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# **Glyphosate: The Fragile Power Behind Argentina's Soy Complex**

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## **Abstract**

The safe use narrative remains a powerful tool for the pesticide industry to keep their products on the market. The narrative claims misuse stems from underdevelopment; framing these pesticide (mis)users and farmers as ignorant, undereducated, undertrained and under-equipped, placing the burden of the problem on individuals. It proposes solutions by framing pesticide users as self-interested, economically rational actors who will correct their choices when educated to the dangers and trained in safe use of the industry's product. The narrative places the burden on the user rather than the industry or product and overly-simplifies the decision making process of people using pesticides. This paper applies Ryan Galt's theory of complex subjectivities as a reconceptualization of aforementioned analysis of pesticide users. This approach theorizes that pesticide users' choices are a product of a multitude of complex influences to reframe how we address pesticide problems. To operationalize this theory, this study uses data from semi-structured interviews with small and medium Argentine soy farmers. The findings illustrate that pesticide problems are not a case of individual misuse but rather are a function of the political and economic history of Argentina culminating in the current agrarian model of production. The holistic approach to pesticide users' choices reveals that reviewing pesticide risks also warrant a holistic approach.

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## 1. Introduction

With the growing body of knowledge and awareness of pesticide hazards, there also is a growing body of knowledge critiquing the current solutions proposed (Miller, 2009). Certain programs, such as Prior Informed Consent and the Rotterdam Convention, are exemplary of the growing awareness of a necessity for global governance schemes for the manufacture, sales, and use of pesticides (Jansen, 2008). Despite this growing awareness, the data on governance, use, sales, knowledge and health effects remains insufficient as a preventative measure against dangerous pesticides and inappropriate pesticide use. This ineffectively reflects the the massive resources required to track an industry plagued with malpractice and misuse of a product with known negative impacts on health, economy, environment and farming efficacy. The pesticide industry actors and national governments usually seek to answer these deficiencies via pesticide governance that adheres to the safe use narrative (Jansen, 2008; Paredes & Sherwood, 2014).

Safe use of pesticides is the prevailing narrative for the pro-pesticide industry as well as many national governments who structure their agriculture systems on pesticide-based crop protection. The narrative presents pesticide problems as a direct function of misuse; this places burden of pesticide problems on individual users. It follows a logic that when farmers are presented with the knowledge and equipment to safely use pesticides, they will do so. This logic of the pesticide users' decision making defines them as self-interested individuals driven by economic rationality, or *Homo economicus*. Commonly, the individual's rational is defined in terms of their local culture's development. This framing of problems as a development issue, to "discursively shift the cause of the pesticide problem to the deficiencies of local cultures and individuals labeled 'underdeveloped' and 'ignorant'" (Ryan E Galt, 2013, p. 339). It identifies a level of development as an overarching commonality where individuals can be targeted to solve cultural issues. At its essence, this is founded on a neoliberal ideology, "as a form of governmentality... by installing a concept of the human subject as an autonomous, individualized, self-directing, decision-making agent at the heart of policy-making" (Bondi, 2005, p. 449). Specifically, the narrative as it presents pesticide users as undereducated, misinformed, and underequipped (Barraza, Jansen, van Wendel de Joode, & Wesseling, 2013; Blok, Jensen, & Kaltoft, 2008; Ríos-González, Jansen, & Javier Sánchez-Pérez, 2013). The solution proposed is to train farmers to safely use pesticides; providing information on dangers, pesticide use trainings, and providing protective protective equipment (Paredes & Sherwood, 2014; Wesseling, Corriols, & Bravo, 2005). This newfound

information supposedly leads to pesticide users to act rationally, IE make safe decisions considering chemicals (Crissman, Cole, & Carpio, 1994). Often these interventions are in response to epidemiological crisis. This is understandable as pesticides are responsible for somewhere between 3-25 million poisonings and over 200,000 deaths each year (Ryan E Galt, 2013; Paredes & Sherwood, 2014; Thrupp, 1988). A few problems arise from this framing, as identified by a number of critical pesticide scholars. Primarily, the subject of the pesticide user that is drawn from the safe-use narrative is often critiqued as simplistic, failing to take into account risk perceptions as handed down from technical “experts” (Ríos-González et al., 2013), different cultural pressures influencing protective gear use (Hunt, Ojanguren, & Schwartz, 1999), availability of protective gear (Crissman et al., 1994), the economic feasibility of spraying per the label instructions, availability of label instructions (Ryan E Galt, 2013), and interpretations of the label itself (Ríos-González et al., 2013). This is far from an extensive list and does not delve into the numerous idiosyncrasies of pesticide use in various local cultures: the farming system and its associated crop protection scheme, types of equipment being used, available equipment, common pesticides being (mis)used, the strength of the State in regulating pesticides, and the strength of the pesticide industry’s lobby. Regardless, it should give an idea that the idea of “safe use” is more complex than providing information to a farmer in order that they correct their use. As such, analyzing a farmer’s or fumigator’s or technician’s decisions on pesticide application, in any given situation, deserves a holistic approach.

From an interdisciplinary perspective, it becomes obvious that approach an individual as the source of the problem as well as the solution is itself problematic. The individual-as-the-problem approach puts an undue burden on farmers rather than addressing systemic problems influencing their farming styles. Pesticide user’s motivations and decisions are far more complicated. Decisions on which pesticides to use and how to use them are influenced by an array of cultural, nonhuman, political, and economic influences (Athukorala, Wilson, & Robinson, 2012; Barraza et al., 2013; Brisbois, 2014; Cowan & Gunby, 1996; Ryan E. Galt, 2014; Jansen, 2008; Paredes & Sherwood, 2014; Ríos-González et al., 2013; Toleubayev, Jansen, & van Huis, 2010; Wilson & Tisdell, 2001). Specifically, the issues with pesticide problems come due to deep systemic issues with the prevailing food regime. Contrary to how the safe use narrative frames pesticide users, their decisions reflect a number of influences beyond self-interest in profit maximization (Ryan E Galt, 2013).

Often times, these pesticide users make decisions that superficially may appear to be influenced by profit maximization, but have more complex influences and deeper implications. This approach to pesticide users subjectivities provides describes their agency and related decisions in context of the systems of which they are a part(Freire & Ramos, 1970). This context presents a site to address outcomes of pesticide use as inherently political. Consequently, pesticide use cannot be reduced to a simple act profit maximization.

Argentina's agricultural system is defined by its massive adoption of transgenic soy, which covers more than half of the country's arable surface. This system reflects a number of safe use narrative elements; an agricultural production system regarded as "developed", highly industrialized and mechanized, relatively high rates of protective gear use, education, and highly specialized fumigation machinery. Furthermore, the styles of small and medium soy farmers are more businesslike than other smallholders with high instances of pesticide problems. This farming style is another element that the safe use narrative claims would resolve pesticide problems. Despite these characteristics, a number of controversies have risen around the production of transgenic soy and the proliferation of the herbicide glyphosate. Two leading issues today are alleged links public health crisis in rural towns as well as growing issues of glyphosate resistant weeds (Arancibia, 2013; Binimelis, Pengue, & Monterroso, 2009; Pengue, 2005). I posit that these farmers, approximately 90,000 in total and over 90% of soy producers, are a group most intimately linked with this agroecosystem and can inform a great deal on Argentina's pesticide problems (Gras & Hernández, 2016). I will operationalize Galt's (2013) theory of complex subjectivities of pesticide users by studying small and medium sized farmers of Argentine soy complex. By applying a holistic analysis of the small and medium farmers' pesticide use, I seek to understand the pesticide problem from the perspective of the largest group of pesticide user/decision makers in Argentina. The Argentine context may help shed light on how problems manifest in spite of adherence to many elements of safe use ideologies. Seeking to answer the pesticide problem by only researching the decisions of the country's elite is insufficient if it fails to address the 90,000 soy growers who represent 94% of the farmers in the country's most populated and economically vital region; 90,000 farmers who work and live in sprayed towns. In order to do so, I ask and will try to answer the following questions:

- What do small and medium soy farmers think about pesticides controversies?
- How do pesticides affect the farming styles of small and medium soy farmers?
  - What are the implications for the safe use narrative?

## **2. Context: Argentina**

As the complex subjectivities approach suggests, talking about pesticide controversies in Argentina without acknowledging the institutions that proliferated the soybean in Argentina overly simplifies history and politics. Latin America is a common setting for pesticide studies, with researchers commonly framing pesticide problems by using “truncated and selective histories of Latin America are used to justify research projects in specific research sites, which nevertheless function rhetorically as generic ‘developing country’ settings” (Brisbois, 2014, p. 600). In order to avoid that, I will attempt to provide a brief but adequate historical analysis that traces political, economic and some ecological roots of the current glyphosate controversy and provides background for my research. In order to paint a richer picture of this and situate farming styles in reality, important events of Argentine history reveal how the political economy have resulted in the modern technocratic regime of protection (i.e. pesticide use). Specifically, looking at historically powerful farmers and their modern counterparts’ role in dictating a series of technological rebirths that follow global trends of technocratic ideologies in agriculture. I will give basic detail on the agroecosystem in the humid pampas, the adoption of green revolution technology of the 1960s and how this laid the ideological groundwork for the proliferation of glyphosate-resistant soybean/no-till technology package. I will also address non-agricultural events in the history of Argentina that directly affected power dynamics among actors that shaped Argentina’s agroecosystem, concluding with more detailed aspects of the transgenic soy production model and controversies.

