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RESEARCH ARTICLE

Searching for family farming in Argentina: chronicles of a technological innovation between two worlds

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Abstract This paper proposes a contribution to the analysis of the processes that accompany the increasing fragmentation of agricultural worlds between contrasting models of development. To this end, we examine an area that has until now attracted little attention in this respect, that of the scientific and technological actors involved; we also look at original mechanisms which aim to create intersections between models of development. The paper is based on research carried out in Argentina, a country where there are two major contrasting models of development, embodied by the notions of agribusiness and family farming. We analyse the trajectory of a technological innovation in the field of machinery, based on the determination of agronomists and manufacturers to adapt agribusiness technologies to the needs of small family farmers. We study the attempts at problematisation and *interessement* that they make in relation to this public and its accompanying scientific and technical actors. These dynamics reveal contrasting approaches to innovation, technology and agricultural development. They also demonstrate the profound misunderstanding that exists between these two heterogeneous worlds.

Keywords Innovation · Science and technology · Agricultural machinery · Family farming · Argentina

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Over the last two decades, the farming sector has been described as an increasingly divided social space. Divided by the different visions of what constitutes good practices or professional approaches (Lemery 2003), riddled with controversy and mobilisation concerning the use of certain technologies (Bonneuil et al. 2008; Pellegrini 2013) or regarding the type of marketing to employ (Goodman et al. 2012). Our contemporary era is thus marked by the existence of multiple agricultural worlds (Hervieu and Purseigle 2015) that have to coexist within professional spaces, institutions or rural territories. Large South American countries such as Brazil and Argentina provide a stage for advanced observation of these dynamics (Albaladejo and Arnauld de Sartre 2012). They have been affected by the increasing polarisation between two major models of agricultural development (Albaladejo 2016)[1] and by the recognition of this duality within public action (Sabourin 2014). On the one hand, there was a strengthening of latifundian farming, heir to green revolution policies, highly technologised and sometimes financialised, essentially producing raw materials for export. Often referred to as agribusiness (Gras and Hernandez 2013), it played a key role in Brazil's and Argentina's economic expansion in the 1990s–2000s (Richardson 2009), whilst at the same time being criticised for the social and environmental impacts caused by the development of its flagship crop, the soybean (Barri and Wahren 2010).

On the other hand, Brazil, followed by Argentina, saw a rise in the so-called "family farming", referring to small producers rooted in regional economies and in production and living conditions that are sometimes precarious. In Argentina, the increasing popularity of this notion in the 2000s stemmed from a political determination to aggregate diverse peasant-farmer organisations around this category,[2] with the specific objective of creating a government ally among the most vulnerable fringes of the rural population. Within the government, whether in Argentina or Brazil (Manzanal and Schneider 2011), incorporation of this new category led to a logic of institutionalisation (Gisclard et al. 2015), with differentiated public policies, government ministries or secretariats dedicated to family farming or groups within technical-scientific institutions. In Argentina, for example this is how the Centre for Technological Research and Development for Family Farming (CIPAF) came into being within National Institute for Agricultural Technology (INTA).[3] The CIPAF itself engaged in the structuring of a sector of small- and medium-sized companies specialising in the production of technologies specific to small family farmers. The Chamber of Manufacturers of Agricultural Machines for Family Farming (CAMAF) was thus created, on a model very similar to that of Argentinian Chamber of Agricultural Machine Manufacturers (CAFMA) which already existed for large-scale agriculture. This plurality of models of agricultural development thus shifted from rural territories and the field of social struggle (Lapegna 2013), to that of state and private institutions tasked with producing knowledge and technologies for farmers, completing a phenomenon of polarising the rural world and the institutions dedicated to it.

In this paper, we will be focusing specifically on this scientific and technological sector, following the hypothesis that it is a privileged space for analysing the tensions

[1] On this notion of model, see also (Godin 2015) on "innovation models".

[2] Some of these organisations did not hesitate to denounce an attempt to control and instrumentalise their action, dedicated until then to defending the so-called peasant or indigenous farming, for political and electoral purposes (Schiavoni 2010; Craviotti 2014).

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and possible articulations between the various actors of the two worlds of agribusiness and family farming. A space which is certainly privileged, but which remains unexplored when it comes to analysing this plurality. Whilst works on the agricultural profession or public action have already revealed these tensions (Goulet 2016; Fouilleux 2015; Lapegna 2016), institutions of agricultural science and technology, or companies of technological vocation, have in fact rarely been observed in this respect. It is as if they constituted a unified social space or a space that had little to do with the transformation and polarisation of agricultural worlds. The specific aim of this paper is to throw some light on this literary blind spot; it examines an innovation in Argentina that aims to make something that constituted one of the technological pillars of agribusiness development—direct seeding, allowing crops to be planted without any preliminary soil preparation—available to small farmers. In so doing, this article also aims to grasp how the actors of the scientific and technological sector are taking ownership of, shaping and challenging this polarised typology of the agricultural worlds that public action has helped to institutionalise.

The paper is based on a study conducted in Argentina between 2014 and 2015.[4] Data collection was based on semi-directive interviews (n = 9) with the main protagonists involved with this innovation: INTA engineers, manufacturers, suppliers of agricultural equipment, civil servants and politicians. Ethnographic observations were also carried out during two events, organised by its manufacturers and distributors, where the innovation in question was demonstrated. Finally, we analysed the content of institutional and commercial documents from INTA or from the companies involved: websites, technical and commercial leaflets presenting the machinery and visual supports used during the technical demonstration events.

