GLOBAL AND ARGENTINE BIOFUEL AGribusinesses FROM THE BIOFUEL BOOM TO AN UNCERTAIN FUTURE

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Abstract Argentina has enormous potential for producing and marketing biofuels in domestic and external markets, based on excellent soybean agricultural and crushing competitiveness, which require a strong institutional environment. The sector is growing fast over and is currently characterised by the coexistence of different scales of production and governances, which vary from hierarchy to market. Three different models of production search for the solution to issues like lack of energy, reducing pollution and producing food, with large-scale production appearing most competitive and medium-scale production gaining competitiveness when coupled to animal production. Finally, producing biofuels in Argentina could present several challenges that put its future in jeopardy and leadership and entrepreneurship will be key to overcome them.

Keywords biofuel, innovation, productive scales, challenges.

1. Introduction

The Biofuel boom reached its peak during the mid 2000’s when most of the developed world and some developing countries openly stated their interest in them and accordingly, established mandatory cuts. This happened all over the world, though mainly in North and South America, Europe and Southeast Asia. These areas have now established a global leadership in biofuel production and use.

As of late 2008, there were 170 ethanol plants in operation in the USA (24 under construction) with a total capacity of roughly 34 billion litres per year\(^1\). Meanwhile, in Canada, the government has planned for 45% of the country’s gasoline consumption to contain 10% ethanol starting last January 1\(^{st}\), 2010.

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\(^{\text{\textcircled{I}}}\) Source: Renewable Fuels Association, RFA, January 2009.
The European Union currently cuts its fossil fuels at 5.75% (started January 2010) and they expect to increase the percentage to 10% by 2020\textsuperscript{III}.

In Brazil, the government hopes to build on the success of the Proálcool ethanol program (it already provides a 22% ethanol blend used nationwide, plus 100% hydrous ethanol for four million cars) by expanding the production of biodiesel which must contain 5% by 2013\textsuperscript{IV}.

In India, the ethanol program calls for E5 blends throughout most of the country targeting to raise this requirement to E10 and eventually E20, although no confirmed dates for these cuts has been issued. In China, the government is making E10 blends mandatory in five provinces that account for 16% of the nation's private cars. In Southeast Asia, Thailand has mandated an ambitious 10% ethanol mix in gasoline starting in 2007. For similar reasons, the palm oil industry plans to supply an increasing portion of national diesel fuel requirements in Malaysia and Indonesia. This all has created a huge demand for biofuels that Argentina could potentially supply, not to mention if Japan and Russia include policies for mandatory biofuel consumption.

The Argentinean biodiesel sector is currently characterised by the coexistence of different scales of production and various forms of governance, which vary from hierarchy to market, and it is expected to keep on showing these characteristics (Daziano et al, 2007), although concentration towards the large scale model is the current trend. Larger scale production in Argentina based on imported hi-tech machinery is the most competitive type of production in terms of costs. Despite this fact, medium scale production could be viable when integrating it with animal production. Moreover, such a productive model could become a key strategic node in certain areas of the country which are far away from ports and hence, have certain productive disadvantages (i.e.: freight costs and availability, fuel availability, local infrastructure). This model would most likely be the result of a network of producers getting together to gain scale and share risks, but in order for it to succeed there will have to be great leadership and collective action. These are two concepts which are not widely spread among Argentinean farmers, who tend to be individualistic.

The sector has achieved great consolidation, though it is expected to keep on growing in the next few years. It has enormous potential for producing and marketing biofuels both in domestic and external markets, based mainly on excellent agricultural and crushing competitiveness and volume, despite some constraints and limitations, which are mainly institutional (Daziano et al, 2006). Leadership and entrepreneurship could be the weapons needed to attempt to overcome these limitations.

The objective of this paper is to analyse the current biofuel business in Argentina, by means of identifying the various characteristics (institutional, organisational, technological) that make it a currently successful and competitive but potentially threatened business, while portraying its development in the short and medium term.

2. Methodology

The research will be descriptive and exploratory as we intended to develop, clarify and/or modify concepts and ideas with the aim of outlining more precise problems or plausible future


\textsuperscript{IV} Source: EMBRAPA, 2008 \url{www.embrapa.gov.br}
hypothesis. Thus, the research was based upon qualitative matters and practical applications (Gil, 1994).