### **2.1 Argentina’s Agroecosystem.**

The pampean region of South America encompasses 750,000 square kilometers, covering nearly all of Uruguay, parts of Brazil, and Argentina. Within this transnational landscape, the Argentine pampas stretch from Brazil in the north, Uruguay and the Atlantic Ocean in the east and the Andean foothills to the west. Scaling down further, the humid pampas ecosystem is within the Argentine pampas and home to approximately two-thirds of the nation’s population as well as production accounting for two-thirds of the Argentine economy (WorldBank, 2017).

Argentina is South America’s second largest nation by a number of metrics: population, total surface area, gross domestic product, agricultural area, and agriculture

exports, as well as transgenic crop production. A great deal of this growth in population, capital and agriculture is due to and found in the humid pampas. Argentina has dedicated approximately ~20M hectares of land surface to soy production in 2015/16, virtually all of which was transgenic, herbicide-resistant soy (FOASTAT, 2017 ). Prior to transgenic production, approximately 10% of agricultural surface area was dedicated to soybean production each year. After approval of transgenic soy in 1996, it covered more than half of the country's agricultural surface by the early 2000s (Delvenne, Vasen, & Vara, 2013; Lence, 2010). The soy expansion now covers approximately 50-60% of the Argentine agricultural surface, with new seed technology allowing for shorting planting-to-harvest cycles, allowing for production to creep beyond the historic grain belt (Pengue, 2005). This widespread adoption of the transgenic soy technology package has greatly reshaped these rolling pampas, an area dedicated, since colonization, to production of cattle and a variety cereal crops in rotation. What was once a varied rotation, albeit imperfect, is now more often a glyphosate-dependent soy and corn monoculture This adoption of the transgenic seed and chemical fallow has a deep history that emanates from the humid pampas, the epicenter of the politically powerful agrarian bourgeois.

## **2.2 The Politics of Agriculture**

The 19th century agriculturalization was most fervent in the humid pampas, notable for its fertile soil, ample rain, relatively flat topography, and a warm, temperate climate capable of two high-yielding grain harvests per year., Quickly Argentina rose to a primary exporter of grain in the global market, proclaiming itself the “Granary of the World”. The export-oriented grain and livestock production incentivized large configurations of property, relying on economies of scale and early mechanized agriculture to proliferate (Gaignard & Figueira, 1989). After a period of stagnation stemming from the Great Depression, Argentine export agriculture suffered until the early 1960s. Aiming to overcome this economic sluggishness, powerful landowners adopted and promoted a technocratic ideology as the desirable way forward with a focus on professionalization of farming. A small cohort of the rural bourgeois founded the Argentine Association of Regional Consortiums for Agricultural Experimentation (AACREA) (Gras & Hernández, 2016). This organization achieved those ends via transition to Green Revolution technologies. These technologies supported their own interests: land management based on their already large land holdings and reduced labor.



Rapid and widespread adoption of hybrid seeds, synthetic chemical inputs, heavy machinery, and an emphasis on economies of scale allowed for a reboot of agriculture. This led to changes in land use, the intensification of production and the expansion of agricultural frontiers. Furthermore, agricultural knowledge and solutions were supplied increasingly beyond the farm-gate. As put by Gras and Hernández (2016):

Thus, scientific rationality was constituted as a value that helped one of the most conservative social classes to present itself as spearheading the Argentine economy. Fomenting an ideology of progress, AACREA put forward technology as the answer to ‘stagnation’. The rural bourgeoisie was thus confronting subordinate classes for whom land concentration was the key obstacle to progress and development.

These technological solutions also began a process of moving traditionally *in situ* practices off of the farm, allowing professional services and private businesses such as seed and chemical companies to exploit land and accumulate capital (Cáceres, 2015; Gras & Hernández, 2008). Consequently, large farmer/landowners laid groundwork for technocratic responses to economic stagnation. This sociotechnical regime was characterized by adoption of hybrid seeds, heavy machinery, professionalization of services, intensification of land use and export-oriented agriculture marketplace, readying the stage for the soyization of Argentina beginning in the late 90s (Lapegna, 2016). But before then, a decade span between the late 1980s and 1990s saw a major shift in Argentina’s political sphere, giving way to the modern agricultural model.

Argentina’s neoliberalization beginning in 1989 under the government of President Menem and continued through his successor, President de la Rúa. The neoliberal structural reforms ended with financial crisis and de la Rúa’s resignation amidst riots in December of 2001(Cáceres, 2015). The 1998-2002 Argentine Great Depression saw unemployment peaking at over 20%, hyperinflation, political turmoil (7 heads of state between 1999 and 2003) and defaulting on US\$132 billion in 2001(Damill, Frenkel, & Rapetti, 2006). After the default and reestablishment of the government, soy exports were a key part of loan restructuring with International Monetary Fund. It was expected that approximately 40% of revenue from soy would contribute to loan payments based on potential yields and associated taxes (Damill et al., 2006; Pengue, 2005) . So the post-crisis government of Nestor Kirchner sought accumulation by transgenic soy as a main pillar of Argentina’s economy (Torrado, 2016). Although the crisis made soy an inseparable part of Argentina, the arrival of GMO predated the financial crisis. During the final years of Menem’s government, transgenic soy

was approved as part of another agricultural reboot during a period of low international grain prices; the response to agricultural stagnation was at its core the same as the response of AACREA in the 1960s (Newell, 2009). The 90s saw a spate of public services privatized and investment in the no-till transgenic soy package (Lapegna, 2016; Leguizamón, 2014). In the face of privatization and state support for expensive technology, approximately 88,000 small and medium farmers went out of business between 1988 and 2002 (Cáceres, 2015; Gras, 2009; Torrado, 2016). This was led by a new association, dedicated to ushering in an evolution of the old technocracy, this time founded on the neoliberal reformations.

With a technocratic ideology firmly in place, the AACREA eventually gave way to the Argentine No-Till Farmers Association (AAPRESID). The association embraced the neoliberal agenda spurred on by Menem's government and technologies offered by a league of Agribusiness Transnational Corporations (ATNCs) settling in Argentina after the approval of field trials for genetically modified crops in the early 90s (Joensen, Semino, & Helena, 2005). The transition echoed the move AACREA in the 1960s, characterized by enlarging landholdings, adoption of cutting-edge seed (now transgenic) technology, the latest agrichemicals and machines that reflect the farming style. Gras and Hernández (2016) sum up the ideological shift that accompanied the adoption of transgenic soy and the no-till model of production.

(T)he characteristics of the bourgeoisie gathered in AACREA were ill suited to the needs of the corporate global project... Here, the key principles for agricultural development are not found in farming activities exclusively, but in firms' ability to take up different business opportunities inside and outside of farming. A new 'capitalist spirit' (Boltanski and Chiapello 2002) was needed...

This new 'capitalist spirit' is found in all scales of soy production, from the mega companies that employ the *pool de siembra* model to small and medium farmers of Argentina. This spirit also gave way to the uniquely Argentine *pool de siembra*. *Pooles de siembra*, or sowing pools, is a system of agricultural production utilizing financial capital to lease large tracts of land and employment of *contratistas* to manage on farm operations: sowing, harvest, fumigation, and transportation. Prominent architects of such businesses are often self-proclaimed "landless farmers" who boast of being able to grow huge quantities of soy remotely (Bell & Scott., 2010). This new model further lowered labor requirements but increased demand for capital and inputs, deeply altering the agrarian structure for large and small farmers alike. The small and medium farmers that did not go out of business during the

mass exodus of the 90s had to adopt both the product and the model of production, defined by this farm-a-business model. The implications for the average smallholder was a drastic shift away from historical reliance on a majority of family labor to reliance on outside labor via contract work, pushing the family in a managerial role.

Today, soybeans various forms (meal, cakes, oil) amount to more than 30% of Argentina's exports (Simoes, 2017) (Also see Appendix 3). The capital accumulated from soy is integral to the well-being of the Argentine populous. The Post-crisis governments of Nestor and Cristina Kirchner "relied on soy-derived revenue to sustain their 'National-Popular' model" (Leguizamón, 2014, p. 155). This model is based on state funded social welfare programs, including "cash transfer programs such as *Jefas y Jefes de Hogar Desocupados* (Unemployed Household Heads program) and the *Asignación Familiar por Hijo* (a monthly allowance for unemployed families with children), have had a positive impact in reducing income inequality" (Leguizamón, 2014, p. 155). Soy and soy farmers thus became culturally significant, being integral to an economic model that eased suffering and tensions of a nation facing devastating uncertainty. The aforementioned post-neoliberal programs of the two Kirchner governments combined with left-over neoliberal ideologies of Menem and De La Rúa manifested themselves via institutionalization of transgenic biotechnology and no-till package. This has resulted in a rigid system controlled by a small pool of powerful actors (Gras & Hernández, 2014, 2016; Lapegna, 2016). The largest agribusiness firms have capitalized on this opportunity. The *pool de siembra* firms such as CRESUD, MSU, Adecoagro, Calyx Agro, Los Grobo Agropecuaria and El Tejar together control millions of soy hectares in Argentina. Companies such as these, along with large soy farmers, account for 6% of soybean producers yet produce an astounding 60% of soybeans in Argentina (Gras & Hernández, 2016). And thus, soybeans and requisite glyphosate use proliferated across the entirety of the humid pampas and its periphery.

