly coupled to the international prices, which would mean that if the price of GM soya on the international market would rise to 600 dollars per ton, the Argentine farmers would have to pay almost half of it in the form of export tax to the government as miss Urricariet of the SRA explains:

"for example when the FOB [FOB means Free-On-Board. FOB- trade values include the transactions value of the goods and the value of services performed to deliver goods to the border of the exporting country] price would be 100, the retention would be 20%, when the FOB price would rise for example to 320.. the retention rises to 30% and like that successively. (…) [W]hat they didn't kept in mind was that if supposedly the price rose to 620, the retention in the case of soya would be 51%, so more than half of it would stay with the government" (Urricariet, personal communication, 22nd November 2013).

With the balance of power being changed in the favour of the Argentine government, the SRA, ConInAgro, CRA and FAA decided to collaborate. They decided to participate in a strike acting on the traffic on all the main roads leading into the city of Buenos Aires by barricading them with farm vehicles (Bravo, 2010, p.9; Cibils, 2011, p.51; Alicia Urricariet, personal communication, 22nd November 2013). In doing so they tried to turn the balance of power in their favour. In the discussion

that followed the Argentine government defined the countryside as a place where the big land owners of the SRA still lived on their estancias while the labourers lived in poverty (Bustos, personal communications, 11th November 2013). While the SRA and the FAA through its president Eduardo Buzzi defines the countryside as the biggest economic sector that keeps the Argentine economy going (La Nacion, 14th August 2013). But instead of supporting this important sector for the Argentine economy this collaboration was being made more difficult by the export taxes imposed on GM soya and other crops.

Further costs are threatening the alliance that farmers in Chaco and Santiago del Estero have tried to establish with GM soya. Next to the fact that the export fee of 35% doesn't discriminate between bigger or smaller producers, it also doesn't discriminate between the different provinces. So a farmers that lives in the province of Buenos Aires, which has a much wetter climate and is only at 100 kilometres of the Rosario harbour, pays the same export fee as a producer in the much dryer province of Chaco which is at almost 1000 kilometres from the Rosario harbour. Through the transportation costs farmers in Chaco and Santiago del Estero are fined a second time, mister Canteros who works as an agricultural engineer in Chaco:

"also we are at a 1000 kilometres of the harbour and we are charged 400 pesos per ton that we want to transport, for someone that is at 10 kilometres this is 60, 100 pesos, fertilizers are more expensive because they also have to be transported 1000 kilometres to here, we experience a different priority, the taxes that we in Chaco have to pay is the same for producers in the humid Pampas, the percentage isn't nominal… it is 35% here and 35% in the province of Buenos Aires, an area in which it always rains, they always have a harvest. So that is the difference that we are talking about, the social difference with very high clases and very low classes and this also exists on the national level. So we pay the same taxes as a producer that is at 100 kilometres of the harbour." (Canteros, personal communication, 1st Octorber 2013).

Miss Urricariet of the SRA mentioned the fact that taxes are the wrong word for the 35% the government collects on all the GM soya export, because by paying taxes to the government inhabitants hope to see some of their payments flow back to their province, city or town in the form of public services like schools, hospitals, cinemas and theatres (Urricariet, personal communication, 22nd November 2013). This point is also mentioned by mister Canteros who lives with his wife and little daughter in the town of Las Breñas, Chaco. He explains that with the production of GM soya on the fields around the town a lot of money is made, but this rise in income is not met with a rise or development of the local hospitals or schools:

"I think that it was a very rapid growth, you see, 98, 99 the whole world started with this crop and it experience a very rapid growth and they left things at the side…in reality the word 'development' doesn't only mean economic development, social development and the health vocations so we have very rich cities and towns, like Las Breñas and Charata that have a very poor and basic hospital. (…) The quantity of the gross intern production of the towns grew but there is no development, with the schools happened the same. (…) When I need a pediatric for my daughter in the middle of the night I don't know where to go, because the doctor isn't here and the other hasn't got the stuff and if you go to the hospital they have the same that I have at home." (Canteros, personal communication, 1st October 2013).

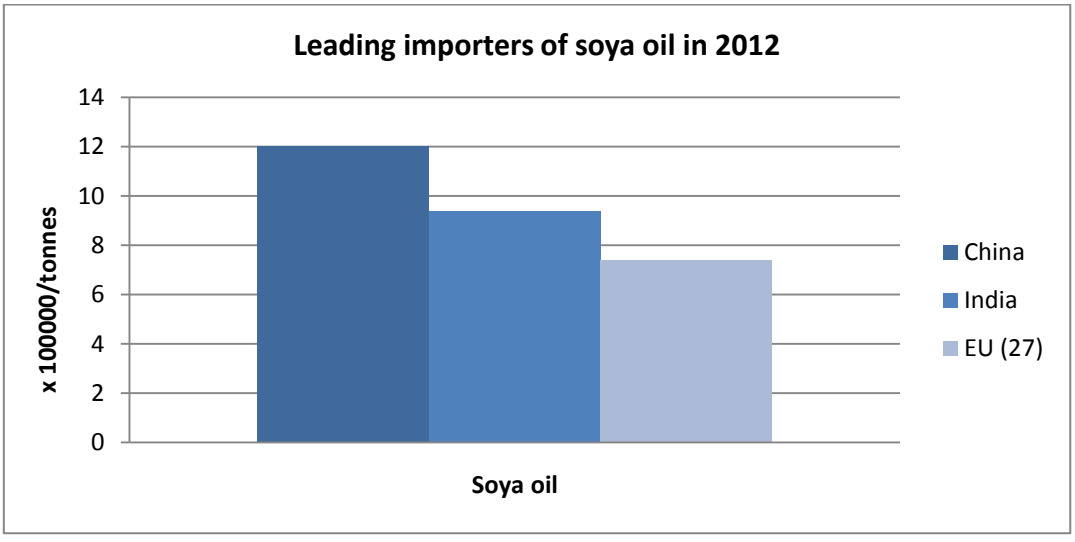
So the alliance that might be possible between the money earned with the production of GM soya and the local hospitals, schools and theatres is not being made. This alliance is also possible with the taxes paid by every inhabitant of Argentina. But in its capacity to act at a distance the Argentine government acts on the money they collect in the provinces. During the government of Carlos Menem, the minister of economy Domingo Caballo changed the tax system in the sense that he

organised for all the taxes to be gathered in Buenos Aires after which they would be redistributed. When GM soya was introduced the taxes were raised tells agricultural journalist, mister Bustos:

"Then soya appeared and suddenly the taxes were raised and all this money didn't stay with the provinces, but all went to the state. So the governors in the provinces had to go to the president to ask for money, and the president said that they only got money if they did what he told them to do. So he transformed in a dictator (…) the provinces can't manage the money themselves, only the oil provinces (…) Neuquén, Chubut, Santa Cruz, Mendoza and a small part of the Pampa. (…) The agricultural provinces. all of them Buenos Aires, Córdoba, Santa Fé, Entre Rios, Corrientes, Chaco, and Santiago del Estro, Salta also, all of them depend on the state. All the income of the agricultural sector goes to the state." (Bustos, personal communication, 15th November 2013).

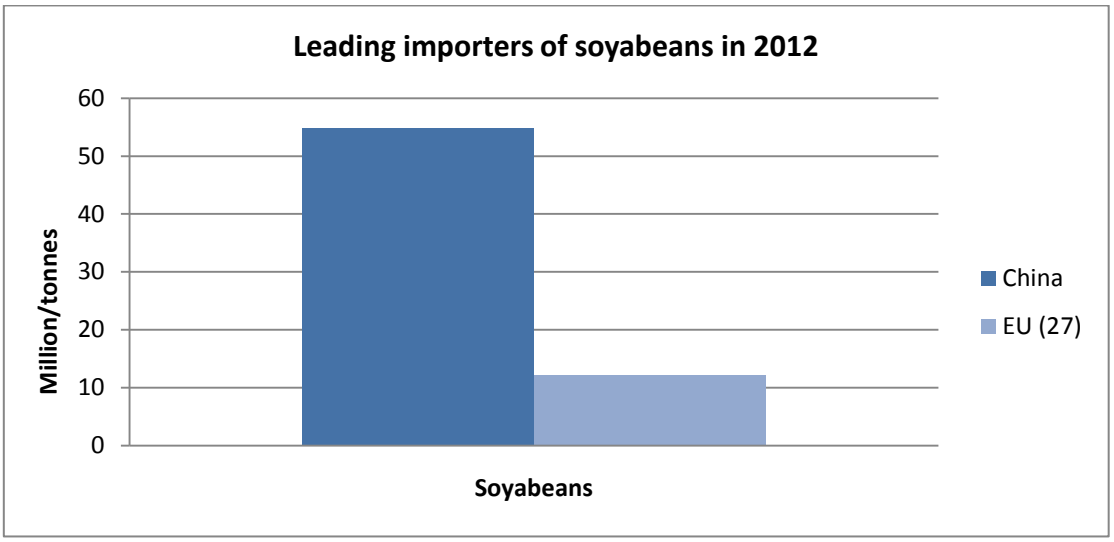
So the taxes paid in Chaco and Santiago del Estero only partially return to these provinces. But the redistribution of the taxes by the government of the Chaco province is being defined according to the amount of people living in a town or city. So the more inhabitants a city has, the more money it will receive from the state. The city of Resistencia has the biggest concentration of people in the province of Chaco so the majority of the redistributed taxes go to Resistencia, while the people that produce and paid most of the taxes live around small towns like Las Breñas. Both the taxes of 35% on the GM soya production and the redistribution of taxes in Argentina change the balance of power in favour of the people living in the cities and into a disadvantage for the producers living in the towns, again mister Canteros explains the unequality this causes:

"they take 100 dollars per ton of soya from me and to bring it there is very expensive. They can take it from me when the hospital develops, when the routes are good and when they don't cut the power during summer, when the social services are very good, you see, if you take 150 then I won't get angry, but the thing is that they take money for nothing, so the state takes 100 dollars per ton, 60 dollars stays with them and 40 dollars comes back to the province of Chaco [that] decides to distribute this according to the city with the most inhabitants and less money to the ones with less inhabitants. So Resistencia receives, I don't remember… 500 million pesos per year and Las Breñas receives 8 million pesos when in reality all the risk and all the production is taken here and in Resistencia there is no production.(…) So this is another form of unequality again." (Canteros, personal communication, 1st October 2013).



Graph 5: Leading importers of soya oil in 2012 (FAO, n.d.)

Since of October 2013, the EU has closed its market for Argentine bio-diesel which accounted for 90% of Argentine export of the almost 800.000 tons of soya oil the EU imported in 2012 (graph 5). In the same year the EU countries imported over 10 million tons of soya beans (graph 6). The EU commission has imposed a 340 dollar antidumping tax on every ton of Argentine bio-diesel (Sammartino, La Nación, 5th October 2013). Thereby interrupting the alliance that Argentina sought to consolidate through the export of GM soya oil, redefined as bio-diesel to European countries. The EU accused Argentina of dumping and unfair competition. Argentina has objected at the WTO, but it will take at least two years for the dispute to settle and until then the antidumping tax needs to be paid.



Graph 6: Leading importers of soyabeans in 2012 (FAO, n.d.)

