Revista de Geografía MERIDIANO
MERIDIANO – Revista de Geografía, número 3, 2014 – versión digital.
http://www.revistameridiano.org/

THE SOYAZATION OF ARGENTINA: an Actor Network analysis of the soya production in the argentine provinces of Chaco and Santiago del Estero

Thaddeus Bergé*

Abstract

This article argues that to be able to do research into the production of GM soya in the Argentine provinces of Chaco and Santiago del Estero it is necessary to take into account both human and nonhuman actors. Actor Network Theory offers this possibility that alters the "modern" ontology that divides between "science" and "nature" and widens the scope of the research to every possible actant (human or nonhuman) we might encounter along the way. Therefore we were able to follow the GM soya seeds from the laboratories of Monsanto in the US until they arrived in Argentina. Then we have followed them through there sowing, growing, and harvesting. By showing the fluidity of the actor network and the different identities of GM soya within this actor network, it offers an alternative view on the discussion surrounding GM soya that mainly has been one of binary oppositions.

Keywords: GM Soya Production; Actor Network Theory; Argentina.

Resumen

Este artículo trabaja con la premisa que para investigar la producción de la soja transgénica en Argentina en las provincias del Chaco y Santiago del Estero sería necesario incluir actores humanos y no humanos. Eso es posible con la Teoría Actor-Red que cambia la ontología "moderna" que mantiene una diferencia entre la "ciencia" y la "naturaleza". Cuando aplicamos la Teoría Actor-Red tenemos un ámbito que es mucho más amplio y podemos

* Master of Science in Human Geography, Radboud University Nijmegen. E-mail: thabee@hotmail.com

encontrar cualquier actor (humano y no humano) que está involucrado en la producción de la soja. Por lo tanto podemos seguir las semillas de la soja desde los laboratorios de Monsanto en los Estados Unidos hasta su uso en Argentina. Y en Argentina podemos seguir la soja a través de su siembra, crecimiento y cosecha. En esta manera mostramos la fluidez de la soja transgénica y sus diferentes identidades que tiene en este Actor-Red. De este modo ofrecemos una alternativa en el debate de la soja transgénica que mayormente es un debate entre dos opuestos.

Palabras-clave: Soja Transgénica; Teoría Actor-Red; Argentina.

Introduction

Between 2013 and 2014 I studied the production of soya in the province of Chaco and Santiago del Estero in Argentina as part of my graduation as a human geographer. Because of the limited amount of pages, this article will only contain a small part of my findings. On writing my 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 marginalized (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). 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.

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".

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. 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.

1. Soya production from an ANT perspective

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 tons of soya oil in 2012. Most of this demand is met by the three biggest producers of soya (figure 1), The United States (US), Brazil and Argentina (NASSAR *et alli*, 2011, p. 6). If we want to study the production of soya we see ourselves confronted with what might be characterized as an "overwhelming impression of chaos and disorganization" (PLOEG, 2009, p.1).

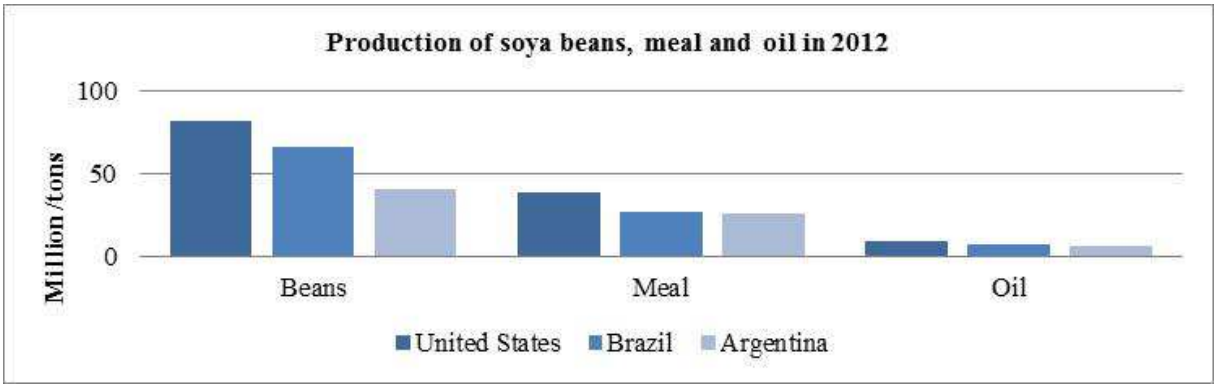

Figure 1. **Production of soya beans, meal and oil in 2012 by the three main producers and exporters of soya**
Source: FAO (n.d.).