### **2.3 Public Health and other controversies**

Running parallel with soy expansion are reportedly growing rates of cancer, birth defects and stillbirths in the towns of the soy zone (Arancibia, 2013). Although numerous studies since the rise of glyphosate have presented findings that glyphosate poses no unreasonable risks when used according to directions, the herbicide has been at the center of a public health controversy in the Argentine "Soy Nucleus" for nearly a decade (Delvenne et

al., 2013) . Movements such as *Madres de Ituzaingo* and *Parentes de Fumigar* have created global awareness around the issue, with media outlets such as the BBC and National Geographic to report on the reported rise in chronic illnesses in what were dubbed “sprayed towns” (Arancibia, 2013; Vara, 2012). Thus far, their mobilization has garnered one notable although arguably superficial victory in the form of no-spray zones. Due to the organization of these groups, there are ordinances in all the towns in soy regions of Cordoba, Buenos Aires, Santa Fe, Las Pampas that prohibit spraying around urban zones, the radius of said zone depending on the town and province in question. The primary radius prohibits all spraying, the second prohibits fumigation with pesticides classified higher than what are colloquially referred to as “green or blue band” pesticides. These are registered as class IV and class III pesticides, the posing the lowest toxicological risk when ingested orally or absorbed through the skin. The third radius approves of terrestrial application of any approved agrochemical, including Classes II & I, known as “yellow and red band” pesticides, posing the highest risk to human health (Arancibia, 2013; Lapegna, 2016; SENASA, 2012 ). The fourth and final radius applies to airplanes fumigation, as this form of application is most prone to drift. Furthermore, many towns now have certification courses for fumigators that teach best practices for spraying, although official licensure is not required. In certain cases, an agronomist or agricultural engineer as well as a town official are needed to sign off on spraying in some conditions. Argentina has also taken steps to ban certain pesticides during the summer months, as certain pesticides are prone to volatilization (when a pesticide turns to vapor and is prone to drifting beyond its intended target) during that season. No action has yet been taken in light of the IARC’s classification of glyphosate as a “probable carcinogen”. Indeed, use of glyphosate is still rampant in Argentina, as soy production shows no signs of slowing.

Besides the controversies regarding public health, the rise of superweeds, or weeds with glyphosate resistance or tolerance, are a growing concern for the soy complex. The glyphosate tolerant and resistant weeds (GT/GR weeds) have a significant impact on soy farmers’ economic security. These weeds can tolerate or resist all together high doses of the herbicide glyphosate, rendering the product an ineffective method of control. These weeds require high doses of glyphosate or mixes with other herbicides that target specific groups of plants, such as grasses or broadleaf species. I will discuss how farmers respond to public health controversies as well as the emerging issue of GT/GR weeds and their implications in my results.

## 2.4 The 94%

Small and medium farms make up the vast majority of farms in the humid pampas. Virtually all of the owners of these farms grow soy, typically 60-70% of their surfaced is planted in soy with small rotation of corn, wheat, sunflower, sorghum and cattle, depending on soil quality (Obschatko, 2006). Most of the small or medium farmers fit into the category described as “capitalized family farmers who are capable of...expanding their production systems... Generally speaking, these farmers cannot be described as poor” with smaller farmers primary challenges being “technical support services for production (financing and credit, technical assistance, marketing support, supply chain insertion, etc.)” (Obschatko, 2006, p. 5). The characteristics of farming styles and requirements for economic viability have recently been defined by Argentina’s accumulation-by-soy model. Viable production in the humid pampas was estimated to be at least 200 hectares in the 1990s and early 2000s (Gras, 2009). Medium sized farmers, those with around 500 hectares, typically do not lack for credit or supply chain insertion. As a consequence of the new technology package (specialized no-till machinery, new fumigation machines for larger plots) and associated growth in farm scale, modern production systems rely heavily on contract work. Small, medium and large farms models are “principally based on...outsourcing sowing and harvesting tasks, which are undertaken by large enterprises offering machinery services” (Gras, 2009, p. 5) In the case of small and medium farms, the owners will take on what accounts to a managerial role, deciding which seeds and inputs to use and scheduling events, monitoring fields for pest outbreaks (Cáceres, 2015). Some farmers who own equipment will also do contract work in addition to their own production. Besides contract work, it is incredibly common for farmers to rent land (Obschatko, 2006).

Along with the loss of 88,000 farms between 1988 and 2002 in Argentina, leased land increased by 52%. This period saw a reduction of around 50,000 farms in the humid pampas. This leased land increase reflects adoption of the *pool de siembra* model, but a small portion is accounted for in small and medium farmers leasing land. Overall, small and medium farmers reproduce, to an extent, the prevailing model for the largest growers. The only difference being that their ability to accumulate capital via economies of scale is severely reduced and unlike the “landless farmers”, they live in the towns adjacent to their fields (Murmis & Murmis, 2012). These farmers were influenced to adopt the no-till soy model due to its low cost and potentially high output. The simplification of production in terms of the supply chain, both for inputs and selling their outputs resulted in the farmers basing

managerial decisions on basic cost-benefit analysis. These decisions would theoretically reflect the safe use narratives model of the pesticide user as *Homo economicus*, an informed decision maker seeking to maximize profits.

It is also common farmers also join cooperatives or associations to advance their interests politically or economically. Some function to control input costs, a more important aspect then ever given the high input nature of soy farming. This allows groups of hundreds or even thousands of small producers to collectively buy inputs, such as fertilizers and pesticides, such as the *Federación Agraria Argentina*, the largest cooperative for specifically medium and small farmers. Associations are typically related to lobbying efforts or technological advancement, such as AAPRESID. Farmers aligning themselves with cooperatives or associations is not a new phenomenon, many cooperatives have existed since the early 20th century (Gaignard & Figueira, 1989).

These are only the basic descriptors of small and medium farmers of pampean regions; the structural changes from social, economic, and cultural perspectives are much deeper than the scope of this document allows me to explain. The most important aspect is the implications for smallholder or mediumholder farmers after soyization. Specifically, there styles becoming exceedingly more businesslike between 1960 and today. This farm-as-a-business model interesting ramifications for the reality of the safe use narrative. See Rotolo (2015), Albaladejo (2013), Murmis & Murmis (2012) Gras and Hernandez (2006), Obschatko (2006).

## **2.5 Glyphosate and The “no-till” package**

Glyphosate originated in a Swiss pharmaceutical company in 1950, and later re-discovered as an herbicide in 1970 by a Monsanto chemist (Dill et al., 2010). By 1993 was the 11th most used pesticide globally measured by active ingredient. Despite glyphosate resistant crops still being 3 years to market, the herbicide had found broad uses anywhere a land manager desired to eradicate all vegetation, from viticulturists managing vegetation in-between rows, to industrial yards, clearing the way for new infrastructure programs such as rail and power lines. Even the Colombian government began aerial fumigation of glyphosate to suppress coca farmers in the 1990s (Charles M. Benbrook, 2016). The widespread adoption in Argentina, USA, and Brazil of glyphosate-resistant crops fueled a global glyphosate boom; by 2014 farmers were using 15 times the glyphosate they had used in 1995.

In kilograms of glyphosate, this accounts to approximately 747 million kilograms of glyphosate applied in 2014. Just in the last decade, more than 6.1 billion kilograms of glyphosate have been released into the environment (C. M. Benbrook, 2016; Woodburn, 2000).

Within Argentina, the timeline of glyphosate reflects global trends. Initially, glyphosate was touted by agribusiness and farmers alike as a miracle chemical. Transgenic soy adoption and consequential glyphosate application, were rapidly adopted. The 1990s saw an increase in land coverage of 60%, from ~5M hectares to 8M hectares. The next decade saw this number jump from 8.6M hectares to 18.1M, stabilizing at ~19M (FOASTAT, 2017 ). This huge increase and eventual stabilization reflects not only transition of less lucrative crops like wheat or corn being replaced with soy, but also an increase in overall arable land production by means of grassland conversion and heavy deforestation. The high rate of adoption and proliferation across Argentina greatly lowered diversity of cropping systems, especially in the soy nucleus where glyphosate-resistant soy now accounts for more than half of arable land (FOASTAT, 2017 ).

As discussed earlier, powerful actors in Argentina's political economy touted a technocratic evolution as a solution to agricultural stagnation. This biotechnology based package was based on glyphosate resistant soy and no-till machinery. This technology package was originally marketed to the government and farmers as a way to conserve soil, improve yields, and lower costs (Benbrook, 2005, 2012; Burachik, 2010; Duke, 2014; Duke & Powles, 2008).

(1) Soil conservation: constant plant coverage and minimal soil movement maintains moisture and soil fauna activity. This prevents erosion and maintains fertility.

(2) Glyphosate resistant soy: A one-size-fits-all approach. This would reduce overall need for herbicides in crop production. Resulting in safer applications and simplification of crop protection, removing the need for complicated herbicide mixes.

(3) Reduced costs: Less spraying and no tillage meant less time spent running fewer machines, lower expenses for gas and maintenance. Indirect benefits were allowing a higher velocity of work, and higher national yields, as well as allowing even fewer farmers to manage more land.

No-till practice implements what farmers refer to as a “glyphosate fallow” or “chemical fallow” as opposed to a traditional fallow, in which farmers plough under residual plant material and allowing wild plant material to grow for a period of time to restore fertility. In pampean regions, this often involved incorporation of extensively ranged livestock. Tilling soil and grazing livestock were natural weed controls in traditional pampean systems; these practices broke up lifecycles of weeds and removed seeds from the soil bank. Today, soy farmers will spray glyphosate numerous times a year in order to clean their fields for soy production, the transgenic mutation of the soy allowing the plant to resist glyphosate while the other plants in the field are killed. This readied the fields for directly sowing soybeans into the soil (Casabé et al., 2007; Cerdeira, Gazziero, Duke, & Matallo, 2011).