4.7 The fluid actor

In this chapter we have followed the soya seeds throught its process of enrolment and redefinition into GM soya seeds, through its sowing and growing until the harvest of the beans and the redefinition of them into oil or beans. Allong the way we have at times followed other chains of actants connected to the actor network of GM soya production in the provinces of Chaco and Santiago del Estero. Without assigning intentionality and freedom to the nonhuman actors we have looked at both the humans and nonhumans actors and how they acted and intereacted with eachother and how they acted on others by processes of interessement and enrolment and how they acted by resisting enrolment and domination by others. We have seen that the GM soya seeds aren't made by "science", but by a whole chain of actants acting within an actor network, we have seen that the GM soya seeds don't enter from the "scientific" into the "agricultural" in the same way we have seen that taxes aren't made in the "political" and act on the "social", they act in relation to other actors, for example with the price of soya on the world market, the national debt of Argentina and the distance to the Rosario harbour. We have seen how knowledge concerning the cultivation of GM soya was being translated by the agricultural engineers which gave them the power to influence the actor network by their way of problematizing and solving of the degradation of the soils which led to specific actors, like fertilizers, herbicides and no-tillage sowing systems to be introduced into the actor network. And we have looked at how the sun and wind interact with herbicides and unwanted relation with the forest, people, animals, schools, water and plants around the GM soya fields. We were able to follow all these actants in this actor network, because we looked at them as

actants (human and nonhuman) in a field of forces that participate in trials of strength and weakness. This also illustrates the point that we should reflect on the term scale that is used within human geography. In following the actants we have crossed from what might be defined as the macro-, to the micro level and from the meso-, to the macro level or the other way around. At times we might even have stayed in between any of these levels. So in order to really be able to look at developments like the introduction of GM soya seeds we shouldn't start out by deviding the multitude of actants into a predetermined micro-, meso-, macro level structure, we should follow the actants wherever they go. We were free to follow the actants because we didn't try to put them into a pre-defined structure, we know that the relations, associations and interrelations within the actor network are fluid and are constantly being redefined and are far from linear, and in this fluidity they don't discriminate between humans and nonhumans showing that both human and nonhumans never act alone, they are always embedded within an actor network and are constituted and shaped by their involvement and their interaction with each other (Lee & Brown, 1994, p.775). This embededness and the fluidity of the interrelations makes it hard to establish sharp boundaries on what GM soya is. In this chapter we have come to know some of these identities, in the form of GM soya seeds they are a commodity that can be sold to make a profit, in the eyes of the agricultural engineer they are a plant that need 75 kg of nitrogen per ton, to the people living around the field, GM soya and its need for herbicide use causes cancer and other health problems, to the Argentine government it's a form of income to pay the interest on the national debt, to the Chineze it is high nutrient pig food and to the EU it is bio-diesel that lowers the CO^2 emissions. In each of these identities GM soya "contains a *variant* of its environment" (Laet & Mol, 2000 , p.252). In their study on the Zimbabwian bush pump Laet & Mol (2000) use the notion of the fluid (p.252) to be able to describe this aspect of an antant. Because of this fluidity, next to the fact that the boundaries aren't sharp, the answer to wether GM soya is succesfull also becomes a non- binary matter. The anwer to the questions if GM soya works can't be answered with a simple 'yes' or 'no', there are many more relevant answers possible. GM soya might proof a very profitable crop, but not for the farmers with small plots, it might provide for high nutrient pig fodder, but not for people. The discussion surrounding GM soya production in Argentina does present the answer to weather it is succesfull as being a binary matter. I will come back to this in the following chapters, but first we we will take a closer look at the GM soya actor network and the cotton actor network and how they interact and redefine each other.

5. GM soya actor network as actor

At the end of the former chapter I argued that by describing the GM soya actor network (without claiming to be exhaustive) I have demonstrated that an actor never acts alone, they always are embedded in an actor network and are shaped and constituted by their involvement and interaction with each other. In their study on the production of soya in Brazil De Souza & Busch (1998) mention the erosion of the peanut actor network by the soya actor network (p.351).We have seen how actants intereacted with each other within the GM soya actor network, now we will look at how this GM soya actor network interacts with other actor networks or how it has redefined other actor networks. This will be done by looking at the cotton actor network that exists in Chaco and how this was redefined in interactions with the GM soya actor network.

5.1 Cotton

In 1878 the first Italian immigrants went to live in the colony of Resistencia and with the help and work of the aborigines and creole people they started the agricultural colonization of the province of Chaco being challenged by the droughts in the area (Altamirano, 2013, p.21). Both the conquistadores and the Jesuits didn't really try to cultivate the vast subtropical forest that was covering most of the surface of Chaco, so for a long time Chaco just stayed the green 'desert' it had been for so many years (Mora y Araujo, 2013, p.36). In the words of historian Oscar Ernesto Mari:

"One of the significant identifying features of Chaco before its incorporation into Argentine society was precisely its hostile nature towards a white civilization. A challenging geography with dense forests, river deltas and insects; a torrid climate, very dry or very humid, depending the zone you are in; but above all the aborigines wars and resistance against the intention to civilize them" (Mari in: Mora y Araujo, 2013, p.36, translated from Spanish by the author).

At the end of the first World War Argentina received migrants from all over Europe, some of them came to the province of Chaco causing the population to rise from 46.274 in 1914 to 430.555 in 1947 (Altamirano, 2013, p.23) where the government set in on "creating new colonies and stimulated the cultivation of cotton, which made de hectares of cotton rise from 20.000 in 1918 to over 112.000 in 1930. The rise in cotton production mobilised many creole migrants from the neighbouring provinces that were used like pawns "golondrinas" (hired labourers without land) and made the industrial and commercial activities rise in the population centres." (Altamirano, 2013, p.23). Over the years the cotton production kept growing and an actor network of associations existed around the cotton farmers and the harvesters from the province of Santiago del Estero and Corrientes:

"Families from other provinces like Corrientes and Santiago del Estero, worked here. There existed a relation between the producer and the harvester, the producer had a card and he would pay for the journey and the next year the same happened, after the harvest they would return happy with the money to their province, to their families. (…) The farmer would arrange for the food and he had a book in which he noted everything and the harvesters had a smaller book and they noted everything and they would check each others books." (Ferrera, personal communication, 26th September 2013).

The cotton harvest in Chaco offered a lot of employment to harvesters from the neighbouring provinces, because it was done by hand, but also because the cotton fibres are being produced in the seeds pods of the cotton plant which demands for these seeds to be separated from the fibres before the fibres can be used and redefined into textile. So after the harvest the cotton has to go to the cotton gin to separate the seeds from the fibres which again offers employment to the people at

the cotton gin and then the fibres are being processed into textiles and eventually redefined in, for example, clothes by employees of a textile factory which are then sold in shops. This chain of actants generates employment, according to the Chaco government and agricultural engineer mister Canteros:

"Cotton generates a lot of work, (…) because the cotton has to be ginned which adds 15 to 20 employees, depending on the machine that is used it could add up to 60, 80 employees. The cotton harvest needs to be transported in 10 or 8 trucks, depending on how much you need, then the cotton is brought to the town to be purified (…) after which the fibre is brought to a textile centre to make things (…) so it generates a lot more employment (…) because of the ginning that is needed." (Canteros, personal communication, 1st October 2013).

Currently the production of cotton is being supported by the Chaco government because it generates more employment in respect to the processing of cotton into textiles. They install new ginning machines through cooperatives and the private sector and they try to brand "Chaco" in commercial centres and in Buenos Aires (Huergo, 2013, p.53). The government wants to make Chaco visible as a cotton producing province.

Before the GM soya actor network could change the balance of power in its favour in the provinces of Chaco and Santiago del Estero it had to expand its network by associating with a lot of other actants. Argentina was always focused on production for the export which made that Argentina was being redefined in the 19th century as the 'wheat barn of the world', because of the amount of wheat it produced and exported (Urricariet, personal communication, 22nd November 2013). We enter the chain of actants when under the General Agreement on Tariffs and Trade (GATT) the export of wheat and corn were being heavily taxed which left soya and sunflower as the only profitable crops for Argentina to produce. So this situation started the change of the balance of power in favour of soya. But this was only one of the many associations soya had to make before it could arrive in Chaco and Santiago del Estero and be able to interrupt the alliance between the farmers and the cotton crop. Soya was developed further in the provinces of Santa Fe, Buenos Aires and Córdoba (Bustos, personal communication, 11th November 2013). It was here that most of the developments described in chapter four took place. Soya first had to associate with Monsanto, RoundUp, Nidera, pesticides, fertilizers, no-tillage sowing systems and combines before it could be planted in the provinces of Chaco and Santiago del Estero. The combination of GM soya seeds, herbicides and fertilizer made associations with soils possible, that before thes associations were made might be deemed unsuited for the production of soya (Nassar & Antoniazzi et. al., 2011, p.4; Bisang, 2003, p.1; Canteros, personal communication, 1st October 2013). In China people could afford to spend more money on food and they redefined their food preferences in the sense that they started to eat more meat. In addition to that in Europe the alliances between car use, prices for gasoline and the amount of CO^2 in the air, formulated in governmental regulations led to an increase in the demand for GM soya oil for the production of biodiesel. This high demand in these countries made the price of GM soya rise (graph 3) as opposed to other crops and made farmers in Argentina decide to sow GM soya instead of other crops. This altered the balance of power even more in favour of the GM soya actor network instead of the cotton actor network.

Other forces acted more directly on the cotton crop. The appearance of the '*picu*' or Boll Weevil in English, made the flowering of the cotton plant and therefore the forming of the cotton fibre impossible. This type of beetle eats all the flowers of the cotton plants so the cotton won't grow.

Many of the farmers in Chaco experienced this plague on their own land. They describe that after eating all of their cotton the Boll Weevils started to eat the wooden fences and eventually even the electricity poles:

"All this part was cotton, over there was also cotton, one year we had beautiful cotton, it grew very well and then (…) it is very impressive how they eat and the damage that the picu plague does is incredible (…) when they broke up the harvest they started on the wooden posts along the road, the posts were covered in 'picu', very impressive how they went on, because there was nothing left to eat on the field, they started on the electricity posts, in the night a electricity post fell like that." (Brabo, personal communication, 30th September 2013).

For fighting the Boll Weevil the farmers had to buy large amounts of pesticides which raised the costs for the farmers. So the farmers were forced to sow other, less expensive crops like sun flower, GM soya and sorghum, but also convert to other activities like rearing animals like pigs, cows, chickens and goats. Some of these alliances proofed to be very profitable and were consolidated by the farmers. For example the alliance with the 'home raised chicken' that is in high demand for the quality of its meat as is explained by mister Ferico, an agricultural engineer of the INTA in Sàenz-Peña:

"The home raised chicken has a larger life cycle. The chickens not only have a well balanced alimentation, they also have access to all the fields around the farm. The taste of their meat is different and they adapt to any form of preparation, on a 'parilla' or with vegetable or other types of food. The commercial chickens obviously have a much shorter life cycle, they are produced in 45 days and when they are sold frozen they contain 40% of water. So when you have two kilos of chicken you are left with 160 grams of chicken, so that is the big difference between the frozen chicken and the consumer wants the home raised chicken, because a kilo is a kilo." (Ferico, personal communication, 26th September 2013).

Instead of defining the different forms of raising chickens as a researcher, the actors define the difference between a home raised chicken and an industrial one. This is where our ANT approach differs from scholars like Jan Douwe van der Ploeg (2009) who has an enormous amount of empirical evidence to support his division of farming practices into peasant-, entrepreneurial-, and capitalist farming systems (Ploeg, 2009, p.3). We accept the definitions given to us by the actors, but we won't add anything more to these definitions of the actors themselves, because by doing this we add something that comes from beyond the facts which can make these definitions 'sacred' or 'majestic' and we get stuck again in binary oppositions. Besides we don't want to reduce the heterogeneous actor network that makes up the farming practice of mister Brabo in the province of Chaco in all its complexity to a definition of a 'peasant farming' system. Mister Brabo himself does however define the way he raises his chickens as different and people are appreciating it, so the demand for it is high:

"the farm chicken, raised this way is selling very well, the people buy many what we call home raised chicken, because we raise it in a different way by us, we feed it corn and it has quality, but excellent, it is just delicious and it is in high demand, very high demand." (Brabo, personal communication, 30th September 2013).