According to Bruno Latour (1992, p. 278) a 'tug-of-war' 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.

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 *apud* 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 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', which implies that nonhuman actors are mere passive actors completely adaptable for use by humans (SOUSA; BUSCH, 1998, p. 351). But what if a soya seeds 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" (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 (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 (1988). 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". This adds to things something more that comes from beyond the facts (LATOUR, 1988, p. 190). 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). 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" (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'.

2. Seeds

Almost all the soya produced in Argentina is genetically modified (BRAVO, 2010, p. 9; BISANG, 2003, p. 1), so this research is about the production of GM soya as opposed to soya that hasn't been modified to become resistant to glyphosate based herbicides. 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 alli*, 2005, p. 531; CELLINI *et alli*, 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. 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 alli*, 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 alli*, 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. 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 alli*, 1987, p. 27; CELEC *et alli*, 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.

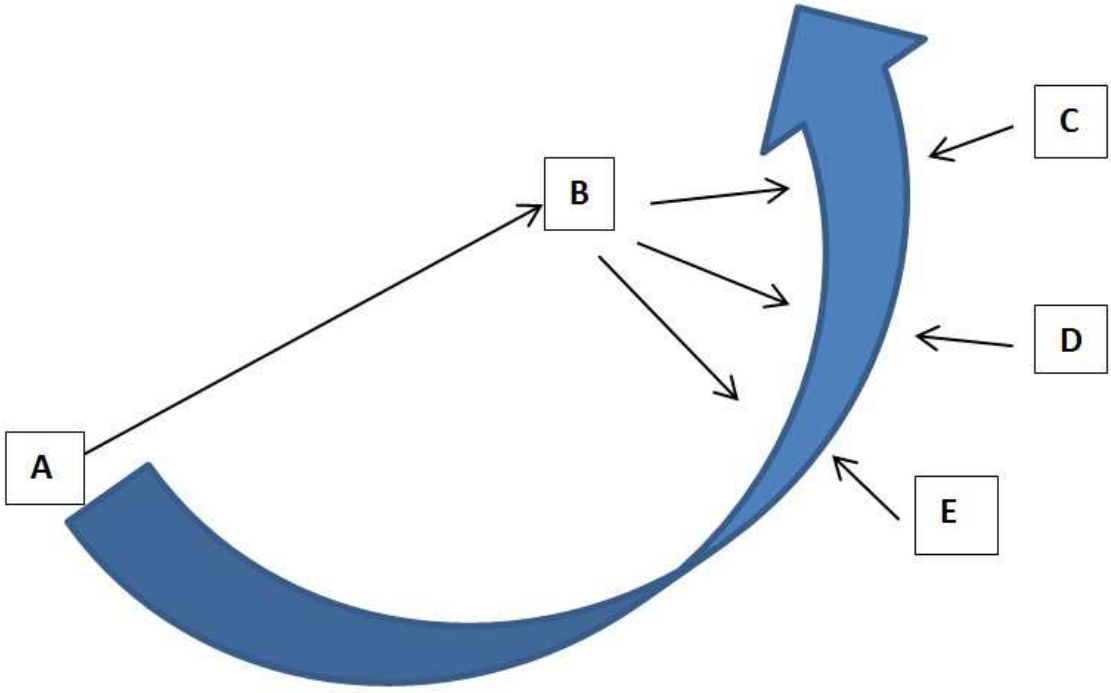

Figure 2. **The process of disassociation the Monsanto established between the GM RR soya seeds and the other actants**
Source: Taken and adapted from Callon (1986, p. 12).

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 (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 enrolled 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 interessement, 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 vaccines, 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.

The alliance that Monsanto has forged with the farmers and the *cooperativas*, was defined by some of the interviewees as too expensive for the small producers and was even called prostitution by the hands of Monsanto (COGNO, personal communication, 1st October, 2013). 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 Federación Agraria de la Argentina (FAA), Confederación Intercooperativa Agropecuaria Cooperativa Limitada (ConInAgro), Confederaciones Rurales de la Argentina (CRA) and the Sociedad Rural Argentina (SRA). All are allowed to speak for small, medium or large producers or the agricultural sector as a whole. 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.

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 is called the '*bolsa blanca*' (BUSTOS, personal communication, 11th November 2013), which is the black market for seeds. 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 powerful 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 (2007, p.135) redefined as 'stealth seeds' without 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 Argentina.