We will build our narrative in a chronological order, following the main phases that marked the trajectory of this innovation. Before that, in the first section, we will reposition our thinking within the literature on the plurality of agricultural development models, and more particularly on their *agencement* and encounter methods. At that point, we will introduce the conceptual elements relating to the sociology of innovation and translation, underlining more specifically the capacity for understanding forms of articulation between heterogeneous worlds that the consideration of said elements provides. In the second section, we will come back to a certain number of elements specific to the case in question, to the ways in which it will allow us to approach the matter of multiple models of agricultural development and to the theoretical or conceptual markers we will be using. In the second and third sections, we will provide a more detailed explanation of the origins of the innovation in question; we will present its inventors and their motivations and we will examine the attempts made to introduce the innovation to small farmers in north-west Argentina. After highlighting the initial failure, in the third section, we will show how the protagonists evolved their project, by mobilising new actors and, above all, by setting out to convince an audience other than the one initially targeted, through the notion of family farming.

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Following a technology between two worlds: empirical option and theoretical roots

The originality of the perspective we are proposing on the plurality and coexistence of agricultural development models lies in our decision to explore this phenomenon through the scientific and technological field. Yet, it also lies in the choice of the empirical object that we studied, in its properties, which will lead us to document the modalities through which these models and these worlds may, under certain conditions, come together or at least be the object of attempts to articulate. Plurality and coexistence are most often presented from the angle of the oppositions, conflicts and cleavages that separate the different models. The emergence of alternative models is thus generally described as being based on the formulation of a critical opposition, of a counter-proposal, a *promise of difference* (Le Velly 2017) compared to a "dominant" or "conventional" model. In certain cases, this level of demarcation has led to relatively hermetic separations. This is what happened in Argentina, for example in relation to the creation of research centres such as the CIPAF, dedicated to family farming and separated from other laboratories in research institutes and universities (Goulet 2016). It is also the case, from a spatial standpoint, of the coexistence of GMOs and non-GMOs, involving strict separation between cultivated plots of land (Hubbard and Hassanein 2013). The rare cases of rapprochement or dialogue to be found in the literature seem to be confined to the exchange of technical practices between production models claiming their alternative nature (Fleury et al. 2014). More often than not, the rising potentiality of certain alternatives is viewed from the standpoint of a conventionalisation (Best 2008), and hence of the risk of certain models being stripped of their alternative nature.

By contrast, the case we will be examining here involves an attempt to articulate agribusiness and family farming. We will be looking at a small group of actors who come from the world of large-scale agriculture and the soybean, and who decided to develop a little direct seed drill for small family farmers. Or to put it another way, a dynamic based on the determination of these actors to support family farming—whereas the relationship between the two models is often described as one of domination, of agribusiness's predation on family farming (Elgert 2016). We will of course highlight the tensions and disagreements, but our empirical starting point will not be that of controversy, of opposition or separation between proponents of contrasting agricultural models. On the contrary, we will be following a process which, from the very outset, was designed to create bridges between these different worlds.

In order to analyse the mechanisms involved in this process, we will use the sociology of translation's framework of analysis (Callon 1986; Akrich et al. 2006). For our research project, this approach clearly has the advantage of having attached an original importance to scientific and technical objects, or to processes of innovation. But above all, it offers a range of conceptual resources[5] that make it possible to address the modalities for a meeting of heterogeneous worlds and actors to discuss common problems, interests and projects. We examine processes of innovation in terms of the efforts made by certain entrepreneurs to interest, recruit and mobilise actors with extremely different identities and interests.

[5] It is worth mentioning that we will not be discussing the theoretical or analytical pertinence of these concepts; instead we will use them instrumentally, to serve our objective which consists in clarifying a relatively unexplored facet of the dynamics of coexistence in agriculture.

Innovation is therefore perceived as a socio-technical process of *interessement*, within which technologies and their environments are constantly and mutually being redefined, as socio-technical networks are created (Akrich et al. 2002). But the merits of this literature also reside in its capacity to grasp the material dimensions of innovation processes, and in particular, in the capacity of material devices to organise interactions between actors and the encounter between heterogeneous worlds. The concept of boundary object (Leigh Star and Griesemer 1989), or intermediary object (Vinck 2011), underlines the question of paying attention to the actors' material supports and equipment when it comes to examining situations of cooperation or encounter (Vinck 2009). The monitoring of these objects and their formatting opens an observation window to capture the levers for collaboration or the possible frictions that might be scattered throughout projects of collective action.

With this literature as a basis, our objective in this paper is thus to examine the forms of, or attempts at, a rapprochement between models of agricultural development following a tangible technical object, from its creation —the development of a prototype— through its commercialisation. We will therefore follow the socio-technical process, made up of successful or aborted *interessements*, and we will highlight the successive transformations that the innovators made to their project. In so doing, we will try to determine the extent to which these famous development models (designated by categories such as "family farming" or "agribusiness"), whilst certainly constituting conventional supports that allow actors to locate their action (Dodier 1995), also constitute entities that they discuss, portray and redefine during the course of their action. If ideas of plurality or coexistence thus suppose the presence, at a given moment in time, of a diversity of archetypal forms and stabilised categories —or in other words, models— we will show that their consistency, their boundaries and their capacity to reflect reality are thoroughly discussed.

The initial project and its protagonists: from agribusiness to small family farmers

The origin of the innovation which interests us here is to be found in Casilda, a small town in the province of Santa Fe, located in central Argentina, at the heart of the zone which for the last 20 years has seen the massive development of field crops such as the soybean, largely due to the dissemination of a technical package that includes direct seeding and genetically modified seeds. The protagonists in this adventure are themselves fully engaged in these transformations. The first, Novasiembra, is a small local manufacturer of pneumatic distribution components for large direct seed drills and a subcontractor for regional companies that manufacture this type of equipment. The second, Fernando Martinez, is an INTA[6] agricultural engineer and development officer; he was one of the historical figures of soybean crop development in the region, assisting farmers who chose to take this path. Whilst their activity is firmly grounded in matters relating to agribusiness, as from the early 2010s, and in parallel to their traditional work, the two partners began to take an interest in small farmers.