For the indigenous farmers in Santiago del Estero their association with animals and the way they raise them has become an important way of defining themselves as opposed to what they define as the "capitalist" way of farming, as Oscar living on a farm near the town of Quimilí explains:

"I think that the future with the capitalist system that takes alimentation as merchandise isn't very favourable, because in order to produces alimentation you need fields, and you have to evict indigenous farmers families

that have been here for five generations and the capitalists think about the farmers production like archaic, an old production system that doesn't produces nothing. But it isn't like that, we produce a lot of very good alimentation and of good quality and sustainable in time, soya isn't sustainable over time" (Oscar, personal communication, 4th October 2013)

So up till now we have seen the alliance between farmers and the cotton crop has been threatened by the Boll Weevil and the GM soya crop that, through changing alliances in Europe and China, has begun to change the balance of power in its favour. But again the climate in the form of floods acted directely on the cotton farmers in Chaco:

In the year 1997-1998 a record was reached with 712.000 hectares of cotton being sown in Chaco (Huergo, 2013, p.53). The harvest was however severely disturbed by flooding's that brought the amount of hectares down to under 100.000 hectares of cotton being sown. But next to the flooding's also the price of cotton on the world market plummeted rapidly. Amongst other causes was the possibility of using polyester for making clothes. The price of cotton fell and farmers were forced to change their strategy by sowing other crops or rearing animals, but the floods left many cotton farmers in debt. Cotton and the other crops in the area got replaced by GM soya. Within ten years the amount of hectares sown with GM soya in Chaco had grown to 123.000 hectares in 1997 and now covers 700.000 hectares which results in a harvest of around 1.6 million tons of GM soya beans each year, while in 2010 336.300 hectares sown with cotton accounted for 445.664 tons of cotton to be harvested. (Ferreres, 2013, p.31).

5.2 Redefining the cotton actor network

In the former paragraph the Chaco cotton actor network was roughly described and we established that due to the characteristics of the cotton plant and the way it produces its fibres employment plays an important role in the actor network in which cotton is being produced and processed. Also the interrupting actants were mentioned consisting of the Boll Weevil, floods and the GATT and the falling prices of cotton that all participated in changing the balance of power in favour of the GM soya actor network. Like any actor network the alliances, interrelation and associations in it aren't static, they are fluid and the alliances are constantly being redefined, constituted and shape in relation to, and interaction with the other actants. This was also the case with the cotton actor network in which the farmers chose to sow other crops or concentrate on rearing animals. After the floods the cotton actor network might have been diminished in size and in the amount of cotton it produced, but it didn't disappear and it wasn't replaced by the GM soya actor network, but both systems interated with each other and redefined each other. That is what this paragraph will be about, the interaction between the GM soya and cotton actor networks and how they redefined each other.

During the visit of the Bunge S.A. fertility plant one of the Bunge organizers told me that you should look at what GM soya replaces, in Chaco and Santiago del Estero it replaces forest or cotton, but in the province of Buenos Aires GM soya replaces wheat which makes the transition less extreme. As we have seen in the former chapter the development of the GM soya actor network was mostly done in the provinces of Buenos Aires, Córdoba and Santa Fé, before it could interact with the cotton actor network in Chaco and Santiago del Estero. The problematization of the soil degradation by the agricultural engineer of the INTA and their translation of the knowledge conserning the cultivation of GM soya and other crops led, in interaction with the GATT and the transfer of information from the US to an actor network in which machines like tractors, no-tillage sowing systems, fumigating

installations and combines play an important role. The farmers within the actor network are therefore forced to associate with machines which elevate the costs of production. Mister Mellinger a Chaco farmer with 770 hectares explains the situation:

"What is happening at the moment with the costs is that all the costs are elevated, so the exploitation is big because you need machinery and everything, you need to have a machine that costs 300 thousand pesos to sow 100 hectares, with this machine you need 1500 hectares (…) that is the thing, this is the difference" (Mellinger, personal communication, 30th September 2013).

From a plot of 50 hectares a farmer can't harvest enough to earn back this investment a farmer needs at least 1500 hectares to earn back his investments in machinery. This makes that the GM soya actor network discriminates against farmers with small plots that consist only of 25, 50 or 100 hectares. The Argentine government by acting at a distance through resolution No. 125/08 strengthens this discrimination of farmers with small plots, by imposing an export fee that doesn't differentiates between big or small producers.

Because of actants like the Boll Weevil, floods and international prices the cotton farmers in Chaco with small plots already chose to sow other crops and rear animals. With the GM soya actor network changing the balance of power in its favour through the GATT, the inability of Monsato and Nidera to consolidate the patents on the first generation of seeds and the association with fertilizers, herbicides and no-tillage systems was now able to arrive at the soils of Chaco and Santiago del Estero. Soils that earlier might be defined as unsuited for cultivation with oilseed crops are now sown with GM soya because of the association with fertilizer and herbicides. This made it possible for the GM soya actor network to arrive in Chaco and Santiago del Estero. I use the word arrive here because this is what literally happened. Agricultural companies from Corrientes, Santa Fe or Buenos Aires rent plots in Chaco and Santiago del Estero to cultivate GM soya (Canteros, personal communication, 1st October 2013). Some of the farmers with small plots chose to rent their plots to agricultural companies for them to sow, while they went to live in the city or town. These agricultural companies are redefined as de '*pules de siembra*' (seed pools) and they might better be redefined as investing companies, because they gather money so the GM soya can be sown and then sell the harvest to earn back their investment with interest, they don't own anything themselves. They only provide for money to facilitate the production of GM soya. Agricultural engineer of the INTA in Las Breñas, mister Loto explains this new actor:

"What do the 'seed pools' do? They accumulate, gather people that invest money. (…) Different companies assemble a system so they can start with the agricultural activity, but they have nothing (…) they don't own any equipment. So they take the money, contract a professional agricultural engineer and he constructs a working plan. How they will execute this plan and they mostly cultivate soya and they look at the plan to know the amount of plots they need in different climate zones to minimize the risk of production (…) so at one of these geographical places they will have the best conditions for a good production. (…) The only thing they have are offices, technicians and vehicles and all the communication ofcourse. (…) It is a agriculture without producers" (Loto, personal communication, 30th September 2013).

So the interaction between both the GM soya actor network and the cotton actor network allows for investment companies or groups of investors, redefined as 'pules de siembra', to make time and associate with the small plots of farmers to sow GM soya. As was argued in chapter four the role of the agricultural engineer as an OPP in translating the knowledge concerning the production of GM soya is crucial. With this knowledge concentrated in the person of an agricultural engineer makes it

possible for people that don't have any experience with agriculture to hire his services. To assemble the money, the GM soya seeds, equipment, and knowledge in the person of the agricultural engineer the investor's only need offices, telephones and computers. This is what Castells (2009) might see as an example of how information technology enables global flows (p.77), in this case between Argentine investors, the production of GM soya and the agricultural engineer, and the GM soya harvest with which they can speculate on the global market. But ANT shows what this 'flow' is made of, makes visible that it is made up of both human and nonhuman actors that interact with each other, but more importantly ANT shows the embeddedness of this chain of actants within the actor network.

So for the production of GM soya a skilled human user is needed in the person of the agricultural engineer that manages the production that is done by associating with a lot of machinery that replaces the skilled employees. These machines only work in alliance with human actors, but much less human labour is required to operate them. There are already machines that are controlled by satellites and the farmers can follow the progress on his mobile phone (Ferreras, personal communication, 29th September 2013). But I didn't come across this kind of machinery in Chaco or Santiago del Estero. When we look at the cotton actor network we see that it offers more employment because of the way the fibres grow in the same pods as the seeds the harvested cotton needs to be ginned and the processing of cotton into textile makes it a more labour intensive actor network, while in the GM soya network most of the work is done by machines as explained by mister Mellinger:

"Cotton is a more complex crop, because of the plagues they abandoned this social crop that they always used to sow. Before there were harvesters, I grew up with cotton and we sowed more then 100 hectares of cotton and we had more than 90 harvesters which was in the 60s (…) people from Santiago that worked in the forest would come to harvest the cotton, but that disappeared. There are no harvesters anymore, very few and it is hard to find them. That's why nowadays they mechanised everything, so nowadays cotton is a crop for only the big companies, companies that have a financial support, because the herbicides are very expensive, the insecticides, it's a whole system, it needs a big investment to be able to earn it back. So I don't have cotton, I abandoned it, but with the INTA they are again returning to cultivate cotton with good results, because Chaco was the ultimate province with cotton, but with all the mechanization, harvesting and everything, nothing by hand." (Mellinger, personal communication, 30th September 2013).

This is also the way that farmers of MOCASE-VC define the problem, in the sense that labour has become of less importance to the GM soya-, and also the cotton actor network. Oscar of MOCASE-VC explains the importance of labour in their community:

"We have a cheese factory which offers employment to ten families and it has a small production capacity, a soya field of 100 hectares offers employment for only two people, so look at the relation that exists (…) to construct a plant to extract soya oil for I don't know how much pesos, offers work to three persons, we make very little money but offer work for ten families." (Oscar, personal communication, 4th October, 2013 Santiago del Estero).

Now we have arrived at what might be the clearest example of how the GM actor network and the cotton actor network have interacted. In chapter four I argued that the engineers of the INTA introduced, in relation with other actants, specific actants like fertilizer, no-tillage systems and a crop rotation system in the GM soya actor network. The agricultural engineer defined the problems and how they should be solved. Especially the agricultural engineers of the INTA defined the problems

they encountered by moving their experimental station close to the production areas and the producers. This happened also in the cotton actor network. In Chaco transgenic cotton has been developed with the help of the experimental station in Sáenz Peña of the INTA. Monsanto developed its own GM RR cotton and plagues like the Boll Weevil are now under control (Huergo, 2013, p.53). At the moment the INTA is working together with local metallurgies to develop a combine that can harvest cotton, and in doing so they try to change the balance of power in favour of the cotton actor network. By facilitating a cotton harvesting combine the costs of the labour intensive production of cotton could be lowered.

At this moment two systems, known as the "stripper" (plate 9 C), which collects the whole cotton plant, and the "pickers" (plate 9 D), which collects only the cotton fibres, are competing with one another (Huergo, 2013, p.53). To be able to harvest cotton, combines that are used to harvest wheat, GM soya beans or corn are being adapted to become redefined as a "stripper" or "picker" harvesters. Mister Wouchuk is a local metal worker who establishes this transformation of combines designed to harvest GM soya, wheat or corn into cotton harvesters:

"Since eighth, nine, ten years we make this system called stripper to harvest cotton. And at the moment we are fabricating harvesters with pre-clean equipment, what does this mean? The cotton is harvested bruto, with shells and the machine sacks the shells, branches and sticks, not for a 100% but for 50% and the this platform cleans the cotton. (…) What I did was taking a part of a ginning machine and designed this machine which we have now and separates all the green sticks (…) The combine originally comes with a harvesting system that doesn't collect the mayority of the cotton, much of the cotton is left on the field. (…) With this new system everything is collected." (Wouchuk, personal communication, 2nd October 2013).

(clockwise)Plate 9: (a) An example of how the combines are being redefined and acted upon, this motor block was replaced between the wheels by the metal workers, (b) parts of the 'stripper' system with pre-cleaning

function, the white arrow indicates the place in which these parts are placed. Plate 9 (c) and (d) show the difference between a 'stipper'combine (c) and a 'picker' combine (d). The black arrow indicates the difference. The stripper needs a pre-cleaning unit because the whole plant, with sticks and earth are taken in by the combine, while the picker only need a tube to transport the cotton fibre to the back, most of the rest of the plant stays on the field (Photographed by the author).

Plate 10: The front of the 'picker' combine, with a close up of the 'picker' harvesting systems, the pins that can be seen turn round and the cotton fibre sticks to the metal hairs on them and is then transported to the back of the combine. (Photographed by the author).