3. 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 and with, which limits the disturbance of the soil structure (TRIGO *et alli*, 2009, p. 1). This system is called no-tillage, zero-tillage 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 alli*, 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 alli*, 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 alli*, 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 the no-tillage systems developed there in practice (TRIGO *et alli*, 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. 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 alli*, 2009, p. 5).

4. The agricultural emgineer

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 *et alli*, 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. 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 alli*, 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. 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.

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 is that 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. 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).

5. Herbicides

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. The rise in herbicide and pesticide use in Argentina 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, p. 66) 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. 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 (personal communication, 4th October 2013, Santiago del Estero):

> 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 kilometers 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.

Mister Mellinger (personal communication, 30th September 2013) 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, it's 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.

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.

6. Growing

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 organize 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 a drought that was in its third year which was almost historical. In 1978 it rained 312 mm and from January until the beginning of October 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 champagnes 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. If farmers can only sow two or three times they prefer forging an alliance with GM soya to ensure the highest financial return. 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. 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.

7. Drought

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. 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.

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.

8. 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. 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 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. 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.

9. 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 equaled 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 any longer 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' (SOUSA; BUSCH, 1998, p. 351) on the GM soya network through resolution nº. 125/08 by which they enroll 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. 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.

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; 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 laborers 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 NACIÓN, 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 kilometers of the Rosario harbor, pays the same export fee as a producer in the much dryer province of Chaco which is at almost 1000 kilometers from the Rosario harbor. Through the transportation costs farmers in Chaco and Santiago del Estero are fined a second time.

Miss Urricariet (personal communication, 22nd November 2013) 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. 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 organized for all the taxes to be gathered in Buenos Aires after which they would be redistributed.

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.

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 (FAO, n.d.). In the same year the EU countries imported over 10 million tons of soya beans (FAO, n.d.). 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.

10. The fluid actor

In this chapter we have followed the soya seeds through 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. Along 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 interacted with each other 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 harbor. We have seen how knowledge concerning the cultivation of GM soya was being translated by the agricultural engineers who 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 dividing 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 embedding and the fluidity of the interrelations make it hard to establish sharp boundaries on what GM soya is. In this article 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 Chinese 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 Zimbabwean bush pump Laet & Mol (2000, p. 252) use the notion of the fluid to be able to describe this aspect of an actant. Because of this fluidity, next to the fact that the boundaries aren't sharp, the answer to whether GM soya is successful also becomes a non- binary matter. The answer 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 successful as being a binary matter.

Final considerations

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. 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, "nature" 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).

Bibliographic references

ALTAMIRANO, Marcos. Panorama histórico del Chaco. In: ALTAMIRANO, Marcos; FERRERES, Orlando; ARAUJO, Manuel Mora y; ETCHEVERRY, Guillermo Jaim; MANZUR, Juan; HUERGO, Héctor; FRIGERIO, Rogelio; BARROS, Marta; CAPITANICH, Jorge. *Chaco*: su historia en cifras. [Resistencia]: Gobierno del Pueblo de la Provincia del Chaco / Fundación Norte y Sur / Consejo Federal de Inversiones (CFI), 2013.

APPADURAI, Arjun. Difference and Disjuncture in the Global Cultural Economy. *Theory, Culture & Society*, London / Newsbury Park / New Delhi: SAGE, v. 7, p. 295-310, 1990.

BISANG, Roberto. Diffusion Process in Networks: the case of transgenic soybean in Argentina. In: GLOBELICS CONFERENCE INNOVATION SYSTEMS AND DEVELOPMENT STRATEGIES FOR THE THIRD MILLENIUM, 5., 2003, Rio de Janeiro. *Proceedings of*… Rio de Janeiro, nov. 2003. Available in: <http://www.redesist.ie.ufrj.br/globelics/pdfs/GLOBELICS_0065_Bisang.zip>. Accessed: 2 jun. 2014.

BRAVO, Ana Lucía. Introducción. In: BRAVO, Ana Lucía; MERELES, Hugo Florencio Centurión; DOMÍNGUEZ, Diego Ignacio; SABATINO, Pablo; POTH, Carla Mariela; RODRÍGUEZ, Javier Leonel. *Los Señores de la Soja*: la agricultura transgénica en América Latina. Buenos Aires: CICCUS / CLASCO, 2010. p. 9-30. Available in: <http://bibliotecavirtual.clacso.org.ar/ar/libros/becas/soja.pdf>. Accessed: 2 jun. 2014.