Novasiembra's interest in these farmers was rooted in the personal trajectory of Mario, one of its founders. During the 1980s, Mario had worked for a local agricultural

[6] Note that one specificity of INTA is that it has its own agricultural research and development departments, whereas in many countries these are often confined to separate institutions.

equipment firm which sold its products in various African countries. He travelled regularly to Central Africa, where he was confronted with the working conditions of subsistence farmers, and where he became familiar with certain pieces of equipment made available locally through French technical cooperation. Specifically, he discovered the tropicultor, a polyvalent animal-drawn tool designed in the 1930s by Jean Nolle, a French farmer, essentially used for tilling the soil. His interest in these little machines, far removed from Novasiembra's business activities, was unexpectedly renewed in 2012. His previous employer informed him of a request made by Argentina's ministry of foreign affairs, during a state visit to Angola by Cristina Kirchner, President of Argentina at that time. With a view to turning the visit into a commercial opportunity for the Argentinian industry, agricultural machinery companies were asked to present technologies that might be of interest to Argentina's African partners. Having no such product to offer, Mario did not take part in this trip, but he nevertheless began to think about a tool based on the tropicultor, which might be sold both to African farmers and to small Argentinian producers. Although this was not the population with whom he was used to working, he could see that it was gaining traction in agricultural policies, through the notion of family farming. The latter embodied one of the leading orientations of agricultural policy at that time, marked by the creation in 2008 of a subsecretariat of state for family farming (elevated in 2014 to the rank of secretariat of state) and by numerous information campaigns throughout the country with the objective of giving visibility to this fringe area of the agricultural population.[7] Realising that these poorly equipped small farmers constituted a potential market, Mario began to explore possible partnerships with certain traditional actors from the world of field crops, who might agree to fund his project. He began by contacting major agrochemical and seed companies such as Monsanto, expecting that they would be sensitive to a project that would help to revive their public image:

> *Why not Monsanto? They are criticised for so many things. I made a proposition, so that they could demonstrate that they are doing something for family farming, at a "philosophical" level. I felt it was an interesting idea for this type of multinational to offer different products, even if they are not directly involved with machinery.*

Whilst these initial attempts were not crowned with success, against all expectations it was a discussion with Fernando Martinez, regional soybean specialist at INTA, with whom Novasiembra had been working for some considerable time that lit the spark. In early 2013, Fernando returned from a holiday in north-west Argentina, in the semi-arid Andean zones essentially populated by indigenous families practicing subsistence farming. He was struck by the rudimentary nature of their farming methods, which contrasted with the trajectory of the farmers he worked with on a daily basis. He was also struck by the fragility of the natural resources, and by the soil erosion in particular, given that one of the benefits of direct seeding and direct seeding techniques, often associated with the notion of conservation agriculture, is to protect soils from erosion (Coughenour and Chamala 2000). When he became aware of the Novasiembra project, he convinced them to develop equipment that would enable small farmers in the north-

[7] This process reached its peak in 2014, a year declared by the FAO to be "International Family farming year", with numerous political and scientific events being organised in Argentina around this theme.

western region to practice direct seeding, as was the case for the soybean producers in his own region. For Fernando, it was a question of allowing small farmers to benefit from the technological advances of agribusiness, particularly in relation to direct seeding and soil conservation:

> *Because I come from the soybean world, I know that there are alternatives that could be applied to family farming (…). The idea is to practice conservation agriculture, as it is the case with large-scale farming, but for small farmers.*

The machine had to be of the same quality as that made available to major farmers. Of course, it had to have features that suited these new users, be easy to repair and to transport using the resources available to the small farmers, yet with the same high-quality specifications as the large seed drills used to sow soybeans, and combining several functions such as sowing and fertilising:

> *Because it targets family farming, the seeder must be inexpensive. Attractive, nice, practical, but inexpensive. High-quality, not cobbled together with scrap iron. That's achieved with the same technology as the large machines (…) It's direct seeding, the same state-of-the-art technology that's used nowadays in the productive zones, but applied to family farming. In one run you sow and you fertilise.*

The protagonists thus presented their initiative from a moral angle, that of actors coming from a different world to that of the small farmers, but convinced of the benefits that they would gain from the technological developments of large-scale agriculture. As Fernando says, not without irony, they felt that by helping these farmers they would expiate the mistakes they made when they took part in the development of agribusiness, so heavily criticised for its social and environmental impacts:

> *In some ways it was to repent for my mistakes, for my contribution to the soybean monoculture, that I began to work for family farming… because I'm accused of many things, in particular of being responsible for this monoculture in Argentina!*

Over the course of 2013, Novasiembra and INTA s' agricultural engineer worked on developing a small seed drill, mounted on a chassis based on the tropicultor that Mario had seen 20 years earlier in Africa. The seeding components were similar to those on the large seed drills and, like the latter, were connected to a mechanism to fertilise along the sowing line. An initial prototype was produced with help from Erka, a company from a neighbouring village that manufactured large seed drills, and to whom Novasiembra supplied its pneumatic distribution mechanisms. In the workshops owned by a firm involved in the agribusiness boom, located in the heart of the field crop zone, were thus produced the first components for a tool for the small farmers Fernando had seen in the Andean regions of north-west Argentina. As evidence of how important these regions and their indigenous populations were to its founders, the seed drill project was baptised Suri, the Quechua translation of the word ñandu, a sort of small ostrich from the Andean regions. Just over one metre wide, with either 2 or 4 sowing lines, the initial model is presented as the first showcase or promise of a "*small-scale revolution*", as shown on the company's website. Let us now return to the way in which

Suri's developers tried to link their project to the small farmers in north-west Argentina, before the first prototype was even built, and to the difficulties that arose when it was presented to local actors.