The front of the picker combine shown in plate 10, also shows the need for a no- tillage system on which the distance between the crops can be adjusted (paragraph 4.2.2) so the front of the combine can also be adjusted to the distances between the row of cotton plants.

The development of cotton harvesters might lower the costs that come with harvesting, but as mentioned above by mister Mellinger "cotton is a complex crop" (Mellinger, personal communication, 30th September 2013). This in relation with the relative large investment needed and the higher risk of earning it back might cause that the balance of power is still in favour of GM soya the production of which is stabilizing around 700.000 hectares and a production of 1.600.000 tons per year, which makes it the primal economic activity in the region (Huergo, 2013, p.54). With the introduction of the cotton harvesters the cotton actor network is being redefined and it changes the balance of power in favour of producers with financial resources and plots of at least 1500 hectares. The cotton actor network therefore discriminates against producers with plots of 25, 50 or 100 hectares. The complexity of the cotton crop can also be exactly the reason why a producer choses to sow it, for example for mister Canteros:

"We have chosen cotton because it is a challenge. But also because we live in Chaco and because we are agricultural engineers we have to cultivate cotton (…) [A]s agricultural engineer I like our crop, cotton better, het requires more management, we need to thing more, it has more opportunities, corn needs rain at very precise moments, it can't do longer then 10 days without rain, after 10 days you're output is lowered by 70%.

When it doesn't rains with cotton, you are able to recuperate and you can solve it" (Canteros, personal communication, 1st October 2013).

Mister Canteros collaborates with cotton because of the challenge that comes with it, the creativity and the skill he, being an agricultural engineer, has to exercise to produce high quality cotton. But the fact remains that you need a certain amount of hectares and money to be able to forge an alliance with the cotton crop. At the moment GM soya is still the main crop in Chaco, but the droughts in the region challenge this alliance, because without rain some producers are again returning to cotton, which can endure droughts better than GM soya can. Leo who sows 700 hectares of cotton in Chaco and rotates with GM soya, wheat and sorghum tells about the special qualities of the cotton crop:

"Cotton as a crop is much more resilient. It is more resilient, and it has more possibilities to allow a harvest and with soya these last years it is going down because there is no water, the wells are drying up so soya becomes more difficult to sow (…) Cotton is a word from Chaco, this is what Chaco did, cotton, animals and carbon. It was always like that." (Leo, personal communication, 1st October 2013).

5.3 The fluid actor

Again we have followed GM soya throught the field of forces, but this time we followed it to Chaco and Santiago del Estero and we have seen how the interaction with the cotton actor network made it possible for GM soya to arrive in these provinces. Floods, 'picu' plagues and the low price for cotton left the cotton farmers to look for alternative ways of production, some turned to rearing animals, others converted to sowing GM soya, made possible by the development of the GM soya actor network and the introduction of fertilizer, herbicides and no-tillage systems. Some farmers decided to rent their plots to investment companies who needed the agricultural engineer to translate his knowledge and sow GM soya for them. We saw the same translation of knowledge by the agricultural engineers of the INTA in defining the problems of the cotton actor network and solving them by developing a GM cotton crop which reduced the thread of plagues, Monsanto developed its own GM RR cotton and the labour intensive harvesting of cotton was solved by redefining combines into cotton harvesting 'pickers' or 'strippers'. In paragraph 4.7 I argued that the fluidity (Laet & Mol, 2000, p.252) of the GM soya makes it impossible to set sharp boundaries, but also that it makes the anwer to the questions: if GM soya works as it is supposed to? Is it succesfull? A non-binary one. This chapter has shown this fluidity again in the sense that it has shown that GM soya might be succesfull in the wet climate of the province of Buenos Aires, but not in the dry climate of Chaco and Santiago del Estero. And that this might have caused a shift in the balance of power in favour of cotton again, but not for the farmers with small plots and not after the cotton actor network has been redefined by its interaction with the GM soya network. In the following chapter we will look at the aspect of visibility and how the discussion surrounding the GM soya actor network is being presented as a binary one by some of the actors that are allowed to speak for other actants.

6. Visibility

For Pasteur to be able to dominate and fight the microbe he had to make them visible first. In this the pasteurians acted “like the first observation balloons. They made the enemy visible.” (Latour, 1988, p.34). In the second chapter I argued and showed that visibility can be important in academic theory, with an example of Van der Ploeg (2008) who illustrated the invisibility of “peasants” in agricultural theories, but also in daily practice with the use of technology needed for some actants to be made visible, the unborn baby that can be made visible by ultrasound technology. In this chapter I will build on that argument and I will take this concept of visibility by looking at how the GM soya actor network becomes visible in respect to how it shapes other actants within the actor network. The instrument of the map will come to the fore as a method used by different actors to make themselve visible. Within “cultural” geography the study of maps is used to make the invisible “political” and “cultural” implications that come with constructing maps visible, even as the power relations depicted in them (Cosgrove, 2008). Within ANT maps can be seen as actants in the spatial transfer of knowledge, transforming knowledge into an immutable mobile, allowing for ideas and knowledge to move physically over space (Cosgrove, 2008, p.165). In this chapter we will look both at maps as transforming knowledge into immutable mobiles and as an instrument, used by the actors to make themselves visible. These might some times have a background in “cultural” or “political” reasoning, but this has to do with the fluidity (Laet & Mol, 2000, p.252) of the actor, as argued in paragraphs 4.7 and 5.3, being the different identities the actor can have within the same actor network.

This chapter will also look at instruments other than maps alone that are used by the actants to make themselves visible. And it looks at how actors, who sometimes are allowed to speak for groups of actors, define, shape and constitute each other, how the MOCASE-VC, the SRA, the FAA, the ConInAgro and the CRA use magazines, radiostation, television programs and websites to make their definitions and problematizations of problems and of the other actants involved, into immutable mobiles.

6.1 Shaping communities

As argued before actants in an actor network never act alone, they are always embedded in an actor network and are shaped and constituted by their involvement and interaction with each other. This shaping of actants by the actor network became directly visible during my research in Santiago del Estero where the indigenous farmers of MOCASE-VC live in communities that are situated within native forest that is surrounded by GM soya fields. Juan, an indigenous farmer, descendant of the Guaycurúes, drew the shape of their community for me in the sand (plate 11). For sake of clarity I have digitally changed the contrast of the photo and drawn a line outside the actual lines in the sand that were drawn by Juan. Juan was one of the first members of MOCASE-VC and has seen his house being demolished by the provincial government (plate 12).

Photo 11: The form of the MOCASE-VC community as drawn in the sand by Juan, the straight line at the top is a route and the bulges at the botton are corners in which indigenous families live. The territory of the community consists of 1.520 hectares (photographed and modified by the author).

In chapter five I argued and showed that the development of the GM soya actor network in the provinces of Buenos Aires, Córdoba and Santa Fe made it possible for GM soya to arrive in Chaco and Santiago del Estero. Due to high price for GM soya and the association with fertilizers, herbicides and no-tillage systems the formerly classified "marginal zones" (Leo, personal communication, 1st October 2013) became suited for cultivation of the GM soya crop. Therefore the price of the land has risen because of the possibility to cultivate GM soya that can be sold at a high price. This has led farmers with small plots to decide to rent their plots to bigger producers or investment companies to cultivate them. The indigenous farmers in Santiago del Estero didn't have the legal rights to the lands they lived on for generations so the balance of power was in favour of investors that wanted to buy the land for GM soya production. This led to the eviction of indigenous farmers from their lands and their farms were being demolished. Through the armed policemen overseeing the eviction and demolition the Argentine state didn't act at a distance anymore, as we have seen before by creating a law, but directly through the armed policemen. Throug this, the imbalance in power and the acting role of the state on the indigenous farmers and their houses became clearly visible (plate 12). By uniting in the MOCASE-VC the indigenous farmers could turn the balance of power, at least a little, in their favour again and they have consolidated their right to their territory for at least another five years through law No. 2660 (Juan, personal communication, 1st October 2013; Paulo, personal communication, 4th October 2013). Without a contract that stated their right to the land the indigenous farmers weren't visible within the Argentine legal system. Until they united in the MOCASE-VC and MNCI and made themselves visible by demonstrations in the province of Santiago del Estero, using the bells of their goats and cattle to make themselves heard and visible. They also demonstrated in Buenos Aires until their visibility was being established through ley No. 2666. Herby slightly changing the balance of power in their favour in the sense that they are allowed to live on

their lands, consolidating the alliance with their territories, but not without being literally shaped by the GM soya actor network, as is shown in plate 11. To be able to use as much land for production as possible the community in which Juan lives has this form.

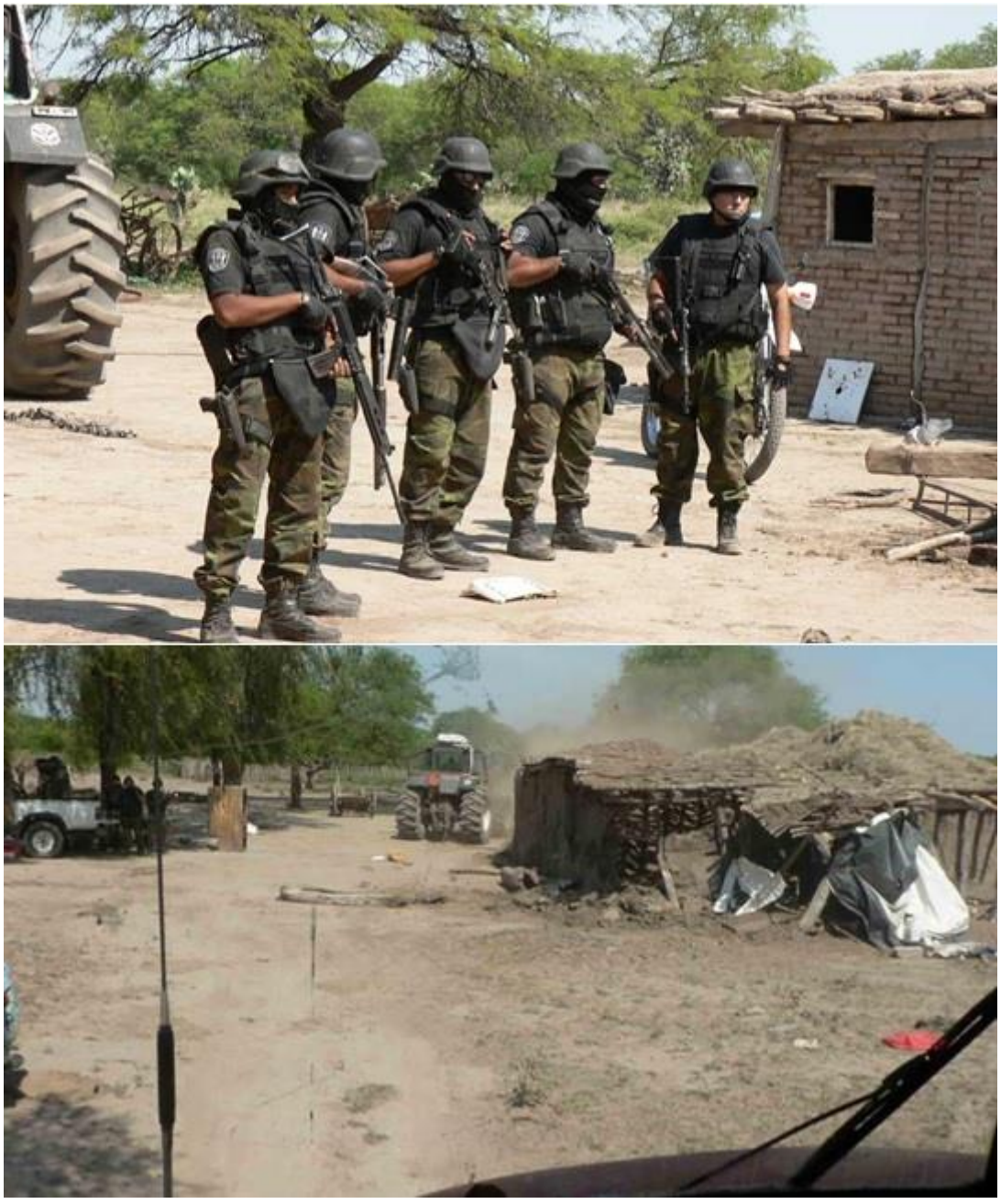


Plate 12: (above) Armed police overseeing the eviction and demolishing of the farm of Juan with a tractor (below) making the state as an actor visible.