CALLON, Michel. Some elements of a sociology of translation: domestication of the scallops and fisherman of St. Brieuc Bay. In: Law, John (ed.). *Power, Action and Belief*: a New Sociology of Knowledge. London: Routledge, 1986. p. 196-223.

_____. Society in the Making: the study of technology as a tool for sociological analysis. In: BIJKEN, Wiebe E.; HUGHES, Thomas P.; PINCH, Trevor (ed.). *The Social Construction of Technological Systems*: new directions in the Sociology and History of Technology. Massachusetts / Cambridge: MIT, 1987. p. 83-106.

CASTELLS, Manuel. *The Information Age*: Economy, Society, and Culture. The Rise of the Network Society. Volume 1. 2. ed. West Sussex: Wiley-Blackwell, 2009.

CELEC, Peter; KUKUČKOVÁ, Martina; RENCZÉSOVÁ, Veronika; NATARAJAN, Satheesh; PÁLFFY, Roland; GARDLÍK, Roman; HODOSY, Július; BEHULIAK, Michal; VLKOVÁ, Behuliak; MINÁRIK, Gabriel; SZEMES, Tomás; STUCHLÍK, Szemes; TURŇA, Ján. Biological and Biomedical Aspects of Genetically Modified Food. *Biomedicine & Pharmacotherapy*, v. 59, n. 10, p. 531-540, 2005.

CELLINI, Francesco; CHESSON, Andrew; COLQUHOUN, Ian; CONSTABLE, Anne; DAVIES. Howard V.; ENGEL, Kjeld H.; GATEHOUSE, Angharad M.R.; KÄRENLAMPI, Sirpa; KOK, Esther J.; LEGUAY, Jean-Jacques; LEHESRANTA, Satu; NOTEBORN, Hubert P. J. M.; PEDERSEN, Jan; SMITH, Maurice. Unintended effects and their detection in genetically modified crops. *Food and Chemical Toxicology*, v. 42, n. 7, p. 1089-1125, jul. 2004.

DOMÍNGUEZ, Diego Ignacio; SABATINO, Pablo. La muerte que viene en el viento: la problemática de la contaminación por efecto de la agricultura transgénica en Argentina y Paraguay. In: BRAVO, Ana Lucía; MERELES, Hugo Florencio Centurión; DOMÍNGUEZ, Diego Ignacio; SABATINO, Pablo; POTH, Carla Mariela; RODRÍGUEZ, Javier Leonel. *Los Señores de la Soja*: la agricultura transgénica en América Latina. Buenos Aires: CICCUS / CLASCO, 2010. p. 31-121. Available in: <http://bibliotecavirtual.clacso.org.ar/ar/libros/becas/soja.pdf>. Accessed: 2 jun. 2014.

FERRARI, Manuel. Nuestros actuales sistemas de producción agrícolas son ambientalmente sustentables? *Informaciónes Agrónimas del Cono Sur*, International Plant Nutricion Institute, n. 48, 2010. Available in: <http://www.ipni.net/publication/ia-lacs.nsf/0/E0F1D4402BFC17B285257984005754F5/$FILE/6.pdf>. Accessed: 2 jun. 2014.

FILOMENO, Felipe Amin. How Argentine Farmers Overpowered Monsanto: The Mobilization of Knoweledge Users and Intellectual Property Regimes. *Journal of Politics in Latin America*, Hamburg: Hamburg University, v. 5, n. 3, p. 35-71, 2013. Available in: <http://journals.sub.uni-hamburg.de/giga/jpla/article/view/686/684>. Accessed: 2 jun. 2014.

FOOD AND AGRICULTURE ORGANIZATION. *FAOSTAT*. n.d. Available in: <http://faostat3.fao.org/faostat-gateway/go/to/browse/Q/*/E>. Accessed: 2 jun. 2014.

HERRING, Ronald J. Stealth Seeds: Bioproperty, Biosafety, Biopolitics. *Journal of Development Studies*, v. 43, n.1, p. 130-157, jan. 2007. Available in: <http://government.arts.cornell.edu/assets/faculty/docs/herring/jds_herringstealthseeds.pdf>. Accessed: 2 jun. 2014.

LAET, Marianne de; MOL, Annemarie. The Zimbabwe Bush Pump: Mechanics of a Fluid Technology. *Social Studies of Science*, London / Thousand Oaks / New Delhi: SAGE, v. 30, n. 2, p. 225-263, apr. 2000. Available in: <http://josiah.berkeley.edu/2007Fall/ER275/Readings/DP1-2/delaet_mol.pdf>. Accessed: 2 jun. 2014.