The paper has a macro-level and micro-level approach. The study of the sector (macro-level approach) sought to obtain the necessary information in order to characterise the sector as a whole, including variables such as identification of the players, assessment of the institutional, organisational and technological environments among others. The results provided are based on primary and secondary information sources: Interviews with experts in the sector and bibliographical search, although some of the results will be given out of the experience of the authors in the field of research. Primary information is based on face-to-face interviews that encompassed various topics related to the developments in the biodiesel sector. Subsequent phone calls were made to clear doubts and obtain additional information to contextualise the answers. A total of five people answered the questionnaires. The object of these interviews is to gain knowledge of the actions taken by the companies to align the governance structures with the market and how the leadership and entrepreneurship in the sector and in the companies themselves impact into gaining second order economies.

A micro-level approach, with the aim to arrive at understanding three different scales and models of production of biodiesel will be performed. The paper includes these three scales of production (large, medium and small) as cases to be studied. The case study method is used as it is a suitable method of analysis in situations where a small sample permits in-depth consideration of the complex and interdependent factors entering into a decision (Yin, 1989). Large scale production will be characterised by plants producing over 60,000 tons of biodiesel per year with world-class technology. Medium scale production will be that which ranges between 20,000 and 60,000 tons per year, having an intermediate level of technology. Small scale production is that made up by plants producing less than 20,000 tons and having a low technological level. The variables studied in order to characterise these three models included the level of technology used, the governance structures used for procurement of feedstock and end-product sale, the attributes of the transactions governed by these structures and the identification of the type of leadership that is most common for each case. The necessary information was obtained by interviews and the authors’ knowledge due to advisory done since 2005.

Research reports and case studies in research groups (Food and Agribusiness Program (PAA)-School of Agronomy-UBA, PROSAP, Pensa, Global Food Network) were also used, aimed at characterising the key entrepreneurial elements and advance the understanding of the development of the sector, following the new institutional economics theory.

3. Literature review
3.1. New institutional economics

In the analysis of an economic system, the institutional environment and its enforcement are as important as the way in which organisations develop in that environment. Besides, firms that have the function of producing –neo-classical theory– and transacting –neo-institutional theory– require a certain degree of technology and organisational ties to carry out their activities. Organisations buy or produce the goods they need to produce their own goods or services, considering transaction costs (at least for the TCE Theory). Organisations thus appear as organisational structures rather than technological functions. The cost of the price mechanism, the cost of the market –the transaction cost– is what leads to the way of governing the transaction.
Transaction costs depend, among other things, on the institutions governing a country, system, region or specific sector (North, 1990). Institutions constitute the rules of the game in a society (North, 1990), country, sector, etc. They are the laws, executive orders, National Constitution, regulations, etc. – formal institutions –; they are also the culture, tradition and habits of the sectors analysed – informal institutions. Williamson (1985, 1993) considers institutions from a “micro analytic point of view” as being “Governance Structures or Institutions” – Market, Hybrids and Hierarchies –, that should be used to identify, explain and mitigate any form of contractual risk. The efficiency of the governance structures is the result of the alignment of the transaction costs with the correct governance structures (Zylbersztajn, 1996).

When there are many and important changes in the context and bilateral dependency, transaction cost economics states that there could be higher possibilities of opportunistic behavior, resulting in lower efficiency of the price mechanism. That is why hybrid forms exist (Ménard, 1996); they represent a shift towards cooperation and administrative controls in order to be able to adjust more rapidly and with greater coordination regarding these alterations.

This explanation leads us to investigate what Williamson proposes in different papers about governance structures. Williamson (1993) establishes that there exist three attributes of transactions: frequency, asset specificity and uncertainty. As the frequency increases, contractual relations will also increase through an increase of trust among the parties. As for asset specificity, the author states that as the specificity of an asset rises, the market determined price mechanism becomes less of an option and the contract, and then vertical integration, become better options. This type of structure can be observed clearly in agribusiness systems with a strong focus on customers demanding quality (Zylbersztajn, 1996). Finally, uncertainty is a consequence of the two preceding attributes; the higher the uncertainty, the higher the tendency towards integration will be.