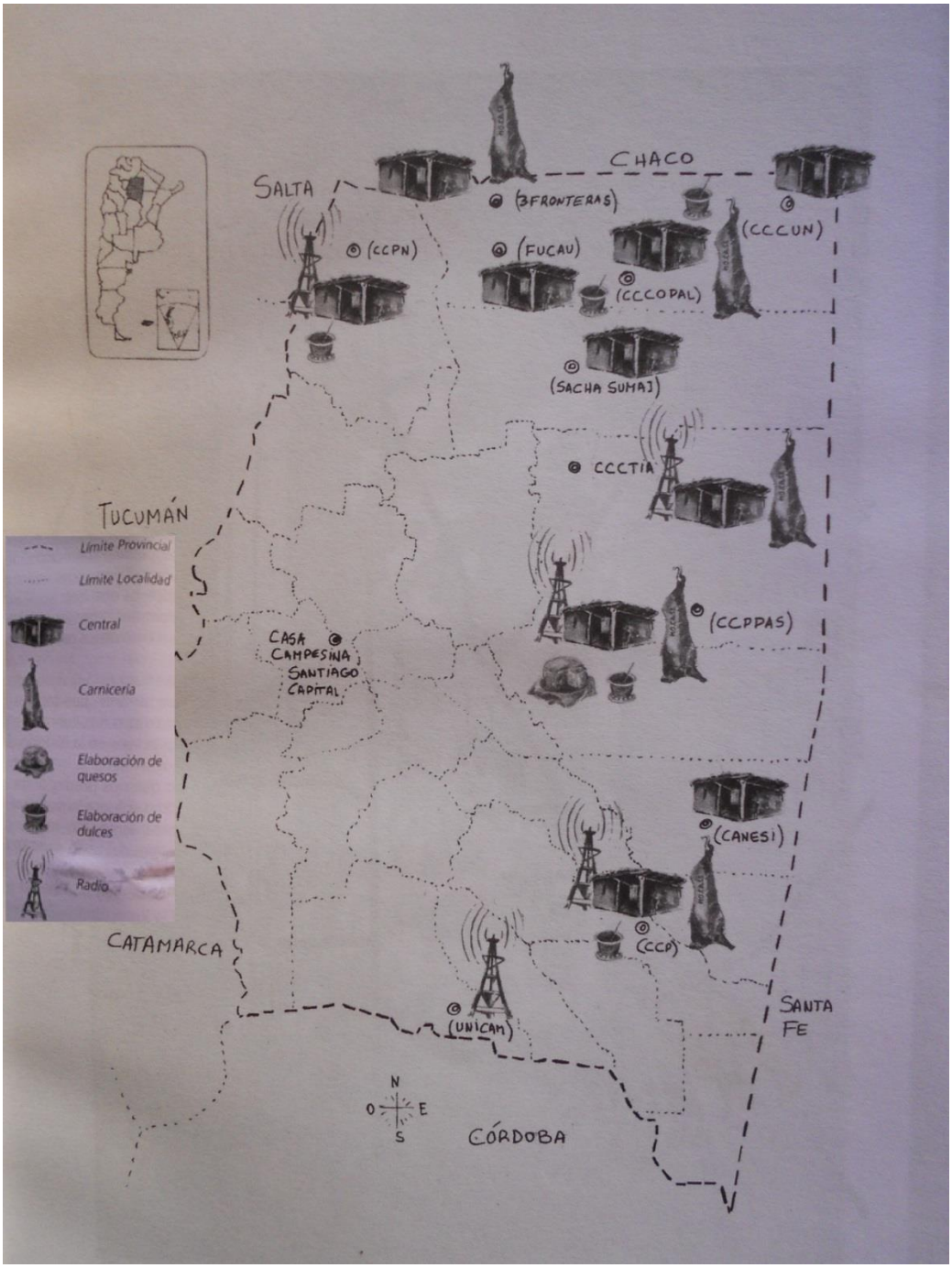
6.2 Making contamination and communities visible

In chapter four the risks of contamination by herbicides was already discussed and I referred to Domínguez & Sabatino (2011) who registered the cases of contamination in Paraguay and Argentina between 2002 and 2007 and came to a total of 40 cases in Argentina (p.66) of which 72,5 % concerned cases in which people experienced the contamination effects and in 27,5 % of the cases it concerned animals or crops (Domínguez & Sabatino, 2011, p. 67). They also made these cases visible

by making a map (map 5). The same was done by the neighbour organization of the mother of Ituzaingó in the province of Córdoba, who made a map of their neighbourhood on which they marked all the cases of leukaemia and malformations and they sought collaboration with researchers to support their claims that the reason for this high percentage of cases was due to the spraying of glyphosate based herbicides (The Goldmanprize, n.d.). Doctors in villages surrounding soya fields all reported cases of cancer and started to work together to establish a register of cancer cases which recently has been taken up by the Argentine government that before that time didn't have a registration system to monitor cancer cases (Starosta & Orden, 2013, p.23). These are all initiatives taken in the provinces Córdoba, Santa Fe and Buenos Aires where GM soya production was developed with the introduction of the GM soya seeds in Argentina. In Chaco and Santiago del Estero the effects of the GM soya production still needs to be made visible.

Map 5: Cases of contaminación made visible by Domíngez & Sabatino (2011, p.69)

To make their communities visible the MOCASE-VC movement uses a map with all their communities, radio stations and factories on it. They distribute this map by printing it in a book on the history of the community in Quimili. This book is part of a series of books on all the communities in their province. These books always have the same title: 'Memorias de los orígenes de la central Quimilí' (Memories of our Origens of the farmer's community of Quimilí) only the name of the respective community is different. In these books the MOCASE-VC writes its own history and how they define the cause of events by using newpaper articles and photos of their activities.



Map 6: An example of how MOCASE-VC makes itself visible by drawing maps which shows all their actants with which they associate to make themselves visible.

These books therefore become immutable mobiles for the knowledge, definitions and ideas of the MOCASE-VC movement to be transferred to other part of their province, but it can also be sold to visitors from Buenos Aires, and brought with them when they visit a congress of the international Vía Campesina. But these aren't the only ways in which nonhumans actors are used to transfer their ideas, knowledge and definitions of the other actants in the GM soya actor network. As mentioned by Oscar in chapter five they also make themselves visible by producing 'good alimentation' in the form of goat cheese, jams and meat that they sell throughout the province and also in Buenos Aires (Gomez, personal communication, 4th October 2013). And as can be seen on the map they also use radio stations to make themselves visible and transfer their information throughout the province.

Plate 13: Another way in which MOCASE-VC makes itself visible (Photographed by the author).

Within the GM soya actor network certain actors are allowed to speak for other actors. The MOCASE-VC is allowed to speak for the indigenous farmers in Santiago del Estero and in their national organization MNCI they are allowed to speak for the indigenous farmers in the whole of Argentina. By joining the intercontinental organized CLOC and internationally organized Vía Campesina, the indigenous farmers can communicate their message throughout Latin America and the world. The SRA, the FAA, the ConInAgro and the CRA are all allowed to speak for their members that can be the farmer cooperatives in Argentina or the small-, and medium producers or all the producers in Argentina. They all use other actants in the form of radio stations, television programs and magazines to make themselves visible and to speak for their members and tranfer their view on the balance of power within the actor network and their definition of-, and relation to the other actants in the same actor network. The radio station of MOCASE-VC is called: 'Radio Monte' (Forest Radio), while the radio station that the SRA, the FAA, the ConInAgro and the CRA promote is called: 'Hombres de Campo' (Men of the Countryside). The ConInAgro has its own television program, called CONINAGRO Teve (plate 14). All the organizations use magazines to make themselve visible and to make their information and knowledge immutable mobiles. In their capacity as immutable mobiles the magazines transfer knowledge in the form of technical article that might serve the farmers in the production, articles on the organization and its activities and articles in which they define their view on the field of forces and the GM soya actor network. In the following paragraph we will analyse the different magazines that are used by the different organizations and look at how they define the other actants in the GM soya actor network through their use of texts and photos in their magazines.

Plate 14: Advertisement for CONNAGRO TV, the title at the bottom says: “We give visibility to corporatism in the countryside” (Integración, January 2014, p.47)

6.3 Defining each other

In chapter four and five we have explored the GM soya actor network by following the GM soya seeds from the laboratory through its sowing and growing till the eventual harvest of the GM soya beans. We have seen how, within this actor network the nonhuman actors, in the form of fertilizer, herbicides, no-tillage sowing systems, fumigation installations, tractors and combines, changed the balance of power in their favour as opposed to nonhuman actants that require manual labour. In the interaction between the GM soya actor network and the cotton actor network we saw the cotton actor network being redefined from a network in which manual labour was very important into an actor network in which the same nonhuman actors as in the GM soya actor network changed the balance in their favour. In doing so they discriminate against the small scale farmers that don’t have the financial resources to obtain these nonhuman actors. By applying the same ANT methodological principles as used by analysis of the data for the former chapters, I used them in this paragraph to analyse the magazines of the SRA, the ConInAgro, the FAA, the CRA and the MNCI. We can see that this difference in the access to these kind of nonhuman actors becomes important in defining the other associations within the actor network.

Plate 15: The covers of the magazines of the ConInAgro, the CRA, the SRA, the MNCI and the FAA (Integración, January 2014; Las Bases, June 2014; La Rural, May/June 2014; Falta Menos, april 2010; La Tierra, August 2014)

Plate 16: The covers of other editions of the magazines of the ConInAgro, the CRA, the SRA, the MNCI and the FAA (Integración, November 2014; Las Bases, October 2010; La Rural, October 2013; Falta Menos, November 2011; La Tierra, April 2014)

We will begin by analysing the covers of the magazines and then move on to the advertisements and then look at the articles. The cover of Integración, No. 38 January 2014 shows a field in which grapes, a cotton plants, two corncobs, a cow and a tractor are being enclosed by a note of a 100 US dollars and a note of a 100 Argentine pesos, with the title “How is the countryside being effected by the falling exchange rate”. The cover of Integración, No. 37 November 2013 shows the flags of both Argentina and Brazil and two hands shaking each other and a group of people above the title”CONINAGRO in Brazil”. The Las Bases of June 2014, No. 73 shows a photo taken at the CRA congress with the title “Concerned about the future” and an advertisement for firestone tires at the bottom of the page. The Las Bases No. 30 of October 2010 shows US dollars pouring into a funnel with coins coming out of the funnels mouth. The title reads: “The law of the funnel”. And the magazine of the SRA of May and June 2014, No. 2 shows a field of wheat with a worldmap over it which in turn is covered by the logo of the World Organization of Farmers with the title: “The global agriculture used to have his headquarters in Argentina”. And on the cover of the October edition of 2013, No.4 the SRA shows a statue at the top of the stadium that the SRA uses for expositions and demonstrations which is situated in Palermo, one of the neighbourhoods of Buenos Aires. The title simply reeds: “Always Palermo”. The front of ‘Falta Menos’, No. 1 April 2010, shows a farmer on a cart that is pulled by a horse or mule and at the bottom is the following text:

“A friend of ours shared a fact that, we think; expresses our conviction. One afternoon he rode in his pick-up truck on a faded road through the forest and saw a girl on a bicycle approaching in the distance, he slowed down to diminish the dust his truck made. When she neared he opened the window and asked: is it long to the next place? A thousand year silence arose from the air and her gaze, ….the girl looked, behind at the old tracks and looked in the direction she had to walk; and after an eternity full of pauses she gave an eternal message:

you have less to go…Maybe we are these walkers, builders, seeing that we have to go less, now we have less to go…" (Falta menos, 2010)

The cover of the 'Falta Menos', No. 3, November 2011, shows a tree in which two faces are visible. One of the branches holds a hoe and another one holding a book with the image of Che Guevara out of one branch grows a corncob. And the last cover is that of the La Tierra of August 2014, No. 7530, which carries the title "Producers and labourers on strike" with a photo of the directive board of the FAA that has made the decision to go on strike. Further the cover offers some short introductions to articles in this edition, one article on the floods, one on assemblies in Mendoza and one on the dairy farmer crisis. And at the bottom it recalls the celebration of the 102 years anniversary of the FAA this month. The cover of the La Tierra of april 2014, No. 7526 carries the title "An achievement of everyone: the FAA has a new statute" above a photo of the FAA congress in Rosario with the members holding their hands up to vote for the new statute. The rest of the cover again introduces articles that this editions contains on the international FAA gathering on family agricultura and a meeting with the Uruguayan president Mujica, a strike is being announced and the agricultural emergency concerning extreme weather conditions and possible help of the provincial government is mentioned.