Consequently, herbicide use, primarily as a function of glyphosate resistant seed, proliferated in the country. The function of glyphosate growth is not only due to the increasing number of hectares put into soy production. Applications per year as well as quantity of glyphosate applied per application has been rising steadily in Argentina since 1996 until 2014. However, the FAO reports that overall herbicide use declined between 2010 and 2014 after having increased more than 10fold between 1996 and 2010 (FAOSTAT). How this trend continues to the present is difficult to define; census data on agriculture in inputs in Argentina is controlled by private companies and data offered by the state is weak. When speaking with farmers, there is no indication that glyphosate use has lessened, and it is likely that use of other herbicides to supplement glyphosate has ramped up.



### 3. Theoretical Framework

My work is based on an analysis of farmers' decisions and opinions concerning pesticides and how this affects their farming style. Specifically, operationalizing Galt's (2013) complex subjectivities approach to explore the context of pesticide users' decisions. He describes complex subjectivity of the pesticide user as "interpellated by multiple and complex causes and with the potential for change" (Galt, 2013, p. 339). This draws on the idea of the interpellated subject, in which individuals identities are defined by the institutions of which they are apart (Althusser, 2008). This conceptualization opposes the prevailing narrative of the pesticide user as a neoliberal subject, self-interested and individually responsible for their actions i.e. Homo economicus. The conceptualization of the pesticide user as Homo economicus underpins the safe use approach to solving pesticide problems.

The safe use approach assumes unsafe or misuse as a direct condition of undereducated, undertrained, and under-equipped pesticide users. Pesticide users create their own problems and these problems can be solved via "instrumental action" i.e. control through ordinances and implementation of safety equipment as well as "didactic communication" via technical training of sprayers (Galt, 2013). Accordingly, users will begin to apply pesticides in a safe manner per the instructions on the label, the instructions themselves prescribed by professionalized, technical experts. These qualities of the pesticide misuser have almost become a cliché of "developing nations", especially relative to reported high rates of safe is in the developed, Global North. This stems from an idea that the industrialized, global north exists as a paragon of development and "these low rates of protective gear use should not be seen as the paragon to be achieved through development and educational interventions that technocratic regimes of protection pose" (Galt, 2013, p. 345). Switching the focal point away from truncated ideas of what is "developing" and questioning the discourse itself by studying why a place is considered "developing" frames pesticide problems would allow for truly addressing problems, in this case the reliance and controversy of pesticides in Argentina. Brisbois (2014), recognizes the need for critical analysis of the systemic issues from which pesticide problems emanate in a study on public health interventions:

While various papers in the sample do contain historical context, this typically deals with topics such as trends in pesticide use or health impacts, or the economic prominence of agroindustries such as banana, cotton, and flower production, without exploring political economic reasons for these phenomena. (Brisbois, 2014, p.606)

The Argentine context provides a unique case in this light, as a “developing nation” with an agricultural regime that strongly applies the safe use framework, as instanced by the ordinances controlling when and where pesticides can be sprayed as well as professionalized, mechanized fumigation services. Their agricultural system is based on a model more akin to a “developed” agricultural model (van Zwanenberg & Arza, 2013). Pesticide applications are most often done by people riding a self-propelled machine with inside of a pressurized cabin and charcoal filter. Applicators also report much higher rates of wearing protective equipment and spraying according to a prescription from an agricultural engineer (Butinof et al., 2014; van Zwanenberg & Arza, 2013). The capital investments and professionalized services offered to soy farmers also would suggest an adherence to safe use, and thus, the argument goes, no unreasonable risks posed by glyphosate. This is all compounded by the internalization of the capitalist spirit that pervades soy production styles. Regardless of aspects of safe use being built into Argentine soy farming, pesticide problems persist.

The persistence of pesticide problems in Argentina is why I chose to use the complex subjectivities conceptualization, as it reasserts pesticide problems as systemic rather than cases of individual misuse. I address complex subjectivities of the largest group of pesticide users in Argentina because safe use would suggest that this group of farmers is at the core of the pesticide problem, with their ability to make economically rational choices at stake.

When safe use approaches assume that training and equipment will sufficiently prevent misuse, they assume that the user exists in a vacuum, aculturally and ahistorically, that is without influence outside of economic rationality. But in reality, farming, even market-oriented cash crop production, is beholden to a number of internal and external values, actions, struggles, etc. that exist beyond economic rationality.

I use of the complex subjectivities approach these interpretations of policy, technology, safe use in a “developing” setting to guide my analysis of small and medium farm owners as pesticide users in Argentina. “(F)armers as pesticide users grapple with knowing that their livelihoods as petty commodity producers depend on externalizing costs in the form of undermining their own bodies through pesticide exposures” (Galt, 2013:339). Here, small and medium soy producers of Argentina provide an alternate take on the commodity producer. In this context, it is possible to see how farmers externalize costs of excessive pesticide use, but rather than undermining their own bodies they begin to undermine their ecosystem and potential for transition. This is the strength of

conceptualizing pesticide users as complex subjects rather than simple subjects driven by a reduced idea economic rationality. My hypothesis is that farmers would either have strong opinions concerning the health effects of pesticides and the activist movements that have publicized them. I expect to find farmers polarized by the movements, either supporting them due to themselves seeing negative health effects or be strongly opposed to movements that protest their farming style. Either way, understanding why farmers choose to use pesticides in the manner they do will shed light on what is influencing their use, whether ordinances or movements have any effect and also how their pesticide use in turn influences their farming styles.

## **4. Methodology**

In this chapter I will present my study design and the components of data collection and analysis that support my questions and theoretical framework. I will explain the basis for my literature review, my methods for interviews, observation, data coding, and analysis.

### **4.1 Study Design**

This investigation is a qualitative design, using semi-structured interviews for primary data collection. The interviews are with 8 soy producers within the Argentine soy belt, four agroecological producers, as well as conversations and interviews with five agronomists and one academic. Interviewing people outside of the immediate focus of the research question enriched the findings. Although initially grounded in a specific interview guide and observation protocol, both methods evolved over the course of a two-month data collection due to various circumstances, including availability of a private vehicle or the farmer's available time. All interviews and observations took place within and around the soy nucleus, specifically the provinces of Buenos Aires and Santa Fe.

As an agroecology student, my implicit bias is one towards a pesticide-free system of production. I view a pesticide dependent food system as lacking in resilience. For this, rather than assume the role of a "neutral" researcher, I attempted to frame my questions and interviews in a way in which my belief and assumptions were suspended; to merely ask questions about what farmers thought, what they do, how they think, what they think will happen. For my literature review and analysis, I attempted to research at least some work skewing towards a pro-pesticide frame or a scientific "neutral". The literature on pro-pesticides within social sciences is practically non-existent, there is much work on epidemiology or toxicology to support the safety of pesticides as a response to anti-pesticide movements. For this, one must read-between-the-line, so to speak, on studies of pesticide efficacy in field trials, toxicology, or press releases and studies of the chemical companies themselves, which are often easy to sum up and also has been done by a number of critical pesticide researchers. Based on my literature review and analysis, I concluded that going to the source (farmers and agronomists/agricultural engineers/extensionists working in the field) and listening would potentially provide the freshest insight.

I began my work with a desire to find a potential inroad for transition, although my resources (time and money) limited my scope. I was able to find one but could not focus ample time to gather empirical data for a thorough analysis, which I will address briefly in my conclusion.

#### **4.2 Data collection and analysis**

To operationalize the complex subjectivities theory of pesticide users, I drew on the methodologies of Ryan Galt and Pablo Lapegna. Both Galt (2014) and Lapegna (2016) employ the extended case method of Burawoy (2000). This allows understanding how the social and natural sciences converge, how politics shape sciences and ecologies. The idea for the observer to exist within the world of the observed, extend observations spatially and temporally, a linking of the micro situation to macro causes and eventually allowing the gleaned information to inform the theory (Burawoy, 2000; Ryan E Galt, 2013; Ryan E. Galt, 2014; Sayer, 1992). Furthermore, Burawoy (2000) emphasizes the necessity of the researcher to reflect on one's own bias and identity create a subjective point of view. This is an act that the researcher partakes in before, during and after the research to understand their own position in relation to who they are researching. At its core, it is recognizing that by stepping into the subject's world, the researcher undeniably affects it. By recognizing and reflecting on this dynamic, the researcher can potentially enrich their own research. Sayer (1992) provides a further integration to shape methods: extensive research and intensive research. These two types of research relate to sampling information from one group (in this case, small and medium sized transgenic soy farmers) and identifying the causal relationships between different groups (supply chain actors, government agents, activists, rural communities, farmers' communities, etc.), emphasizing connections between spatial scales (local "farm level" up to national and transnational political economy) (Sayer, 1992).

I chose to locate myself in the capital city, Buenos Aires for logistical reasons, as my only contact and institutional link were both located in Buenos Aires. I had been offered a space to work and network with fellow researchers. Shortly before I arrived, the federal government greatly decreased available funding for researchers and consequently this offer was no longer available. Although I initially figured this would hamper my mobility, as I had already rented a space in Buenos Aires, I was able to use it to my advantage by using the city as my base and venturing to locations north, south, and west of the capital.

Due to primarily fiscal constraints, my observations and interviews were limited to a 10-week period in Argentina, in which 5 separate excursions were taken to different sites in Santa Fe and Buenos Aires provinces, as well as a handful of conversations with academics and industry people in the capital city, Buenos Aires. Three excursions were cancelled due to flooding and farmers needing to prioritize their own work. Unfortunately, two of these cancelled trips were for follow-up interviews although the initial interviews provided rich enough data for analysis. These abrupt changes in the schedule allowed for extended literature review and reflection on interview processes, as well as experiencing, however briefly, a direct challenge these farmers face constantly.