Problematisation and failed *interessements* in north-west Argentina

Problematising tillage

In 2012, whilst thinking about the development of what was to become the Suri, Fernando established an initial contact with actors in north-western Argentina to heighten their awareness of the utility of a direct seed drill adapted for use by small local farmers. He did not enter into direct contact with the latter, but instead with actors he identified as strategic, namely his colleagues in INTA's local agencies. As in the rest of the country, in this area INTA had extension agencies and, most importantly, an IPAF (regional branch of the CIPAF, centre for research on family farming). It was therefore perfectly natural for Fernando to first contact local IPAF's engineers, not far from the Bolivian border. He strove to problematise the tilling practices of local farmers, to increase IPAF's engineers' awareness of the soil erosion issue and to draw their attention to a technical solution which would make it possible to sow crops without tilling the soil:

> *What we are proposing here, is conservation agriculture. The idea being that the soil should be conserved rather than exploited. We can use it, but not exploit it. (...) Traditional tillage destroys the soil, it's a real scourge.*

Yet Fernando quickly realised that his IPAF colleagues were not convinced by this attempt at problematisation. Whilst the soil conservation issue was very much discussed in the Pampas farming region where Fernando came from, 1300 km away, it did not appear to be pertinent to this local context, where the main problem was one of access to water. As the regional IPAF agricultural engineer in charge of mechanisation issues at that time pointed out:

> *People don't see it as a major problem. What matters to people is having access to water; they're not even aware of the soil issue. They aren't aware of it because we're not aware of it, we can't see it. (...) We weren't mentally prepared to think about soil and direct seeding. We really weren't. So of course, we didn't pay any attention to what he* (Fernando) *was telling us.*

So whilst these soil deterioration and direct seeding technologies were extremely important in the Pampas, Fernando suffered a setback with his colleagues specialised in family farming. He then went to one of INTA's local development agencies in Humahuaca, some fifty kilometres from IPAF. Unlike the latter, the agency is not dedicated to family farming, either institutionally or in name, but is located in the heart of the geographical zone that Fernando was targeting—a zone where subsistence farming predominates, thus offering a useful and alternative entry point. However, Laura, the agricultural engineer he spoke with, in turn pointed out that soil conservation

was not a local priority. She told him of other needs that local small farmers had expressed:

His concern was for the soil. It was all about the soil. (...) I told him that in my opinion, in the local agricultural systems, I couldn't see any soil issues, and that in reality the problems had to do with mechanisation. That there were no tractors.

One positive signal nevertheless came from the manager at the experimental Abrapampa station, to which Laura and the Humahuaca agency reported. At that time, INTA was carrying out a major restructuring of its activities at national level, through the drafting and implementation of "regional projects with territorial focus" (PRETs) designed to strengthen articulations between research and extension activities. Soil conservation emerged as a key topic that was being examined in various parts of the country, although the north-west region had not yet taken any action on this matter. The Abrapampa station manager felt that Fernando's innovation gave his team the opportunity to develop activities in this respect. Laura says:

This coincided exactly with the moment PRETs were being drafted, and in our PRET there was nothing about soils, no-one mentioned the subject. (...) Fernando was here at that time, he was travelling around the region, saying that we should problematize the soil question, that direct sowing must be used to avoid any more soil erosion, and ... the end result was that my bosses decided that we had to work on the soil issue.

Suri's misfortunes in the Andean land

On the basis of these encouraging factors, Fernando therefore returned to Casilda, to continue developing the Suri with his Novasiembra partners. At the same time, he teamed up with Laura to organise a 1-day demonstration that would take place in July 2013 in Humahuaca, to show the machine to farmers and actors in the north-western region. This event marked the first display of the prototype. Fernando attended with the two Novasiembra's directors, who for the first time discovered the region and an agricultural context that radically contrasted with the one they experienced during their everyday activities. The day began with Fernando giving talks indoors, explaining to the farmers the importance of soil conservation and the need for direct seeding. He began by projecting a slideshow of the Suri in action in Casilda, pulled by a mini-tractor. He immediately saw how hard it was to actually get the farmers to show an interest in the Suri; they were far more interested in the mini-tractor than in direct seeding and the problem of soil conservation:

What the farmers wanted, was the mini-tractor, not the seed drill. Of course the seed drill changed the production process, but the tractor meant they could get rid of the mule, the horse, etc. They said: 'I want to see the little tractor in the photo!' (...) It's as if, at such a small scale, they couldn't see that soil conservation was fundamental. Because they were small [producers]*, they couldn't understand.*

Things became even more complicated when it came to the demonstration outside in the field, this time leading to perplexity on the part of the INTA agency technicians from Humahuaca. Laura was first of all surprised by the nature of the machine. She thought she had been clear with regard to local farming conditions, and was astounded to discover a seed drill equipped with a compartment for spreading chemical fertilisers—something that was not available to the small local farmers, who used guano to fertilise their fields. Similarly, the size and weight of the machine were poorly suited to the conditions of transport available to the local farmers. Yet what really struck the agricultural engineer was first and foremost the fact that the Suri could not be used to any great effect in a context of animal draught power, which was the main source of traction used in the region:

> *The machine, when it arrived, could not be used with a horse yoke. I had found some horses to pull it, because I thought that… So I went to get some yokes, because we wanted to show the farmers that it could be pulled by horses… so we tried to attach the yokes, but it was too heavy for the horses, it didn't work very well. So we had to ask the agricultural school to lend us a tractor, and we finally got it to work. But then we'd lost all the virtue of a machine drawn by animals – it had become a seed drill pulled by a tractor.*