The different display of nonhuman actors on the covers of the magazines is interesting to note. Money, tractors, different crops, conferences or buildings are shown on the magazines of the ConInAgro, CRA and SRA, with the magazine of the FAA standing out in the sense that it shows more the direct problems of their member, like floods and calls for strikes, without symbolically showing the problems like on the cover of Integración or La Rural. The magazine of the MNCI shows a horse pulled chard or a tree. Also the titles or texts reveal a different message or alliance. The text on the 'Falta Menos' is a story referring to the forest and featuring a girl on a bicycle and the symbolic way the indigenous farmers still have to go. While the titles on the other magazines refer to exchange rates, a call to strike, laws or concerns about the future or express opinions on the role of Argentine agriculture in the world or that the SRA will always be.

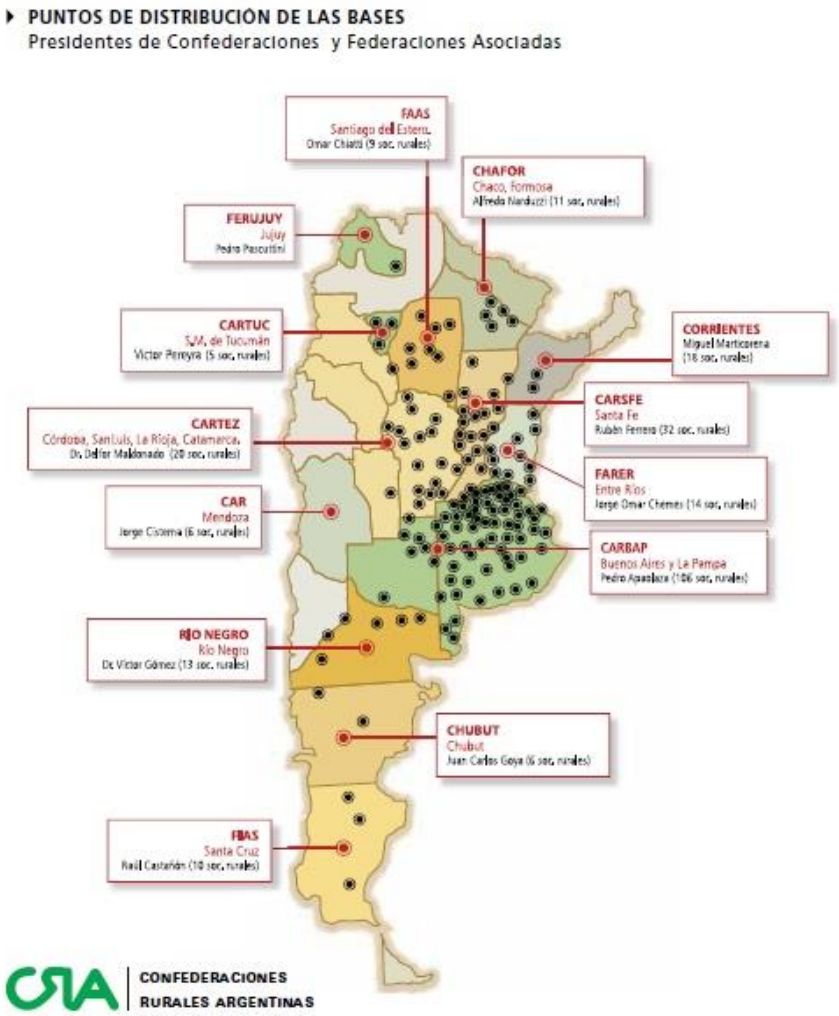
If we turn the pages of the different magazines the alliances forged by the different organizations become clear. In the 'Falta Menos' magazines there are no advertisements of agricultural companies or banks. The lay out is all in black and white and with illustrations and photos which show mostly people, trees, horses and other nonhuman actants in the form of manual tools used by farmers in the fields. Photos of demonstrations and projects which show groups of people with banners, flags and drums, wearing t-shirts and caps with the logo of MNCI or MOCASE-VC. Photos of groups of young people in the countryside with a guitar, or a group of people sitting on the ground outside a small house made of wooden plates and other material, women with their children on their arms. Illustrations in the form of cartoons are mostly showing oppression of the farmers or people by people that have money or power. Themes of the articles are climate change defined as caused by the current organization of society, the conflict surrounding land titles, water scarcity, reports of demonstrations or projects, histories of a place or people, special report on a person that is an example for their cause and declarations of MNCI. The 'Falta Menos' consists of 25 to 30 pages.

Plate 17 : (above) A few cartoons that were printed in the ‘Falta Menos’ of the MNCI in which the farmers are depicted as surpressed by landlords or man in suits. (below) Also photos of their members working the land with manual tools (Falta Menos, November 2011)

The magazines of the ConInAgro, Integración shows advertisements on the first two pages followed by an editorial. The magazine contains 60 pages and shows a lot of graphs that illustrate articles on the dollar or production of meat, GM soya or other crops. It also contains reports of conferences and gatherings with photos of people in suits or shirts holding microphones, standing in front of a PowerPoint presentation in a well lit conference room with glass plate tables and wooden furniture. Interviews with new members or a folksinger and a report on a gathering with people of the INTA.

Plate 18: (left) The back of the 'Falta Menos' with photos of a demonstration for 'food sovereignty', (right) and some photo's made at the annual ConInAgro conference (Falta Menos, April 2010; Integración, January 2014)

The Las Bases editions of the CRA have a lay-out like a newspaper and presents itself also like one. An edition contains around 28 to 32 pages. When we turn the cover the first page shows us an editorial and also a map (map 7)with the amount of members they have in each province of Argentina which is a total of 65.000 producers. In this way CRA is also using a map to make themselves and their members visible. The article are a lot of interviews with CEO's of big companies like Shell or with an economist. Las Bases contains reports on congresses of the CRA or on agricultural themes – like the meat production and the taxes on export – which show a lot of men in suits holding microphones or sitting in a conference room. The articles show many photos of the presidents of companies like Dow that were present at one of the conferences. It contains articles on young members of the SRA and also a lot of graphs illustrate articles on production. And it shows photos of demonstrations and contains articles on more environmental friendly production. The advertisements contain a lot of images of nonhuman actants in the form of farming technology like machines to feed cows, harvesting machines and also pick-up trucks of Ford or Chervolet.



Map 7: A map in Las Bases with all their distribution points throughout Argentina (Las Bases, June 2014, p.2)

The La Rural edition of May-June 2014 shows advertisements at the first two pages which is followed by an editorial. The editions contain 88 to 96 pages. This edition is mainly about the OMA conference that took place in Argentina and addressed issues of sustainability, world hunger, women and the youth that is active in the SRA and the closing of the OMA conference which was through a visit to local farmers. Other articles are on the political situation in Argentina and the representation of the SRA at the UN. A summary of the activities of the SRA, an article on horses and a report on a forum of enterprises and an interview with a writer. The edition of October 2013 is mostly about the annual exposition of the SRA in Palermo. The ceremonial opening of the exposition is shown, the speech of the president of the SRA and a lot of photos taken at the event which show the cows that won awards, the horse demonstrations and the visitors and all the activities they could join on the exposition. An article on the boom in the construction industry illustrated with a lot of graphs. An article on the re-instalment of an important railway. An article on the pressure of the taxes on production. An article on the production in Salta and a report of a forum on the genetics of bovines. Another article on the taxes in relation to inheritance. An article on the milk production, a report on a congress organised for university students and two articles on charity events in which the SRA participated followed by a summary of the activities of the SRA in October and a memorial for a deceased member.

Plate 19: An example of an advertisement from the magazine of the CRA on which the nonhuman actors in the GM soya actor network are shown (Las Bases, October 2010, p.31)

The magazine of the FAA, La Tierra, has the same newspaper lay-out as the Las Bases and an edition can contain 28 to 32 pages. The second page in both editions advertisements on the benefits that members have by certain banks or other companies. Followed by articles on the FAA organization by articles on conferences or the annual FAA congress and some articles on the grain or milk production and the difficulties the farmers in these sector are facing through government policies or extreme weatherconditions. An extensive part of every edition shows articles from the differen affiliations of the FAA throughout Argentina, including women's affiliations. These articles show many photos of conferences or local gatherings but not always in well lit conference rooms, also in small rooms with plastic stools for the people to sit on. Some pages of technical information and every edition ends with 'El Grito' which is the magazine of the youth organization within the FAA. Although much of the magazine contains articles on the FAA itself and its affiliations throughout Argentina, it also contains advertisements for agricultural equipment like tractors, fumigators, second hand combines and no-tillage sowing systems.

Plate 20: An advertisement for Chevrolet with the title: "Another thing we are proud of and is part of our soil." (Las Bases, Octubre 2010, p.10)

From this analysis we can also recognize the different groups of actors these actors are allowed to speak for. The FAA is allowed to speak for the small and medium producers, which becomes clear from the more sober lay out of their magazine and the focus on their affiliations in all the provinces.

The CRA is allowed to speak for the medium and large rural producers just like the ConInAgro, which is allowed to speak for the cooperatives of medium and large rural producers, the SRA that is allowed to speak mainly for the cattle breeders (Filomeno, 2013, p.11-13). The MNCI is allowed to speak for the indigenous farmers in Argentina.

With their information becoming an immutable mobile the SRA, the CRA, the FAA and the ConInAgro participated in the discussion concerning the right of the farmers to save their own seeds and not having to pay the royalty to Nidera or Monsanto. By publishing their opinion in their magazines and by speaking for their members, being the small, medium or large scale producers. For example the FAA argued for "technological sovereignty"(Filomeno, 2013, p.46) for their members and wanted a stonger role for INTA instead of having to pay royalties to private companies. The SRA, the CRA, the FAA and the ConInAgro signed different documents against the extended royalties on seeds and in the Argentine congress a senator referred to these documents in supporting his claim against the proposition (Filomeno, 2013, p.46). So through making their knowledge and opinions in forms of documents and their magazines it became mobile and could make them visible within the Argentine congress. The MNCI became visible in congress by the establishment of law No. 2660 that established the rights of the indigenous farmers of their lands. In their magazine they argue for 'food sovereignty' to solve the food crisis and within the international Vía Campesina movement this is one of the main arguments, to give the sovereignty over food back to the farmers in order to solve worldhunger. This is how the MNCI and MOCASE-VC member define the relations within the GM soya actor network, they are fighting for food while the 'big producers' fight for their technology in the form of GM soya seeds, tractors, fumigators and combines:

"That is what we always say, we produce alimentation for ourselves, the big producers produce alimentation for the vehicles, for the tractors, they produces energy for the animals, fodder. And they also industrialise the origins of the crops. The consumers don't realize where their food comes from, and if they do realize it they don't want to know and buy what is the cheapest." (Paulo, personal communication, 4th October 2013).