Four of the trips were weeklong excursions to different study sites, the fifth trip was a day long excursion cut short due to flooding. Although there are advantages to living among the producers, a number constraints kept me from doing so. The soy zone is a vast area with an infrastructure poorly suited for travel without a personal car. As such, rental companies are primarily in large cities, expensive, and my budget did not allow for more than a few car rentals. Consequently, I opted for periodic stays in the countryside using a combination of public and private buses and car rentals. Due to having a home base in Buenos Aires, I was able to turn this to an advantage and meet farmers in multiple areas around the soy zone, adding a geographical richness to my study. I was able to uncover commonalities found across the soy zone that allowed me to make better analytical generalizations. The analytical generalizations are strong because these farmers face slightly different circumstances and have more divergent histories than if all of my interview were just based in a single town in the soy zone. I found it imperative to create a study from which I could draw strong analytical generalizations because my research is not based on working with a statistically relevant sample size or data collection based on statistical relevancy (i.e. survey). I did at one point consider using a survey for further qualitative collection. During my limited time communicating with farmers, I found their response time to emails was less-than-adequate to justify sending out a survey.

### **4.3 Literature Review**

Due to the nature of the complex subjectivities theory, my literature review covered numerous areas of study including but not limited to: political ecology, pesticide studies (epidemiological, toxicological, political, economic, environmental), Argentine agrarian

history, Argentine anti-pesticide movements, analysis of the transgenic soy regime in Argentina and broader food regime analysis with a focus on biotechnology in Latin America. Initial research was done on general pesticide studies, with a focus on safe use narrative critiques and technology studies with a political ecology focus. Although I do not make it explicit during my introduction or theoretical framework, my study is implicitly focused through the political ecology lens; the environment and agroecosystem of Argentina is inherently politicized. During my time in Buenos Aires, I was able to access books in city libraries unavailable in Wageningen's or NMBU's online libraries, typically books written in Spanish covering Argentine agrarian history. I also focused on articles written in Spanish after 2010 by Argentine agronomists working at INTA, the University of Buenos Aires's College of Agriculture and University of La Plata's college of agriculture to better understand the current focus of pest management. Not all of this is represented in the paper, but it gave me a much richer picture of the internal work of Argentina that focuses on the soy complex.

The strength in my literature review fed my data collection, in terms of ability to speak confidently about certain historical instances or understanding farmers' changes in farming styles in the past. This worked both ways, as when I returned to transcribe and code my interviews, my immersion in these topics made for more robust analysis.

#### **4.4 Methods**

My methods were based on participant observation with small and medium farmers as well as different important actors in the soy complex. Some interviewees only had time for interviews, lasting from 45 minutes to two hours, whereas I spent entire afternoons or days with other farmers, engineers or academics driving around the soy zone, visiting various sites, with interviews taking place when appropriate. See Appendix 1 for a list of interview respondents.

##### **4.4.2 Interviewee Criteria**

I initially had chosen to seek out farmers of medium or small scale within the soy growing area of Argentina, with a focus on the “Soy Nucleus” or its periphery. For a maps of the humid pampas, Soy production and my interview/observation sites, refer to appendix 2.

My criteria for soy farmers is based on a number of abstractions and assumptions I had drawn from analyzing literature. Foremost is that these farmers would be representative of a “soy middle class”, live nearer to their farms or fumigated areas and be more inclined to focus on long term management.

- a) Own their own property
- b) Be a small or medium producer. This is not an officially designated number in Argentina as far as I could find. I decided that, based on conversations with engineers and farmers, that less than 1000 hectares would be medium and under 500 would be small. All of the soy farmers interviewed owned or owned and rented between 150-600 hectares.
- c) As most of the farmers I spoke to rent additional land, I decided that they must not rent enough to put themselves into a category of “large” or over 1000 hectares.
- d) And finally, they must manage the land themselves. These criteria prove tricky, as there is a great deal of contract work. If the work is contracted but management decisions stay with the owner, then they fit my criteria.

I interviewed 12 separate farmers and an additional 5 agronomists and 1 academic, all of whom are male. Four of the farmers were agroecological producers in soy areas, the remaining 8 fitting my criteria as property owners who also manage their property, each with distinct agricultural history, and a majority of their property in soy. Even “manage” comes with a disclaimer: only 1 fumigates their own property, only 2 sow and harvest their own property, and 7 of them rent property depending on the year. Furthermore, one agricultural engineer I spent a day with nearly fit the criteria despite not owning his own land: He has worked for a family owned company as an engineer for nearly his entire career, manages the land along with the family (owners) with a long term outlook, lives very close to the property, and has a say in decision making and management and even partook in much of the manual work involved. The fieldwork and observations revealed that the criteria needed to be looser than I originally assumed. See appendix 1 for details on interview respondents.



### **4.3.3 Semi-Structured Interviews**

I strived for casual, semi-structured and open-ended interviews. The interview site varied; some in cafes over a cup of coffee or lunch, others in the offices of agricultural cooperatives while sharing yerba mate, trucks driving among the farmers' fields, or during tours of a cooperative's warehouses and stages area. Each interview began with a casual, open ended question concerning the history of the soy producers farm. I then focused on timeframes, if applicable, that would likely result in drastic management practices on their own farms and in farming landscape. I then asked about general pest management practices, allowing for room to speak for themselves about how they practice now, how it was in the past, and what were the biggest challenges facing them in the present. We also discussed how their management style and cropping system influences their pest management and the changes they had seen in the last few decades, with a priority on pre 1996 and post 1996 changes. Not only did we discuss challenges from a crop protection perspective but from an overall farm perspective and how they perceived future challenges. Other topics were where they receive information, as well as their views on general controversies around glyphosate. This gave a sense of influences from the complex subjectivity framework: State, Capital, Cultural, and Nonhuman influences. I tried to address sub themes that would give rich descriptions of these themes: knowledge, community, farming styles (historical->present) and pesticide controversies. I also tried to speak to the farmer about their vision for the future. This was a totally open ended question, one which might be influenced by the previous topics. This often gave me a sense of what truly was controversial or challenging for the farmer being interviewed.

### **4.3.4 Observations**

The observations in this research can be considered both participatory and non-participatory. They were conducted over a two-month period, from mid March 2017 until mid May 2017. The observations coincided with field trips for interviews. A field journal was kept that doubled as a place for reflection. None of my respondents lived on their farms, and thus a number of my interviews and conversations took place in towns and small cities. When logistics allowed, I joined producers on tours to their farms as well as cooperative offices and staging areas. The time spent on these tours, driving with a farmer in their truck or with an agronomist in office is what I would consider participatory observation time. Non-

participatory observation would be the time I spent on my own in the countryside observing the general makeup of the fields as I transected the soy zone. My observations are used to verify information that I found in literature or interviews.

#### 4.3.5 Analyzing and Coding Data

The transcripts of the interviews were coded according qualitative analysis tools charts based on meaning units, condensed meaning units, sub-themes and themes (Graneheim & Lundman, 2004). The meaning unit is a statement taken directly from transcriptions then distilled to its essence as the researcher sees it, followed by an interpretation of latent text. From the latent text, the researcher can draw a category or sub theme. From these sub themes, the researcher will link to a theme (figure 1). Using my themes and subthemes, I can see how farmers act with economic (ir)rationality and how they view, address, or contribute to the pesticide problem and debate.

Meaning unit	Condensed meaning unit	Interpretation of the underlying meaning	Sub-theme	Theme
The problem today is that we are using much larger doses to kill what is tolerant. And we have mixes in the tank to control tolerant weeds	We are using larger doses of glyphosate to kill tolerant weeds	weed management is changing back to old methods	Reactionary weed management	Culture & nonhuman

**Figure 1:** Examples of meaning units, condensed meaning units, sub-themes and themes from content analysis of an Interview with Walter Comelatti, a soy farmer.

## 5. Results and Discussion

In this chapter I will present my results while simultaneously discussing my three questions presented in the introduction. Each sub chapter will address my research questions respectively.

### 5.1 What do Farmers think about pesticide controversies?

*Glyphosate has a long history of safe use. In evaluations spanning four decades, the overwhelming conclusion of experts worldwide has been that glyphosate, when used according to label directions, does not present an unreasonable risk of adverse effects to humans, wildlife or the environment.*

*Monsanto News, April 17, 2017*

*But the same solution is to simplify everything with glyphosate and now it doesn't serve you.... But the people, the community, say "glyphosate, glyphosate, glyphosate!" Always with the same, the same which each crop. And the weeds began to grow resistances*

*Andrés, Pilar, April 28, 2017*

*In some of weeds a resistance to glyphosate appeared. And so, there was a return to the old herbicides because we used glyphosate and nothing more.*

*Norberto Andreo, San Rafael, April  
29th 2017*

When addressing problems concerning health effects of pesticides, farmers framed most of their responses within the safe use narrative. Walter, a lifelong farmer from the soy nucleus, tells me "Pesticide labels are important, they indicate their level of danger. The sprayer must have a conscience because they are poisons and disasters are possible." Walter gives deference to the labels and those with working knowledge of spraying pesticides, i.e. following the labels. He goes on to clarify that pesticide drift in particular is potentially dangerous for populated areas "And it is dangerous for the people, the urban area in total." When move on we speak specifically of glyphosate risk, he references the label again, expounding:

I do not know, I do not have the knowledge, I don't know until where it affects your health. But whichever other pesticide is applied, can be much more toxic than glyphosate...I do not have the knowledge, but that it [glyphosate] can affect a person's life. But in much, much longer time period, and I do not know what problems there would be.