Other aspects of the demonstration revealed the extent to which the machine was unsuited to local constraints. To perform high-quality seeding, the Suri needed flat ground, and the plot of land belonging to the farmer selected for the demonstration was covered with the small furrows traditionally used in the region for irrigation. Talking about the attempt to sow the barley during this demonstration event, Laura continues as follows:

> *The demonstration took place on a plot of land belonging to a local farmer, who had worked it the way they do in that region. He* (Fernando) *had asked me for the land to be ready for sowing, so there were furrows. But then he said: 'But the machine will never make it, it has to be flat!' To which I replied that if it was flat we couldn't irrigate, because that's how we irrigate here!*

With the farmers' expectations being focused more on the mini-tractor than on the seed drill, and with the characteristics of the latter having no chance of convincing either the farmers or INTA's technicians, by the end of the demonstration event the work of *interessement* done by Suri's promotors in respect of actors in north-western Argentina had failed. Whilst it appeared that the question of soil conservation might engage local actors, the machine struggled to meet certain regional requirements and specificities. Above all, however, in terms of how the farmers and agricultural development in general were viewed, the situation revealed the profound differences of opinion between Suri's promoters from the Santa Fe province and its soybean crops, and INTA's agricultural engineers from the North West.

Surprises and divergences between agronomists

If Laura was surprised by the seeder's specifications, so were Suri's promoters, forced to measure the divide separating them from INTA's local agents, in whom they had

expected to find natural allies. Mario, who usually worked with large-scale crops and related technologies, expressed his surprise at Laura's expectations regarding the need for the seed drill to spread guano:

> *When Fernando introduced us to the young woman in charge of the family farming project, she asked us how we were going to spread the guano… the guano? You have to go and fetch it with a wheelbarrow, spread tons of it, whereas with a single handful of urea fertilizer you can do just as well! And we're talking about the person in charge of the project to mechanise family farming?*

This use of guano, and more generally the range of traditional practices recognised and supported by INTA's agronomists, came as a shock to Suri's designers, for whom access to synthetic inputs was an essential element of agricultural development. Fernando talked about his astonishment at the opinions of his colleagues who work on a daily basis with the small farmers, given that like him they are agricultural engineers, trained in the country's universities and working for the same public institute for agricultural research and extension:

> *We believe that there's nothing wrong with spreading urea, fertilizers. I can't see why some producers should be allowed to spread fertilizers or herbicides as they wish, whilst producers in the north-west of the country have to work with a hoe and a wheelbarrow! Because they could produce a lot more! So we realised that as far as family farming was concerned, it was all about social issues and not about production (…) Yet the production problems are huge, even if there are of course social issues too (…) But I believe we need to introduce technical innovation, something that offers concrete results.*

Mario agreed, stressing the importance of making big farming technologies available to small farmers, and distancing himself from the arguments put forward by supporters of family farming in terms of its contribution to food sovereignty[8]:

> *If we take advantage of machines, of the technological package that's now available, and if we begin to do serious work, the question of food sovereignty will become something concrete. Not a slogan.*

Suri's promoters thus criticised the actions of INTA's local agronomists, but in turn the latter questioned the approach of their agribusiness colleagues. Whilst they usually supported the idea of allowing small farmers to participate in the design of technological innovations, to make them actors of their own development and to valorise their knowledge (Elverdin et al. 2014), they felt that the failed Suri demonstration was a perfect example of the type of action to be avoided. It represented a top-down vision of innovation which excluded potential users from design activities, and which would clearly be the approach preferred by engineers working with large-scale industrialised

[8] Regarding debates on this notion, and on the distinction made with that of food security, see (Bernstein 2014, Jansen 2014).

agriculture. The person in charge of IPAF's mechanisation programme for north-west Argentina criticised what was felt to be a linear approach to innovation, distancing users from the places where development took place:

> *In my opinion they began all that, the Suri thing, with almost no dialogue. Whether with the regional technicians or with the farmers. (…) It's a way of working that's very much… in keeping with what INTA has always done. In the spirit of what they* (Suri's designers) *are used to doing at home, in the wet Pampas, in respect of an agricultural sector that is very interested in the technologies it is offered. And not at all in a spirit of joint construction, joint development of technologies.*

This demonstration campaign was thus a failure for Novasiembra and Fernando, who had been unable to convince the actors of north-western Argentina that the Suri might be the answer to their problems. Surprised by the nature of said problems, by the working conditions of small farmers and by the attitudes of local agricultural engineers, they found themselves facing a reality that was radically different from that of the large-scale farms of the Pampas, with which they were so familiar. Against all expectation, it was in the Santa Fe region, and more broadly in the Pampas, far from the north west and the indigenous populations that Fernando had put forward as a symbol of family farming, that new actors were to come together to support the Suri, and even that the range of products that the agronomist and the entrepreneurs were proposing, was to grow.

New market, new products, new allies

In 2013, whilst Fernando and Novasiembra were fully focused on the north-western region, to their great surprise signs of interest were being shown from the Pampas provinces, dominated by field crops and a latifundian agrarian structure. This interest was not coming from the long-awaited indigenous small farmers, but instead, against all expectations, from other farmers and even from politicians who saw the machine as an opportunity to resolve local strategic issues. For example, there was confirmed interest from the authorities in the province of Santa Fe, from the governor himself. An engineer by trade, he took a personal interest in scientific and technical matters, making this sector one of his political priorities, creating for example an agency for the promotion of sciences, technologies and innovation. When he discovered the Suri at a regional exhibition, he became interested in the project, seeing it not only as an opportunity to encourage an original technological innovation within his own region, but also to take action to help vulnerable people throughout the province as a whole. The mayor of Casilda, where the Suri was born, who also had a position of responsibility within the provincial government, had this to say of the governor's interest:

> *The governor is interested in the development of machines on small or large scales; we currently have machinery under development for large-scale agriculture, but it remains very inaccessible to small producers, family farmers and the family economy which exists on a very small number of hectares. These are*

machines for small surface areas, inexpensive and designed for family farming. So in the governor's opinion, this project was valid in all respects.