And where the FAA puts emphasis on the INTA to take a role in making technology more available to the small producers the indigenous farmers in the person of Beco, claim that INTA also works for the big producers and doesn't help the small farmers:

"And in the Sociedad Rural and the INTA, which is an institue on the national level suposedly for the small and medium producers, but they work for the big businesses and they say that the small producers need to sow transgenic seeds to be able to survive, and if they don't they won't, so they don't care about the life of no one, the only thing that matters is money" (Beco, personal communication, 4th October 2013).

In article on the OMA conference in the SRA magazine of May and June 2014 the relation between food production and hunger is being debated. In the article different African and Indian organization are quoted that define the relation between hunger and the current way of production in the same way that MOCASE-VC does:

"Aggrey Mahanjana, secretary general of the Asociation of African Producers in South-Africa pointed out that it is impossible to better the efficiency and agricultural productivity if poltics exist that aren't leadin to a more profitable agriculture. This is why to him the challenge mentioned by Quinn " to go especially to the governments and their support to the small farmers". "Without farmers there is no food, and without food, there is no future" emphasized Evelyn Nguleka, president of the National Union of Producers of Zambia, to define the motor that drives the capacity and the potential of the producers. From this motive and to its

perspective, the metaprinciple of the entities related to the sector need to focus on “make that more people become farmers”, what we need now is more people that produce if we want to save the world. “We believe that the family farmers on small scale are going to be a key component in saving the world and alleviate poverty (…) “Alimentation shouldn’t be considered like whatever other commodity on the marker; we need to have a concept of food sovereignty, so to say, a right of the people to count on healthy food and culturaly suitable”. (Assefh, 2014, p.17)

Plate 21: A banner that hung over a chair at the MOCASE-VC base in Quimilí.

The article also acknowledges the costs that come with technological innovation but ends however with a quote of the president of Aapresid saying:

“to Belloso [president of the Aapresid] “innovation is a process in which an idea is being transformed int a good or value and satisfies the needs for which its was created”. “Sustainability is especially important in the primary production. It is important to promote no-tillage as a production system to maintain a sustainable agriculture (economically, environmentally and socially), explains the leaving president of the Aapresid. And additionally: “The role of the government needs to be central to generate public politics to promote and estimulate the sustainable management that is favourably to the rotatin of crops, in this aspect we have an enormous deficit in Argentina”. Luis María Firpo Brenta, director of the laboritories of the SRA, emphasized the big technological changes in the agricultural life of the last thirty years “like no-tillage; the use of satelites; the new hibrides, to name but a few”. “The Sociedad Rural Argentina fulfilled an important technological and innovative role in the transfer of technology amongst its members”, explains Firpo.” (Assefh, 2014, p. 17)

This quote shows that the problems surrounding the production of GM soya is defined differently by the different actors that are allowed to speak for their members, and so are the solutions they offer and propagate. Overall it appears to be a discussion of binary oppositions.

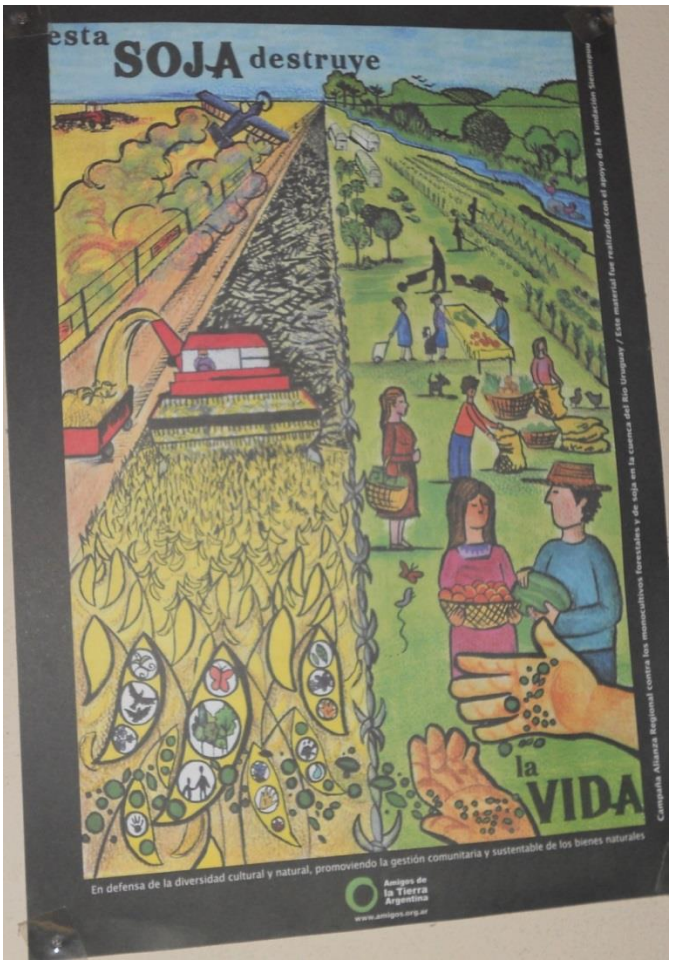


Plate 22: The title on this poster reads:"This soya destroys life" (Photographed by the author).

From the poster shown above (plate 21) it becomes clear that MOCASE-VC define their alliance with their crops and animals as healthy and sustainable as opposed to the way that 'capitalist farmers associate with the GM soya crop which is, according to MOCASE-VC, changing the climate and destroying life. The images used to bring their definition across is by display of their nonhuman actors, which are manual agricultural tools, hands, baskets in which they gather their harvest, wheelbarrows, and many people. While they display the 'capitalist' way of farming always in association with nonhuman actants like tractors, airplanes and combines. From the analysis of the magazines the same definition becomes clear. In the 'Falta Menos' the articles were illustrated by pictures or illustrations of farmers working the land with manual tools or chards towed by horses. In comparison with the other magazines the photos showed more nonhuman actants in the form of cars, tractors, combines, airplanes and agricultural chemicals and the people in the photos mostly wore suits or shirts, this was the way in which they made themselves visible in their magazines. Both MOCASE-VC and the SRA, the CRA, the ConInAgro and the FAA are protesting, the former against the government and seed companies like Nidera and Monsanto and MOCASE-VC against 'capitalism' and the big producers.

6.4 The fluid actor

The former analysis shows the inequality within the GM soya actor network and in the field of forces. The imbalance of power between de different actors and the difference in access to the nonhuman actors needed for GM soya production. It shows the interelations between the actors and how they

defined these interrealtions. For example the different opinions on the position and work of the INTA. But it also shows a difference in the visions on food production and on how the GM soya actor network should work and function according to the different actors. According to the FAA, the CRA, the SRA and the ConInAgro agricultural technology should be accessible and export fees shouldn't be too high, while according to MNCI the actor network should produce healthy food for people and not fodder for animals and bio-diesel for cars. This difference in definition also shows the different and unequal positions of the actors within the network. The indigenous farmers don't have access to the technology that the members of the CRA, the FAA, the ConInAgro or the SRA use and they don't export their products. And again this shows the fluidity of the GM soya as argued before in both chapter four and chapter five. Depending on the way the different actors define GM soya "it contains a different *variant* of its environment " (Laet & Mol, 2000, p. 252) and therefore the answer to wheter GM soya production is succesfull will always be different and never just a simple 'yes' or 'no'. But it is important to note that all these possible answers aren't universally valid, and the "right" answer will be different to all the actors involved.

7. Conclusion

What this study has done, by applying an ANT approach and following the GM soya seeds through the field of forces in which they are produced, sown, grown and harvested, was trying to make as many human and nonhuman actors as possible visible, tried to made them to speak and showed how they shape and constitute each other. The ANT approach allowed us not only to move freely through the field of forces, but it also allowed us to make the interactions between the human and non-human actors in this actor network visible. Instead of setting out by describing the production of GM soya through a-priori structures and historical narratives in which GM soya and all the other non-human actors involved are subjected to a passive and uninfluential role, we let the actants lead us.

Because of this freedom to move freely to the field of forces we were able to show that the walls of the soya cells acted by resisting the introduction of foreign genes and how technological solutions like a gene gun had to be developed to be able to dominate and genetically modify the soya plants seeds. We made visible how the laboratory by dominating the cells, cultivate them in petri dishes and categorise them could turn the germplasm used to produce the GM soya seeds into an immutable mobiles so they could be transferred to other countries and arrive in Argentina. We have seen the enrolment of the GM soya seeds by seeds companies like Nidera and Monsanto. For the farmers to be able to cultivate the GM soya, knowledge concerning this crop had to be translated by the agricultural engineer who became crucial because of the way he problematized the degradation of the soil and the way the INTA moved its laboratories closer to the producers. The solutions offered introduced fertilizer, herbicides and no-tillage systems to the GM soya actor network.

We saw how associations between actors were interrupted, shifted or terminated. The GM soya farmers united in the FAA, the CRA, the ConInAgro and the SRA opposed the payment of royalties to Monsanto and Nidera for the GM soya seeds, we saw how the Argentine state protected them by law No. 20.247 to save their seeds. With their association with the farmers being terminated we looked at the ways Monsanto and Nidera tried to restore the alliance through patenting a new type of GM soya seed and individual contracts with farmers. We showed how the use of herbicides also acted outside the fields on actants like the trees, houses, people and animals. And we saw some weeds resist their domination by glyphosate in developing resistance against it. And in Chaco we saw how the Boll Weevil and floods interrupted the harvest of the cotton, leaving room for the GM soya actor network to arrive and interact with the cotton actor network.

We made the connection between the former developments that discriminated against the producers with small plots and how the Argentine government by imposing a 35% fee on export of GM soya strengtened this discrimination. These associations made the production of GM soya only possible for producers with at least 1500 hectares causing producers with smaller plots to choose for rearing cows, pigs, goats and chickens. With the droughts in Chaco and Santiago del Estero we saw the farmers fight these conditions by associating with other families or join in a movement like the MOCASE-VC through which they could obtain the means to stay on their farms. Other small producers decided to rent their lands to investors and this left room for the ‘pules de siembra’ to make time but only with the help of the translation of knowledge by the agricultural engineer.

Taking the principle of ANT that an actor never acts alone, but always embedded in an actor network in which the actors are shaped and constituted by each other we could show how the GM soya actor network literally shaped the communities of the indigenous farmers in Santiago del Estero. Besides

we could make visible how the GM soya actor network interacted with the cotton actor network in the sense that the agricultural engineers were allowed to problematize the issue of the labour intensive harvesting and ginning of the cotton and offered the solution by introducing redefined combines to harvest the cotton mechanically, discriminating against the producers with only 25, 50 or 100 hectare plots. Together with developing GM cotton seeds this allowed for the cotton crop to return to be sown again in Chaco, but not by the small scale producers and not after being redefined by the GM soya network.

Finally we looked at the methods and actants the different farmer organizations used to make themselve visible and how they defined the other actants in the GM soya actor network. We looked at the immutable mobiles in the form of magazines and books of the SRA, the CRA, the FAA, the ConInAgro and the MNCI and the MOCASE-VC which they used to transfer their knowledge. It became clear that all these organizations were striving to acomplish their solutions to their definition of theproblems within the GM actor network. The SRA, the CRA, the FAA and the ConInAgro strived for 'technology sovereignty' and the MOCASE-VC and MNCI for 'food sovereignty'. Showing the different in definition of how the GM actor network should work and what it should produce, which is healthy food for people for the MOCASE-VC and access to the technology and lower royalties and taxes for the SRA, the CRA, the FAA and the ConInAgro. And this in turn showed the imbalance in power between the different actors within the GM soya actor network, the inequality in access to technology in the form of actants like tractors, combines, fertilizer, herbicides and GM seeds.