Walter expresses some support for the safe use narrative. He views pesticides as necessary, potentially dangerous, but explains that it is possible, if one follows instructions, to insure safe use. But he does seem weary of synthetic pesticides, telling me “chemicals are bad but necessary”. Andrés inferred that the proliferation of herbicides is systemic, and given the importance of soy to Argentina, there is no other way.

Hernan, another lifelong farmer and friend of Walter, also echoes this sentiment, that safe application is up to the conscience of the pesticide user. “In this zone, glyphosate is not sprayed with airplane because of drifts... sometimes you can do damage to other crops because you can't control much with the airplanes...so we [spray with airplanes] only when necessary and with much care.” When talking about controversies of pesticide drift, I asked him about laws that prohibit or limit spraying when the climate is unsuitable. Hernan tells me “These regulations do not exist. The only thing is the conscience of the one spraying. Nothing more... it is asked that those who are spraying use their best conscience, with whichever chemical.” Hernan emphasizes the need to be cautious agrichemicals, especially glyphosate, but does not mention any dangers in terms of human health. For him, the bigger risks of glyphosate use are the possibility drift and damaging a neighboring crop not resistant to glyphosate. In line with the safe use narrative, the person doing the spraying is the primary danger. Both Hernan and Walter approach chemicals as potentially dangerous but necessary as well as controllable.

The common response I received when asking more about public health concerns is that there are ordinances to prevent damage to the population from pesticide misuse. When I asked Hernan about potential negative health effects, he responded by explaining the ordinances in Junín. “Ok, this city has an ordinance stating that this zone...starting with a marker for the urban area, you cannot spray within 2km of that mark with an airplane. 500m with terrestrial equipment.” Rather than say whether or not he believes chemicals are dangerous, he defers to the ordinance, saying that they take the precautions necessary for the public and beyond that the pesticide users conscience is the final determinant of misuse.

None of these farmers have perceived a rise in cancer (or any other public health problems reported by anti-fumigation movements) in themselves (for those who do spray), colleagues or communities. This is likely is the reason backing their tepid response to claims staked against glyphosate's low toxicity. Farmers also showed a strong faith in how pesticides were presented to them, either by their own training, by professionals, or labels. Acceptance of information given to them by the industry and lack of perceived illnesses in sprayers or community certainly contributes to the internalization of the safe use narrative by the farmers.

Andrés, farms for a family business 20 kilometers down the road in Pilar. He graduated and began work as agricultural engineer just shortly after transgenic soy was approved for use in Argentina. His perception is that pesticides overall have gotten much safer in the last few decades. When asked about the anti-pesticide activists:

I really don't know who tells the truth and who lies, but I think that whichever thing you use in whichever quantity, you need to take precaution. But, me, personally, to have seen people who live near glyphosate and have problems with the usage and health? there aren't any. Nor are their sprayers with problems. Yes, you have sprayers from before with problems but they sprayed red band insecticides.

He goes on to explain further the ordinances prohibiting spraying, as well as specific part of the ordinances. There is an exception to the distance in cases of proper climatic events, primarily wind, that allows green and blue band pesticides to be sprayed closer to town if spraying downwind from the town. Andrés, like the aforementioned farmers, puts his trust in controls for the safety of pesticide application. Specifically placing the burden of safety on the person rather than the product. There is a general acknowledgement of risks, but also that these risks can be controlled, at least as far as human health is concerned. This is a type of flawed logic followed in contested topics like firearms, where the common trope by the pro-gun lobby is *guns don't kill people; people kill people*.

Rodrigo, a farmer with land in Arroyo Dulce, a small town near Pergamino about 100 kilometers north of Junín, addressed the problems of spraying by addressing citizen action “in the countryside we have towns with 50,000 or 100,000 inhabitants, or 2000 inhabitants like Arroyo Dulce. You have the same problem there now; the people are starting to be conscientious about the activity [spraying pesticides].” Rodrigo seems to think that pesticides pose more of an issue for the environment when misused; he explains the ordinances to me then concludes by saying “but I can still apply 50 tons of pure urea to my land, and its legal.”

Implying that the ordinances do not address environmental issues posed by agrichemicals but suffice to calm the collective conscience of rural citizens. And Rodrigo does not mince words, he thinks of highly pesticides as far as his production system is concerned. When group of us are speaking about options for controlling GR/GT weeds, Rodrigo says he has also used *soja STS*. This seed is a transgenic variety of soy that is resistant to glyphosate as well as the herbicide family of sulfonyleureas, which includes the commonly used residual herbicide metsulfuron-methyl. These herbicides that can kill broad leaf species as well as certain grasses. Rodrigo uses these seeds so he can supplement glyphosate use with sulfonyleureas. Omar, a farmer and retired Monsanto engineer cautioned against the dangers of these herbicides but quickly Rodrigo jovially announced “oh, I love it! Nothing lives and I spray fewer times.” Rodrigo’s statement, at its essence, reflects a cost-benefit mindset of Argentine soy and consequential pesticide use. Environmental hazards and public health concerns can be accounted for later; the important decisions are controlling economic costs on a seasonal basis.

It appears, based on personal accounts, that as pesticide users, these Argentinian farmers do not find pesticide-use controversial from a public health standpoint but remain acutely aware that pesticides are not inert substances. As such, they do not challenge the prohibitive ordinances, typically citing these as adequate responses by the state to protect public health. Furthermore, the pesticide sprayer should be sufficiently protected by the specialized machinery used to apply pesticides, and if not, it is the fault of their poor conscience. Each farmer, in turn, applies aspects of safe-use narrative, especially as it pertains to an ideological mandate of neoliberalism for self-responsible choices. As seen in each statement, elements appear of the individual conscience, the efficacy of labels, deference to professionalization, and cumulatively these risks as controllable and reasonable.

What then is controversial for a farmer begins to reveal itself when farmers begin to talk about their modern problems in context of transitioning to transgenic soy and the accompanying style of pest management. Under this context, farmers are often quite pessimistic.

## 5.2 Pesticides and Farming Styles:

*We are many producers that are beginning to do this now, it is to mix herbicides. Adding one or other mixes to the glyphosate for that which the glyphosate doesn't control, for what escapes it.*

*Hernan, Junin, March 2017*

Driving down a dirt road, Andrés and I arrived at a parcel he manages. We step out to inspect his fields; one is recently harvested, the other a mélange of vibrantly green soy surrounded by beans ready for harvest. Due to flooding, he had to resow six weeks after his initial sowing. Andrés pointed to a small plant with white buds “That you have there, with the small white balls, that is also resistant to glyphosate.” I asked Andrés about his life in ten years, he responds laughing “Which way will I go? Hopefully working in a bank or working somewhere else, because this work is going to be incredibly difficult.”

I asked him how many weeds are now resistant. Andrés responds “There are more than 15, there are many resistants to glyphosate. And the growth is exponential. They started 1,2,3 then 10 and more.” Reports vary, especially depending on interpretations of which weeds are resistant and tolerant. This can depend on the life stage of the weed, the zone, as well as the amount of glyphosate a farmer is willing to spray in order to prove it is merely tolerant. Semantics aside, each farmer or engineer I spoke to expressed common concern about five. The five are, listed with scientific and common names (in Argentina): *Amaranthus quitensis* (yuyo colorado), *Sorghum halepense* (sorgo de alepo), *Chloris elata* (cloris), *Conyza bonariensis* (rama negra) and *Lolium perenne* (ryegrass). The emergence of GR and GT weeds puts a great deal of economics stress on virtually every pampean farmer in Argentina.

Searching for deeper meaning in the politics of glyphosate resistant weeds reveals links to what Gras and Hernandez describe the new ‘capitalist spirit’ of Argentine agriculture (Boltanski & Chiappello, 2002). Walter frames this new farming style as something that the farmers had little choice but to adopt. The style encompassed what to grow but also how to make economics decisions.

During the campaign of 1996, there were many varieties of crops. There were much more fields with hacienda, with cows. And so, it was totally varied...in the year 2000 I had more

sheep than soy. And I didn't have another manner. And after 2 years passed, the producer began to act as a business. The idea of 'cost-benefit' began with the soy.

Looking to how pesticides are used can be tethered to the type capitalist ideology implanted in farmers as they transitioned to soy. Walter goes on to tell me about problems of the cost-benefit rationale when it comes to glyphosate use, explaining "This was fantastic when it began. The problem is that *El Argentino* applies the cost/benefit to the maximum and beyond." Walter sees the problems associated with glyphosate as an ideology of soy, one that appears to have originated beyond individual farmers, pressures from a number of events I covered in the introduction. This runs counter to the framework the same farmers applied to pesticides when asked about whether or not they may pose a health hazard. The adoption of glyphosate resistant soy was an offer the farmers could not refuse. This is evident when speaking to farmers about the pressure of GR/GT weeds. The emerging weed ecology in Argentina is a function of soy monocultures, simplified rotations, no to low-tillage system, and strong reliance on a single herbicide. All of these reasons hover at the surface of any herbicide resistant weed analysis. One must dig only a little deeper to uncover the roots of the weeds resistant to glyphosate; the narrative offered of AAPRESID, the financial crisis of the early 2000s and recently available transgenic soy are but a few primary drivers. The very real and immediate problem for farmers of herbicide resistant weeds threatens their own economic security. In this case, the problem shifts back from the person to the object, in this case the technology package and glyphosate. Walter still tries to adhere to a diverse rotation but laments the loss of his old rotation:

The rotation that I used was perfect, when I am talking about the years 96-2000. The rotation that I tried to carry has many parts counter to profitability, it is difficult to make the numbers work. But is is a question of that which makes more sense for controlling weeds, and the betterment of the soil. In the 90s and so on, you either do soy or soy. And the rotation was lost. It was where the problem began, because now there are resistant weeds because of monoculture. When the rotation was lost in those years, our rotation now is wheat, soy, corn, soy, more or less.