At the end of 2013, Suri's designers were asked to meet with the governor, who granted them funding to finance their attendance at regional exhibitions. Similar interest was being shown by managers at INTA's Santa Fe office; when they learned about the project and its initial media hype, they formalised an agreement between INTA and Novasiembra. With family farming gaining ground within national policy and at INTA itself, the development of the Suri was an opportunity for the regional centre, at the heart of a zone that symbolised the progress that agribusiness was making, to showcase its contribution to family farming. So this interest, along with that shown by the governor, gave the Suri and its designers a certain amount of symbolic recognition, until then unhoped for. It also happened to coincide with a change in the attitude of Fernando and his partners. At the end of 2013, they were trying in vain to interest actors in the north-western region, but above and beyond the political contingencies, they became aware that the technical characteristics of their machine were starting to attract the attention of a category of farmers they had not (or to no great extent) so far taken into consideration and which was very different from that to which they had confined family farmers. The contours of the latter were to be gradually redrawn, as was the technological offering that they had so far developed.

A new product for "another" family farming

Following the north-western campaign and a certain number of exhibitions they organised in the Pampas region, the two entrepreneurs and INTA's agricultural engineer became aware that the demand was not where they had initially thought. So they decided to evolve their offering, at least in part, in order to target another market segment that had unexpectedly come to their attention. Fernando explains this bifurcation:

So we attended a conference on quinoa, in Jujuy, but we already had a fairly clear idea that the small-scale family farming market wasn't what we had idealized, thought. So we also brought the pneumatic distributor – which was Novasiembra's main product – to the conference. And that's when we realised that that there was a market for a type of agriculture, let's call it "empresarial" or "small-scale commercial", in which no-one was showing any interest. (…) It wasn't the audience we had hoped for, they weren't marginalised. (…) We hadn't met the indigenous people we were expecting to meet. Instead we'd met small farmers, with 6 or 7 hectares, who generally farm grasslands and want to protect their soil.

It was essentially during their demonstration events in the provinces of Santa Fe and Buenos Aires that Suri's promoters met this population of "intermediate" farmers, who did not fit into the family farming category as they had initially imagined it. They were farmers who cultivated a few hectares of land in peri-urban zones, near cities such as Rosario, La Plata or Buenos Aires, producing cereals, fodder crops or vegetables.[9] With

[9] On the population of peri-urban market gardeners, often Bolivian immigrants, and on their role in supplying cities such as Buenos Aires, see Le Gall (2015).

a far higher level of capitalisation than the north-western farmers, they sometimes have quads or other vehicles capable of pulling a small seed drill such as the Suri. The small seed drill allows them to do without the usual service providers, whose large seed drills cannot always get onto their small plots of land or are not always available on the required dates. This awareness that the potential market was probably more likely to be found among a different type of family farmer, led the partners to make two decisions.

The first was to develop a new machine, this time baptised with a name that had no Andean consonance: the Tucurra (literally, the grasshopper). This new tool differed from the Suri in that it was self-propelled and was shaped like a tiller. It was nevertheless a direct seed drill, with the disks and seeding components positioned at the front of the machine. The Tucurra presented the specificity of incorporating the pneumatic distribution system sold by Novasiembra for large direct seed drills, to increase the precision of seed distribution. The new machine essentially targeted vegetable seeding, where the seeds are very small and require an extremely precise distribution system. Fernando talks about the emergence of this new opportunity, which stemmed from the combination of a new machine, with new technical properties, and a new audience challenging the categories which had until then shaped his vision of the farming world:

> *A market that we had never even imagined emerged for other machines!* (The farmer) *is between the vegetable garden and… he fits to some extent into family farming, but up there, in the La Plata green belt… the Bolivian vegetable garden (…) We call them FF and SU. At INTA we sometimes say* "*family farming*" *and* " "*small-scale unit*". *And all the others are part of the SU category. The market gardeners… with small-scale capital, with little land.*

The new Tucurra seed drill was an immediate success, especially with the peri-urban market gardeners, and this success might well have definitively buried the Suri project, but that was not at all the case, and as from 2015, the Suri also entered into a new phase of its existence. Fernando's and Novasiembra's second initiative, following the failure of the north-western campaign and their realisation that there may be a new market among "intermediate" farmers, consisted in relaunching the Suri project by attracting partners who, like themselves, came from the world of large-scale field crops.

Suri's revival

If fate had not yet smiled upon the Suri and its designers, the latter believed this to be due to two problems. Firstly, and obviously, the difficulty they had encountered in stimulating any concrete demand from family farmers in the north-west. But focused as they initially had been, on north-western Argentina, Fernando and his partners also realised that they had failed to respond to the demands of these famous "intermediate" family farmers, who had clearly demonstrated their interest. We must not forget that the Suri had remained a secondary activity for Novasiembra and Fernando, whose core business lay with large machinery and soybean producers. The little time they were able to devote to it—time that was fully taken up with the north-west region—and SME Novasiembra's limited logistic capabilities, were a major obstacle when it came to simultaneously exploring multiple markets. So once the decision was taken to make

this new population a priority, the challenge rapidly became one of finding the material resources with which to envisage a production for the Suri that would be both high-quality and responsive to a level of demand whose true potential was only beginning to be revealed.