In doing so this research has anwered its main research question:

Who are the human and non-human actors that make up the GM soya actor network in the Argentine provinces of Chaco and Santiago del Estero, can they be made visible and made to speak, and in what way do they shape and constitute each other?

So the human and nonhuman actors that make up the GM soya actor network in Chaco and Santiago del Estero have clearly shown to form a heterogeneous network in which most actants could be made visible, not only the most visible ones that were able to change the balance of power in their favour but also the ones that were being dominated by other actors. This research doesn't claim to have been exhaustive but it has done everything to try and be as thorough as possible. Actants were made to speak by showing them resisting or acting within the actor network which showed a process that is far from linear. Moreover the way they acted or resisted shaped and constituted other actors made the GM soya actor network into a network in which the associations and alliances are constantly being redefined, interrupted and sometimes terminated. This brought to the fore the fluidity of the GM soya in the form of different identities within the actor network. GM soya ensures high revenues by selling it on the world market, but not for farmers with plots of 25, 50 or 100 hectares, GM soya also generates high revenues for seed companies like Monsanto and Nidera, but not for the farmers that have to buy from them. GM soya redefined as bio-diesel lowers the CO^2 emission in the EU, but contaminates the air of the people living near the fields, it feeds pigs in China making their meat available for more people, but it doesn't feed hungry people. GM soya production might be successful in the wet climate of the provinces of Buenos Aires and Santa Fe, but not in the dry climate of Chaco and Santiago del Estero, and GM soya might generate higher income for the Argentine state, but excludes farmers with small plots. These identities might be categorised according to political ways of reasoning, GM soya as tax instrument; environmental ways of

reasoning, CO^2 emission reduction and herbicide contamination; economic ways of reasoning, GM soya as an high revenue generating crop for farmers and seed companies, even Marxist ways of reasoning, the small farmers can't purchase the GM soya and machinery but large scale farmers and the 'seed pools' can. And finally these identities also have a moral connotation; GM soya feeds pigs in China, but not the hungry people elsewhere in the world. By formulating these identities in this way, by presenting them as binary oppositions it might be possible to just answer the question if GM soy is successful with a simple 'yes' or 'no'. But what this study has tried to show is that all these identities exist within the same actor network and that the sciences in sticking with the modern ontology of putting everything in boxes that aren't made for it – boxes like "globalization", "social", "nature", "economic", "political", "agriculture", and "Green-, and Gene Revolution" – aren't able to encompasses or explain the heterogeneity of the identities and the interrelations between human and nonhuman actors in the GM soya actor network.

By accepting the fact that all these identities and interrelations between human and nonhuman actors are part of the same actor network that exists in a field of forces in which nothing is reducible to anything else and there are only trials of strength and weakness (Latour, 1988, p.158), we have taken science out of the 'tug-of-war' (Latour, 1992, p.278) between subject and object, or human-, and physical geography, the heterogeneity of the identities described above and the interrelatedness between all the actants involved makes it impossible to maintain this binary opposition that is at the basis of this "modern" ontology. So "subject" and "object", "human-", and "physical" geography, "natue" and "society" are so intertwined that it is impossible to separate them. In the same way there doesn't exist a divide between "science" and "politics" or "society" and "science" they are all interrelated and connected in an actor network. This way of formulating and doing research has both ontological and epistemological consequences. The consequences for the ontology have already been mentioned and that is that everything is real, everything is taken into account, both human and nonhuman and especially the interrelation between the two. Epistemological consequences are that we won't present science as a place that offers us the only real answers because of the method through which they are reached. We will only state that the world is a field of forces in which both human and nonhuman actors are connected, but without a-priory stating in which way these connections might occur or exist (Latour, 1988, p.6-7).

From the above we can conclude that the objective of this study was twofold. To offer an alternative way of doing research and radically altering our ontology and epistemology by presenting ANT , but also to show the application of ANT in the field by studying the GM soya actor network in Chaco and Santiago del Estero. This also touches directly upon two profound discussions. The first was the subject of the preface, the introduction and the former paragraph. The latter appeared in chapter six concerning the way the MNCI and MOCASE-VC members defined, Monsanto, the SRA, the FAA, the CRA, the ConInAgro and the INTA. They blamed Monsanto, big producers, companies and capitalism for the fact that they were being evicted and that people got sick from the herbicides. In their relation with the continental CLOC and international Via Campesina they connected the GM soya actor network directly with "world hunger" which could be solved by giving them, the indigenous farmers, 'food sovereignty' (plate 21) so they could produce healthy food for people. The FAA on the other hand asks for 'technological sovereignty' and a bigger role for the INTA in this and the SRA clearly sees the solution of 'world hunger' in applying more technology in the form of bio-technology and no-tillage systems (paragraph 6.3).

Concerning this last discussion this research hopes to offers an alternative view in the highly moralized and simplified discussions surrounding the production of GM soya in Latin America. This discussion has been dominated by using container terms like “world hunger”, “globalization” and “capitalism”. But by defining Monsanto’s GM RR soya as the main cause of hunger many other actants that participate in the actor network are obscured. For example in the case of Monsanto’s GM soya seeds in Argentina, the fact that GM soya production took off so quickly in this country was the fact that the enrolment of the Argentine farmers, by Monsanto was interrupted. The patent on their seeds was being withheld from Monsanto in Argentina, keeping the price for the GM seeds relatively low and allowing the GM soya to spread much quicker through Argentina. So it was rather the disfunction of the “capitalist” way of doing business by Monsanto and the disfunction of “globalization”, concerning the international UPOV and TRIPS, that the GM soya could change the balance of power in its favour in Argentina. In the same way to define bio-technology, no-tillage systems and crop rotation as the solution for sustainable development, as is done by the INTA and Aapresid (Ferrari, 2010; Bisang, 2003, p.10), again obscures the fact that the climate needs to allow for the rotation of more crops. If it is too dry to sow more than one crop farmers might choose only the crop that secures the highest financial return, which in this case is GM soya and therefore actually worsening the degradation of the soils. Therefore the interrelations between the actants and the way they shape and constitute each other deserve much closer attention. Instead of simply focussing on the most visible or dominant actants like Monsanto – besides the fact that the actual distribution of Monsanto’s GM RR soya seeds in Argentina was done through Nidera, another seed company – we should focus on the field of forces in which they emerge. We should look at the processes of interessement and enrolment (chapter four) used by the actors to consolidate alliances, but especially also look at when they fail to establish these processes, like the example mentioned above on Monsanto that couldn’t obtain the patent on its GM RR soya seeds in Argentina.

If we keep ignoring the field of forces in which the actor networks are embedded we won’t be able to come-up with solutions that can effectively solve problems caused by the GM soya actor network and which have come to the fore in this study. The different identities that GM soya can have within the actor network make the answer to these problems all but binary. So to come back to the question of if GM soya production in Argentina is successful we can’t give a universally valid answer. But we can say that as long as these different identities of GM soya exist alongside each other – with the agricultural engineer defining GM soya as percentages of nitrogen, potassium and phosphor, the people around the GM soya field defining the production of GM soya, and its use of herbicides, as the cause for cancer and malformations, the indigenous farmers in Santiago del Estero defining it as the cause for “world hunger”, the Argentine government defining it as a profitable tax method, the Chinese define it as cheap pig fodder and the EU defining bio-diesel, based on GM soya oil , as the solution to reduce CO^2 emission – the solutions to eventual problems concerning the GM soya actor network will be equally heterogeneous and the outcomes even more. So all these definitions at some point or place have to come together in order to be able to formulate a solution that doesn’t only solve only one of the problems defined above. This explanation might make some readers think of a supranational organization that should take this task upon itself. But, besides the fact that the supranational “level” doesn’t exist, it appears far from ideal to add another actant to this multitude of actants. According to the ANT approach there doesn’t exist a national, continental or international level, so the coming together of all these identities could happen at the same level at the same time,

namely within the field of forces in which some actants might be more visible, others might be enroled, but in which none of the associations and interrelations are static.

Meanwhile we might conclude that the less visible actors might unite themselves in organizations which seemed to work for mister Brabo who associated with other famers families to solve their problems (paragraph 4.4.1) and the indigenous farmers that organised themselves in MOCASE-VC. The other farmers already established their visibility in the Argentine congress through their association with the FAA, the CRA, the SRA and the ConInAgro.

All in all this research has clearly given "evidence that "science" and "society" are both explained more adequately by an analysis of the relations among forces and that they become mutually inexplicable and opaque when made to stand apart" (Latour, 1988, p.7).

This conclusion but more in general the ANT approach ask for a completely different way of looking at the world. Just like ANT offers an alternative to the "modern" ontology, it also offers a non modern view of the world and its history, as becomes clear from another book written by Bruno Latour (1991) which carries the title 'We have never been Modern'. To develop this view and way of doing research further, a lot of work still needs to be done, to get the experiences of people and the research done by scientists out of the modern boxes, – social, nature, science, political, society, etc. – and instead of trying to force them into this pre-defined structure and not reduce the actants to anything else, a new method of research is needed. Most recently this has taken form in AIME, which stands for 'An Inquiry Into Modes of Existence' that offers an alternative project, to the modern project that was roled out over the world not so long ago (AIME, n.d.). The development of this new method of doing research is an ongoing process and the same holds for the author for whom this research was the first with an ANT approach which might explain the sometimes unclear parts in which I myself was struggling to escape my own predefined ideas, and my "modern" education as a researcher, and to force myself to go back to the actants themselves and what they had to tell me.

7.1. Reflection

The use of ANT ask for a profound reflection because in its aim to avoid dualistic thinking it has granted the right of representation to anything, the enfranchisement is universal (Lee & Brown, 1994, p.778) which was already mentioned in the reflection in chapter three. Because of this ANT could become the only representative of the nonhuman actors in their studies. In seeing the world as a field of forces it makes everything political and presents ANT as the most fairest of them all, through its concept of generalized symmetry, ANT becomes 'the only game in town'(Lee & Brown, 1994, p.780). In seeing the world as a field of forces in which everything that resists is real (Latour, 1988, p.227) it leaves little room for seeing the world in a way other than in domination and resistance (Lee & Brown, 1994, p.781). ANT doesn't leave place for things to remain unmapped. These point have been addressed by ANT scholars like Law, Mol, Callon and Latour by using a fluid topology (Laet & Mol, 2000) or "hybrid colectif" (Lee & Brown, 1994, p.786). In this study we also have used this concept of fluidity and showed its power in showing the multitude of identities that one actor can have within the same actor network. Moreover ANT does offer a perfectly designed strategy for studying the production of power and actants (Lee & Brown, 1994, p.780-781). Because of its view and radical ontology and epistemology it was difficult to really formulate a clear analytic methodology or use other types of analysis. The fact that the validity of this research isn't derived from the method used, but from the data, the actants themselves it is impossible to formulate a clear

predefined epistemology or method, as you might expect from a “modern” research project. At the same time the development of the ANT methodology is still an ongoing process as becomes clear from experiments like AIME.

This research could be greatly improved by doing research in other parts of both provinces and to enlarge its data gathering. The snowballing method used in this research didn’t get me to all the actors involved and might ask for a different method in selecting interviewees to also include interviews with people at Nidera and other farmer organizations then the SRA would improve the embeddedness of the findings in data. Although this study brings an important point of view to both academic research and the discussion surrounding GM soya production, it would be more powerfull if backed by more data.

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