LA NACIÓN. *Eduardo Buzzi dijo que Cristina Kirchner excluyó al campo del diálogo "por revanchismo"*. 14 aug. 2013. Available in: <http://www.lanacion.com.ar/1610683-eduardo-buzzi-dijo-que-cristina-kirchner-excluyo-al-campo-del-dialogo-por-revanchismo>. Accessed: 2 jun. 2014.

LATOUR, Bruno. *The Pasteurization of France*. Cambridge: Harvard University, 1988.

_____. One More Turn After the Social Turn: Easing Science Studies into the non-Modern World. In: MCMULLIN, Ernan (ed.). *The Social Dimensions of Science*: studies in Science and the Humanities from the Reilly Center for Science, Technology, and Values. Notre Dame: Notre Dame University, 1992. p. 272-292.

LEE, Nick; BROWN, Steve. Otherness and the Actor Network: the undiscovered continent. *The American Behavioural Scientist*, v. 37, n. 6, p. 772-790, may 1994. Available in: <https://www.academia.edu/1316907/Otherness_and_the_actor-network_The_undiscovered_continent>. Accessed: 2 jun. 2014.

MCPHAIL, Beverly A. Questioning Gender and Sexuality Binaries. *Journal of Gay & Lesbian Social Services*, v. 17, n. 1, p. 3-21, 2004.

MONSANTO. *Biotecnología*. n.d. Available in: <http://www.intactarr2pro.com.ar/02_1_biotecnologia.html>. Accessed: 2 jun. 2014.

NASSER, André; ANTONIAZZI, Laura Barcellos; BRANDÃO, Joyce; MOURA, Paula. *Soy Strategic Gap Analysis*: Brazil and Argentina. São Paulo: ICONE, 2011. Available in: <http://www.idhsustainabletrade.com/site/getfile.php?id=221 >. Accessed: 2 jun. 2014.

PARAYIL, Govindan. Mapping Technological Trajectories of the Green Revolution and the Gene Revolution from Modernization to Globalization. *Research Policy*, v. 32, n. 6, p.971-990, jun. 2003.

PENGUE, Walter A. Transgenic crops in Argentina: The ecological and social debt. *Bulletin of Science Technology & Society*, v. 25, n. 4, p. 314-322, 2005.

PLOEG, Jan Douwe van der. *The New Peasantries*: struggles for autonomy and sustainability in an Era of Empire and Globalization. London: Earthscan, 2009.

PAARLBERG, Robert L. *The Politics of Precaution*: Genetically Modified Crops in Developing Countries. Baltimore / London: The Johns Hopkins University, 2001.

ROMÁN, Joseph. *The Three Uses of Glocalization*. Paper prepared for the 78th conference of the Canadian Political Science Association. Toronto: York University, 2006. Available in: <http://www.cpsa-acsp.ca/papers-2006/roman.pdf>. Accessed: 2 jun. 2014.

SANFORD, John C.; KLEIN, Theodore M.; WOLF, Edward D.; ALLEN, Nelson. Delivery of Substance into cells and Tissues Using a Particle Bombardment Process. *Particulate Science and Technology*: An International Journal, v.5, n. 1, p. 27-37, 1987.

SMITH, Richard G. World City Actor- Networks. *Progress in Human Geography*, v. 27, n. 1, p. 25-44, feb. 2003.

SOUZA, Ivan Sérgio Freire de; BUSCH, Lawrence. Networks and Agricultural development: The Case of Soybean Production and Consumption in Brazil. *Rural Sociology*, v. 63, n. 3, p. 349-371, 1998.

STIGLITZ, Joseph E. Argentina Short-Changed: Why the Nation That Followed the Rules Fell to Pieces. *The Washington Post Sunday*, 12 may 2002.

TRIGO, Eduardo; CAP, Eugenio; MALACH, Valeria; VILLAREAL, Federico. *The Case of Zero-Tillage Technology in Argentina*. Discussion paper 00915. Washington: IFPRI, nov. 2009. Available in: <http://www.ifpri.org/sites/default/files/publications/ifpridp00915.pdf>. Accessed: 2 jun. 2014.

VERBEEK, Peter-Paul. *Moralizing Technology*: understanding and designing the morality of things. Chicago: University of Chicago, 2011.