In the wake of the north-western campaign, Fernando and Mario set out to convince a regional farm machinery manufacturer to dedicate a few of its production lines to the Suri. They found a suitable partner in early 2015, in the shape of Dumaire, a company to which Novasiembra sold its pneumatic distribution components. The advantage of such a company, specialising in the manufacture of large machinery, is by no means self-evident, and the partnership merits closer examination. Dumaire was founded in the 1970s and initially built tilling tools. With direct seeding booms in the 1990s, the company completely overhauled its business activity and began to produce direct seed drills. Its decision to manufacture the Suri, and hence to instigate another major turning point in its trajectory, can once again be explained by a situation of crisis. Since 2012, Argentina's field-crop sector had been in difficulty, largely due to the effect of falling world markets and an unfavourable fiscal policy. Following the boom in seed drills sales in the 2000s, like its competitors, between 2012 and 2015 the company became bogged down in an unprecedented slump. Dumaire had to let a large proportion of its employees go, and even leave empty a new assembly line that had been built just before the onset of the slump. For Gerardo Dumaire, the project that Suri's developers proposed at the end of 2014 was thus a twofold opportunity. Firstly, to diversify, at a time when its standard production was falling; and secondly, to become a pioneer in a new market, that of machines for small farmers, which it believed to have huge potential. Over recent years, he too had been interested in the political communication surrounding support for family farming and by INTA's action to back the sector; he saw the Suri as an opportunity he should grasp and support, even if it would take time for business to take off. He said:

> *I thought it was very interesting, because it seems to me that there are places like northern Argentina, Peru, Venezuela, Bolivia, and who knows where else… I felt it was an ideal seed drill for many places. I'm familiar with Bolivia, because we've sold a fair bit there. I know Peru and Brazil, and there are places where I said to myself: 'Who's going to sow here?' No-one's going to come with one of our seed drills. And those are the places I told myself were perfect for this machine.*

Yet, Gerardo Dumaire did not agree to become involved simply because he believed there was a potentially flourishing market. It was the Suri itself that convinced him, the way it worked and looked. It was the formal partnership between INTA and Novasiembra, and the INTA stickers placed on the prototypes to embody said partnership that constituted "trust devices" (Dubuisson-Quellier 2003) which, in his eyes, guaranteed the quality and reliability of this innovation. As he said:

> *It's something that is very important to me, in relation to the seed drill. It gives it prestige. INTA is a highly respected institute… (…) It's a guarantee when you are talking with people. If it's approved by INTA, that means it definitely works well.*

Between state and the private sector, developing a new market

Dumaire produced its first Suri in May 2015. In addition to making its assembly lines available, the partnership also opened up distribution channels. As early as spring 2015, one of the distributors in the Plata region began to organise demonstration events, either via INTA's experimental station network or through agricultural faculties and he quite quickly succeeded in selling a few units in the peri-urban zones of Buenos Aires. He had previously only been interested in large-scale farming, but like Dumaire, he saw an opportunity to diversify his activities towards this hitherto unexplored and under-exploited sector:

> *I'm interested in everything, not just family farming as such. There's an opportunity here, because family farming is relatively underdeveloped, under-mechanised. Very manual, with few machines or tools with which to improve productivity.*

He nevertheless stressed the importance of adapting his sales practices to suit this new kind of market, rooted in informality and relatively unaccustomed to meeting with INTA agronomists, technicians or machinery salesmen. He therefore opted for a strategy of assistance and advice to win over the farmers and provide follow-up:

> *There's a very real lack of connection between the farmer and the agricultural engineer. A huge gulf. Sometimes technicians can't even gain access to these people. The closest contact that these people have with technicians is when they buy plants, seeds or agrochemicals (…) So if you sell the Suri without any follow-up, without explaining how it works… in any case, that's not the way I sell it. I sell it with at least two or three visits, to give the farmer some advice, to explain how he should sow.*

So for Suri's designers and their new partners responsible for the manufacturing and marketing, it was a case of giving themselves the wherewithal to adapt their practices to suit a market that was just as new to them as the north-western region itself. Yet their shared vision of the way in which the family farming market might 1 day keep its promises, requires the *interessement* of another type of actor, the State. The same State that had helped to allow the category of family farming to exist within its institutions and to make it a model of agricultural development in its own right. This position, shared by all of the actors mobilised around the Suri, was based on the conviction that the machinery market for family farming would only open up if the State, through its policies to support this category, made this demand solvent. For example by granting subsidies for the purchase of these machines, thus making them available to small farmers, or by introducing credit programmes; this is how Dumaire sees Suri sales taking off:

> *All of that has to come from the politicians, otherwise it's very complicated, for people to come and buy individually, it's hard. There has to be political support (…) But I think that one day it should be able to take off. Right now, personally I don't have the contacts to organise that. I certainly have it in mind, at some stage,*

to go and build contacts within a ministry, within the government, so that they decide to buy a given quantity, and at that point I think it could take off.

It was in this same spirit that Fernando devoted a considerable amount of energy to trying to make politicians aware of the innovations he was developing with Novasiembra. With numerous actors he had contacted within various ministries or with politicians themselves, it was a question of looking for public funding that would allow farmers to buy Suris or Tucurras. The State and public policy, the very entities that had helped to make visible and shape this category of family farming, thus became the target—more so than the farmers themselves—of the market to be built for the proposed innovation. For these agribusiness actors, they thus became allies that have to be convinced, the people on whom the eventual success of their innovation will depend—just as the agronomists from IPAF or other family farming institutes have been at the outset.

Conclusion

Following the trajectory of a technological innovation, our aim in this paper was to help analyse the tensions or modalities of coexistence between models of agricultural development in Argentina. To this end, we looked more specifically at the actors in the scientific and technological field, on the assumption that this was a privileged area of observation. We studied the case of a project led by an INTA engineer and agricultural machinery entrepreneurs, rooted in the world of agribusiness and large-scale field crops, who were trying to design a direct seed drill for family farmers. This original attempt to create intersections between agribusiness and family farming allowed us to highlight the ruptures that exist between these two worlds, made up of farmers, companies and research and extension organisations.