This is an instance of what happens when zooming in on how these events manifest themselves in the lives of the small and medium farmers, we see abandoned rotations, a seemingly forced adoption of soy and the associated agribusiness ideologies. Revealingly, monoculture and the obvious glyphosate use is to blame for resistant weeds. The new capitalist spirit fomented in the farmers a focus on cost-benefit analysis. Walter explains "[70% soy] is a more profitable rotation because it is more economic in terms of cost for



sowing. It is the crop with smallest costs for implementing.” Soybeans were adopted due to the low cost of sowing when employing the new technology package. This has damaged the more complex rotations of the past. Hernan describes his own form of management pessimistically “[my] rotations are not good because I haven’t cultivated even 50% or 50% [soy and corn] but rather mostly soy.” The pressures to adopt glyphosate resistant soy resulted in a host of problems posing a problem for the agroecosystem at large.

When speaking about the transition to soy, Emmanuel, a friend of Andre and soy farmer, tells me:

Today a liter of gasoline for tractors costs 16 or 17 pesos [~\$1]. The agricultural machines of today consume quite a bit of gasoline. If you were to going stay with the traditional form, you have to pass with a disc, pass again with the rakes, another pass with the roll and then you sow. Today, you do it in one pass, with direct sowing unlike before with at least 4 passes on the tractor. Like four times you have to move [the soil]. And so the costs change a lot. And I didn’t include the time costs, the manual labor involved to move everything. Sowing was optimized [with direct seeding].

Transitions to soy are spoken to in pure economic sense, glyphosate is framed inexpensive on a number of levels: reducing passes in machinery, reducing time and money spent on mixing other chemicals and guaranteed effectiveness in its initial years. The new cost savings gave farmers a wide margin with work with, and spraying a little more to control weeds did not pose an issue. Rodrigo echoes Emmanuel’s sentiment on cost savings, “what happened was the companies came and talked to us about maximizing your yields but for us, really it was about minimizing costs.” The low costs of soy provided a level of insurance for farmers, and glyphosate only served to compound that insurance. Low cost, simplified production systems would guard formers from crop failures or uncontrollable climatic events. Formerly, pest management came inherently through a more complex, knowledge-intensive mechanism of cultural controls inherent to a combination cropping-livestock system that were abandoned with the arrival of direct seeding and glyphosate fallow. And so, in the face of cost minimization, small and medium farmers are now feeling their margins squeezed as the land itself responds to glyphosate dependency. Hernan expresses a similar sentiment to Walter when referring to his years farming from the 1970s until late 1990s. “In this time I didn’t sow mostly soy. I rotated a lot. I sowed a little more maize. Soy started in a massive way in 2000. In this period, I cultivated at least 50-60% soy, 30% corn. And so, it is an economic choice” He goes on to explain his motivation to change:

Soy is cheaper to sow and with less cash you sow, and the final count is similar, or there is very little difference. I am inclined to sow a plant with a lower cost that if there is a bad climate it won't ruin you. And this is the history of the rotation, not for another reason, the rotation is what it is because of the economics of the producer.

These farmers now need to adopt certain techniques that the direct sowing soy package was supposed to replace. Primarily, this means spraying a wider variety of chemicals over a vastly expanded area of arable land instead of using cultural controls, such as crop rotations and livestock. Andrés regularly expressed concern for the return to old and how this solution does not address real issues. One of his primary concerns is the use of residual or preemergence herbicides. This class of herbicides are sprayed prior to a crop being planted and have a relatively long period of biological activity, posing a risk to next seasons crops, an especially potent dynamic in a country with high rates of short-term leases for cropland. Sulfonylurea compound metsulfuron (common brand name is Ligate from DuPont) is a common residual herbicide for controlling GR/GT resistant weeds in Argentina (Exttoxnet Network, 1993). It can affect crops like sunflower or corn up to 22 months after being sprayed and is discouraged for any field that will be used for clover or alfalfa pasture (Purdue, Cornell). Andrés' opinion is that glyphosate changed the culture of weed management, it created a sense of complacency and now the country is in a dire situation. He explains:

It was too easy. During this time, the engineers thought it was a joke. If you arrived late to your field, you just raise the dose [of glyphosate]. If you usually use two liters, you throw three if you're late. But today, if you arrive late, for example with amaranth, after it is finished growing, nothing kills it. Not with 3, 4, 5 [liters]. Nor with any product. You have no option but to till. And that always was a good option in the past. If you arrived late, you can finish it with that. Now, we are returning to the years before, determine the weed and determine the product. The problem now? It affects the soy or corn crop if it is residual.

The new methods to supplement glyphosate are undermining the narrative initially offered to these farmers while still remaining reductionist in nature. Initially farmers thought they could abandon tilling, conserve their soil, and most importantly save time and money by avoiding complicated pesticide mixes. Potentially accelerating the issue was the speed in which GT/GR herbs emerged and that they were unexpected. "In the beginning we used a higher quantity, if two didn't work, then try four. Eventually no amount killed the weed, and so the producers turned to using residual herbicides." recalls Rodrigo. "And apparently there is a difference, you see, between tolerant and resistant. [The weed] *Rama Negra* [*Conyza bonariensis*] is [glyphosate] tolerant, and with a big dose [of glyphosate] you can kill it when

it's small...And such the solution for *rama negra* is something inoffensive, like 2,4D." The residual herbicides are also prescribed along with tillage: "the main problem is *rama negra* here... And it initially confused the engineers, they did not know how to combat it, the solution was to till but minimally." All of the soy farmers I spoke to are feeling the pressure of glyphosate resistance.

Fausto, another soy nucleus farmer, has been farming since the 1970s. When asked about his weed management techniques he sprays just as anyone else but "with the weeds, that subject is a little complicated because of the resistant ryegrass, resistant *yuyu colorado*, all that happening with them." and now must implement spot-spraying techniques "for ryegrass, use a graminicide/grass killer. I fumigate 'by hand', I use precise spraying when there is weed pressure." But explains that even now he is having difficulties with herbicides besides glyphosate "[I sprayed glyphosate] once, twice, and I didn't see anything. So I use some graminicide and neither did that do anything, it was aggravating." Despite the growing ineffectiveness of pesticides, Fausto tells me "I have confidence in a new chemical that will certainly function." But Fausto's optimism was not shared by all of the farmers.

During a tour to various of the fields under his care, Andrés remains skeptical. We drive from field to field, witnessing the differences in good and bad practices, effects of personal economics, contract work, climate, effects of a particular lots soil or topography. The varied farm styles create a weed pressure that is difficult to control in spite of how strong any given farmers weed management is. Between contractor equipment, flood waters and birds carrying seeds between fields, it appears as if one farmer's problem quickly becomes everyone's problem. I asked Andrés about the future of chemical control and direct sowing. He took a pensive pause and told me

I don't know. There are many people waiting for another glyphosate, magical, that would help. But according to the studies going on and with the people working in this theme, there is not a single product that could be released now. Whichever product, you have to have many years of study for release to the market. And there isn't a single one that already has been studied and that can be released and be effective.

Andrés concludes that the convenience of glyphosate resistant soy "completely simplified or region". Today, many farmers, agronomists, and other stakeholders alike are waiting for the new glyphosate, something simultaneously as convenient as glyphosate but, as Andre describes, would not cause "the classic problems and mess that we have now". Ultimately, the problem itself has created a situation where people seek a solution via the same means

that produced the initial problem. And so farmers will continue, for now, to farm with no-till practices while undermining the narrative of cost-savings and simplified pesticide management that were born from no-till. This means using tillage and an array of herbicides including metsulfuron and 2,4D. During a conversation with two of Andre's friends, we talked about various practices. Emmanuel and Alejo explained to me the changes they have seen since transgenic soy was first released.

Before, there were not nearly as many pests as there are today. There are definitely more today, after the change of the culture of how the land is worked. Before, all the crops rotated. For every crop you have, the soil is moved, prepared, sown, finished and that was ended with direct sowing. When the direct sowing started, the weeds appeared.

Emmanuel speaks from personal experience:

Today the reflex is to control weeds with a combination between soil movement, crop rotation, and herbicide application. But not just glyphosate application, using a mix [of herbicides] to spray with. There are those who are beginning to incorporate these other practices but the problem is there is no governmental or economic support for the farmer to be able to do other things, there is no way to ask for money. And so the producer just prefers to do soy.

Rather than incentivize or create pathways for different manners of control the government too has locked itself into a capital accumulation model founded on the soybean production chain. This chain accounted for 5.5% of the national GDP and over 30% of exports and 10% of the nation's tax base last year. The soy complex responds to the threat of weeds that are adapted to no-till production and resistant to glyphosate by advising minor tweaks to its initial narrative. A little tillage is good, a little less glyphosate is good, a little more of other herbicides are necessary. The plausibility of safely using pesticides already contested, as shown in critical pesticide scholarship. But the current situation of soy in Argentina begs the question: Does safely using pesticides actually control their potential risks? And are all potential risks adequately addressed when implementing pesticide dependent regimes of crop protection?