What stands out in this trajectory, are two major phases in two very distinct geographical areas, and an evolving equipment offering. During the first phase, the innovators concentrated on the semi-arid north-western region and its Andean family farmers, with a technical offering that focused on the Suri. The second phase took place in the fertile Pampas regions, with peri-urban farmers very different from those initially targeted, and with a new Suri offering that added a second seed drill specially designed for market gardening. Using the sociology of translation's framework of analysis, we have shown that throughout the two phases, Suri's designers and promoters endeavoured to focus on a vast cohort of heterogeneous actors: extensionists and researchers from agricultural institutes, manufacturers of large agricultural machinery, local and national political actors and, above all, small farmers whose profile evolved significantly from one phase to the next. They set out to convince them that their machines—the Suri in particular—provided solutions to the problems they were encountering, thus encouraging them to get behind the innovation. The small seed drill was thus presented as a means to resolve the work organisation issues facing small peri-urban farmers, to limit soil erosion, to help impoverished Andean family farmers, to allow agricultural machinery manufacturers to generate some profit during periods of crisis, to help them become pioneers in a potentially promising market, and to boost the image of political actors by demonstrating their concern for small farmers and

vulnerable sectors of society. In so doing, we have seen that in order to gain the attention of these actors, it was necessary to convince them to set aside existing practices and thus to break away from existing sociotechnical configurations (Goulet and Vinck 2012); in this case, in north-west Argentina it was a question of convincing farmers—or the engineers working with them—to pull away from the traditional tilling, fertilisation and irrigation methods that were preventing them from switching to direct seeding. But as we have seen, the difficulty encountered in operating these changes and *interessements* led to failures: despite all their efforts, this is why Suri's promoters were unable to sell their machine in the north-west region, and why they gradually redirected their attention to another audience, another region and another type of family farming.

These twists and turns, and their related failures, reveal the importance of the ruptures that appeared within agriculture's scientific and technological spheres. The case analysed here, with actors historically linked to agribusiness showing a sudden interest in family farming, reveals their apparent ignorance of this category of farmers, whose emergence in the institutional landscape is closely bound up with State action, and of INTA's agronomists working on their behalf. The latter, and, more broadly, all of the actors with links to the government and to public institutions, were nevertheless priority targets for their attempts at *interessement*. As far as they were concerned, these were the sole spokespersons for a category —family farming— whose name, at the beginning, was the only thing they knew. Yet whilst the construction and emergence of categories play a key role in the genesis of innovations or new markets (Blanchet 2017), we have seen here how immensely difficult it was for Suri's promoters to find the category of family farming that they had initially imagined. Through trial and error, they managed to evolve their technological offering and marketing practices, whilst at the same time redefining the scope of a category that was hard to grasp in the real world. Whilst the category and notion of family farming are in themselves conventional footholds, allowing their project to be understood and appropriated by other actors, they are ultimately ineffective when it comes to embracing a population that is far more complex than might be suggested by the typologies that binarily oppose family farming and agribusiness. Classification and categorisation systems, and their claims to exhaustiveness, often suffer when confronted with reality in all its complexity (Bowker and Leigh Star 1999). Ultimately, the redefinitions that arise from this confrontation and pathway, the new *agencements* that they produce (Callon 2016) and the scientific and technical actors officially dedicated to family farming, thus remain excluded, to the benefit of operators rooted in the world of agribusiness.

From this initial desire to allow family farmers to benefit from the technological progress of large-scale agriculture, two main factors emerge to catch the attention of works that analyse this plurality, or this coexistence between models of agricultural development. First and foremost, the close examination of the trajectory of a technological innovation embodied here within a machine, offers a reading that allows us to go beyond the overarching visions of the main movements that were shaking the agricultural worlds, revealing, for example, the emergence of contrasting models of development. It allows us to understand how actors actually integrate these categories into the course of action and model their contours at the same time as those of the technologies. Revealing the co-productions between social and technological orders (Jasanoff 2004), this perspective invites us to consider this plurality and coexistence not just in terms of symbolic, political or moral contrasts, but also with regard to the

practices and objects that they engage. So the failure to introduce the Suri during the first phase of its existence was not just the result of cultural resistance to a technology that embodied the agribusiness model. It was the very way in which the tool existed — the fact that it was not suited to local conditions— that triggered the challenges it was to face. On the basis of these facts, sociological analysis might want to revisit the identity of the actors engaged, their practices, their collectives and the types of solidarity they rely on, so as to propose a comprehensive reading of these logics of pluralism, of coexistence or of encounter between models of development.

To understand these logics, we believe it is important to underline a second factor, relating to the profound divergences that this study reveals regarding the definition of the "right" ways of innovating, or of thinking about the place of technology or producers within dynamics of change. The innovators' surprise when faced with engineers who appeared to be content with the ancestral practices of the Andean farmers, and who even questioned the validity of using inputs that constituted the very pillars of green revolution (Cornilleau and Joly 2014), give us an inkling of the profound ruptures that exist between engineers, extensionists, researchers or manufacturers, depending on the type of agricultural model they are dealing with. Each party's action would therefore seem to relate more to anti-programmes (Latour 1996), than to facets of the same scientific and technological sector capable of interacting with and serving a common project of society. So whilst the agricultural sector, along with the State action that frames it, reveals an increasingly pronounced polarisation and breakdown, it is clear here that the scientific and technological actors are actors of this pluralism in their own right. In any case, the diversity of their epistemic commitments (Granjou and Arpin 2015), linking practices to forms of moral or political engagement, confirms the challenge of approaching the plurality and coexistence between models of agricultural development from scientific and technological spheres.

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