### **5.3 Implications for Safe Use**

The uncertain futures of these small and medium farmers of Argentina presents an example of the inadequacy of the safe use narrative. Recalling the quote from Monsanto concerning glyphosate's safeness, its "long history of safe use" and the "the overwhelming

conclusion of experts” proclaiming that use according to the label will present “unreasonable risk of adverse effects to humans, wildlife or the environment” (Monsanto, 2017). One aspect of the safe use narrative that is underrepresented is how this narrative frames pesticide problem entirely as a health concern, whether to humans, wildlife or the ecosystem. This is echoed in the controversy surrounding glyphosate, the agencies that could challenge glyphosate’s hegemony, such as United States Environmental Protection Agency, the European Union's Food Safety Authority address risks in a toxicological or epidemiological framework, typically from the perspective of its carcinogenicity. Monsanto frames their response in the safe use narrative, albeit vaguely. This vagueness opens the concept of what types of risk we should consider reasonable for our food systems.

In Argentina we see that safe-use of pesticides is a dubious proposal at best; glyphosate now simultaneously plays the role of the protagonist and antagonist. Glyphosate’s status as a miracle chemical created “the illusion of infallibility of glyphosate to control weed species shifted emphasis toward chemical control at the expense of integrated weed management and the weed control experts groups ” (Binimelis et al., 2009). Tellingly, as glyphosate consumption increased, herbicide use of 2,4-D and atrazine (the most widely sprayed herbicide prior to 1996) both nearly disappeared in the first years of glyphosate and have increased since the appearance of glyphosate resistant herbs. This reflects the information provided by the farmers I interviewed. The use of glyphosate has created posing unreasonable risks to a small or medium sized farmer’s future livelihood. Rather than approaching these problems with more holistic responses, the solutions presented to farmers come as a “transgenic treadmill” (Binimelis et al., 2009; Pellegrini, 2013). Currently, Monsanto has released, albeit only in the USA, soy resistant to dicamba. Nidera has varieties of soy resistant to sulfonylureas. Dow AgroScience, as early as 2007, was attempting to develop soy varieties resistant to 2,4-D, another common glyphosate supplement in Argentina. 2,4-D resistance has already been identified with 16 weed species as of 2007, with the earliest weed identified as early as 1952 (Binimelis et al., 2009) (Schulz & Segobye, 2016). Underpinning these new developments in herbicides is that they are relatively non-toxic to mammals and pose minimal threats to other wildlife. What is missing from the point is a holistic approach to understanding what is actually at risk when relying entirely on pesticides. This reliance is associated with cropping systems with practically no biodiversity, monocropping with clean fields, and heavy use of fertilizers. This massive change in the agroecological system by “the substitution of traditional crops by GR soy within the last

couple of decades represents a large scale, unplanned, ecological experiment, whose consequences for natural ecosystems, and aquatic environments in particular, are poorly understood”. Implicit in this statement is that humans, and most definitely farmers, require these services. Furthermore, the reactive action being taken by the soy apparatus in the form of new transgenic seeds favor farmers with more resources, disproportionately shifting risk over to small and medium farmers (Binimelis et al., 2009). (Perrings, 2005; Binimelis 2007). The idea that glyphosate can be safely used fails to account for all of the effects averse to humans, wildlife, and the environment.

## 6. Conclusion

I would like to address a few points on my conclusion, beginning with an underlying theory behind Galt's (2013) complex subjectivities approach and the friction presented in this case. On the surface, it appears as if a rendering of pesticide users as rational economic actors is a valid model for the Argentine farmer. But in using the theory as a suggestion to view management decisions holistically, other influences were revealed. I operationalized the theory to underpin what I would ask farmers and the research I would do to analyze their responses. Despite the farmers citing cost benefit analysis and economics as the drivers for their adoption of soy, these reasons were merely a piece of the picture. Their adoption also came from a place in which they had no other options and it was presented to them as the sole way to support their farming ventures during recent turn of the century. The transgenic soy complex, the new weed management system progressed as a function the newfound ideology ushered in along with the soy production model (Cáceres, 2015; Gras & Hernández, 2016; Newell, 2009). I see the internalization of the safe use rationality as an interpellation of State and Agribusiness ideologies put forth during the neoliberal reboot of the 1990s. The farmers then are attempting to follow an economic logic that is underpinned by neoliberalism and economic rationality, but are brought to this point by a complex interpellation of AAPRESID, the neoliberal government, international biotechnology companies, etc. (Gras, 2009; Gras, Hern, xe, & ndez, 2008). This serves as a dismissal of Homo economicus all together as overly simplistic, because even in the case of people using pesticides that have internalized these ideologies, stronger forces are at work influencing their weed management strategies and thus pesticide use. Ultimately, this leads to an analysis of the safe use narrative as dangerously myopic when trying to solve pesticide problems.

This model for correcting pesticide problems is too simplistic because it does not adequately capture what influences pesticide users' decisions. In order to see why pesticide problems, persist in a given context, I recommend a holistic framework, such as complex subjectivities. In applying a holistic analysis of the Argentine context, properties emerge that that diverge from commonalities found in other critical pesticide scholarship. This context shows that farmers adhere to technocratic pest control regimes which in turn adhere ideologically and practically to safe use. In this case, we see that farmers acknowledge the need for personal safety, adherence to pesticide labels, and some basic schemes to protect citizenry (the no spray zones). Regardless, problems still arise. In studying this group of farmers, it is shown that their decisions to adopt soybeans came from a set of political

circumstances and histories in which they play a role as support but also as actors that must sink or swim, as evidenced by the mass exodus of farmers between 1988-2002. These influences put enormous pressure on the farming styles of the farmers, who must figure out their own method of glyphosate soy production. Eventually, this crop-protection regime reapplies pressure on farmers to begin to adopt new farming styles that undermine the proposed benefits of the no-till production package, typically characterized by returning to the old forms of management. This includes tilling, applying mixes of herbicides but also a reassertion of the transgenic hegemony via new transgenic seeds that resist a variety of herbicides to supplement glyphosate, some of which have been ineffective against certain weeds for more than a half century. This undermining of the initial narrative creates uncertain futures for farmers who cannot so easily switch between farming styles and are beholden to the technology offered to them. This find offers an interesting continuation in how state, biotechnology industry, and farmer responses to herbicide resistance influence the direction of farming styles in the future. Already we see a doubling down on the same mode of production in Argentina, likely due to the importance of soy to the economic security of the entire nation. Another interesting point of departure is how pesticide use translates to alterations of farming styles via superweed, specifically if and how farmers will recognize or seek the need for an alternative to high input agriculture.

As I reflect on my field work and research, I recall I was initially motivated to use research on pesticide problems as an inroad for alternatives, framing pesticides as the lynchpin to the soy complex in Argentina. In attempting to analyze and put my thesis together, this aspect fell by the wayside due primarily to time constraints. But, as I conclude, I feel the need to mention that within the ordinances prohibiting pesticide spraying, there exists a small niche for alternatives. There exist multiple farmers in Argentina as well as INTA engineers that are organizing experiments for the efficacy of agroecological transitions in extensive farming systems, using these no spray zones as the impetus. These are just the farmers that I spoke to, a tiny portion of the farmers growing soy in the humid pampas. As far as a continuation of this research is concerned, I feel that this is the most important find in my study of Argentina's soy complex.



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## Appendix 1: Respondents to Semi-Structured Interviews

Attendants present at each interviews	Occupation (respectively)	Setting	Approximate Duration of Recording
Hernan	Farmer: Soy, Corn, Wheat	Café near Hernan's home in Junín, Buenos Aires Province	50 minutes
Walter	Farmer	Café near Walter's home in Junín, Buenos Aires Province	90 minutes
Emmanuel	Soy Farmer	His farm, truck, Lehman cooperative silos and storage facilities in Pilar, Santa Fe Province	90 minutes
Emmanuel & Alejo	Emmanuel: Soy Farmer Alejo: Agronomist specializing in soy pest management	Lehman cooperative offices in Pilar, Santa Fe Province	40 minutes
Martin	Agronomist (Emmanuel's brother)	Martin's truck, his father's farm in Nuevo Torino, Santa Fe Province	30 minutes
Juan & Norberto	Farmer/Doctor and Retired Engineer	Restaurant in Rafaela, Santa Fe Province	90 minutes
Andres	Farmer/Engineer	Truck and various fields around Pilar, Santa Fe Province	60 minutes

Omar, Juan Manuel	Omar: Retired Engineer, Farmer Juan Manuel: Professor, <i>Centro Interdisciplinario de Estudios Agrarios</i>	In Omar's truck driving to various sites between Pergamino and Salto, Buenos Aires Province	45 minutes
Luis Miguel, Miguel, Juan Manuel, Omar	Luis Miguel :INTA Agronomist Miguel: INTA Agronomist Omar: Retired Engineer, Farmer Juan Manuel: Professor, <i>Centro Interdisciplinario de Estudios Agrarios</i>	INTA Offices, Pergamino, Buenos Aires Province	110 minutes
Rodrigo, Juan Manuel, Omar	Rodrigo: Farmer (Soy, Corn Wheat)	Offices Federación Agraria Argentina in Salto, Buenos Aires Province	60 minutes
Fausto, Juan Manuel, Omar	Fausto: Farmer (Soy, Corn, Wheat)	Fausto's home in Salto, Buenos Aires Province	30 minutes
Carlos Ruiz, Andrea, Gabriel	Carlos Ruiz: Farmer (Agroecological, Cows and pasture) Andrea & Gabriel: Farmers, Married (Agroecological, Cows and pasture)	the home of Andrea and Gabriel, Saladillo, Buenos Aires Province	60 minutes
Juan Keihr	Farmer, owner and operator of La Aurora, Agroecological cattle farm	Juan's farm, La Aurora, near Benito Juarez, Buenos Aires Province	180 minutes

## Appendix 2: Maps

Map of humid pampas



Map of Interview Sites



Appendix 3: Argentina's Exports, 2014