### 3.2. Entrepreneurship and leadership

Developing entrepreneurship research within economics differs somewhat from that of other social sciences. Entrepreneurship has been and will continue to be studied in virtually all disciplines, from social anthropology to organisational theory to mathematical economics (Henrekson, 2007). Entrepreneurship can be defined first, as a concept which deals with individuals and organisations that actively contribute to renewal and change in the economy. It does not really matter whether the entrepreneur is the person who provokes change or merely adjusts to it. Concordantly, entrepreneurial action can mean either the creation of opportunities or the response to existing circumstances, in the presence of which entrepreneurs have the daring to embrace risks in the face of uncertainty. Second, entrepreneurship is a function, one that is carried out by specific individuals. Given that they choose to do so, the activities may be productive, unproductive, or even destructive from a societal perspective (Baumol, 1990).

Baumol pioneered the role of institutions for entrepreneurial behavior; how “the [social] structure of payoffs” channeled entrepreneurship to different activities. If institutions are such that it is beneficial for the individual to spend entrepreneurial effort on circumventing them, the individual will do so rather than benefiting from given institutions to reduce uncertainty and enhance contract and product quality. The outcome in this case is expected to be one where corruption and predatory activities prevail over socially productive entrepreneurship.
The supply of entrepreneurial effort is also likely to be influenced by the institutional setup. The wealthy world does a good job of directing entrepreneurship toward inherently productive purposes (a large part of the explanation for wealth).

Based on broad historical studies (Rosenberg & Birdzell, North) it is now widely recognised that protection of private property rights is of fundamental importance for economic growth. With secure exclusive private property rights, productive entrepreneurship is likely to thrive. This happens because successful entrepreneurs know that they will retain the entrepreneurial rents they earn and because specialisation and the division of labour are greatly facilitated, which broadens the range of potential entrepreneurial discoveries.

However, how could entrepreneurial attitudes be explained in emerging countries, with high uncertainty –mainly institutional– and a significantly low respect for property rights? In this case, with weak institutions, entrepreneurship could be achieved developing collective actions, with strong influence of leaders and collaborative leadership.

According to Allen (2002, 2005), in many emerging economies, markets are oftentimes imperfect and incomplete. This causes the objectives of firms to switch from being run in benefit of shareholders to being run in benefit of all stakeholders within a chain, thus creating a net of relations which can prove helpful in order to overcome market failures. He also states that it is not necessarily optimal to use the law to ensure good corporate governance, in such economies. Other mechanisms such as competition, trust, and reputation may be preferable.

Literature on leadership deals with the issue of how to achieve collaboration and unity between groups. A collaborative leadership role is process oriented. A collaborative leader identifies relevant stakeholders and brings them to the table –as inclusively as possible–, keeps them at the table and helps them to deal with one another constructively. Huxham and Vangen (2000) define leadership in multiparty situations as “mechanisms that are central to shaping and implementing collaborative agendas” (p.1171). As a result, entrepreneurial attitudes in a “multi-organisational relationship” respond to coordination and development of networks due to uncertainty and weak institutions –unity creates strength.

4. Mapping

Globally speaking, the large scale model, based on hi-tech machinery is predominant. It is the most competitive in terms of costs. This scale is mainly covered by two types of companies: oil companies (distribution and logistic know-how and ownership of the distribution channels) and crushers (productive know-how and ownership of the most important raw material, crude vegetable oil). It is also quite common to find joint-ventures of some kind between these two types of companies because of these complementary characteristics. Despite being the large scale model the most widely spread, medium scale production could be viable when combined with animal production of some sort. In fact, this productive model could become a strategic node in certain key areas which are far away from ports and consequently, have certain productive disadvantages (i.e.: freight cost and availability, fuel availability, local infrastructure). Meanwhile, small scale production is destined to disappear, mainly due to technological and quality problems and the viability of its products and by-products.

The chain is composed firstly by a primary production link, grain production. Secondly, there’s the secondary production link, crushing and production of oils and protein.
concentrates or distillation. Afterwards, there’s the biofuel production link, in which oils and sugars are turned into biodiesel or ethanol. After this process there’s the marketing link and finally the blend and distribution link, in which petrol companies blend biofuels with fossil fuels and ship it to their distribution points. It is important to mention that between any two links of this chain there is always a transaction, which can be governed in different ways from the market to the vertical integration, passing through the hybrid forms. In Figure 1 the basic design of the global production and marketing biofuel chain can be observed.

**Figure 1. General design of the global biofuel chain.**

Source: Own elaboration

5. The current Argentine biodiesel scenario

For the past 15 years, agribusiness has been a fundamental sustain towards adding value in argentine food. Within the agricultural sector, Argentina is a key player on a global level, excelling in the four most important productions: soybean, sunflower seed, maize and wheat. Argentina is the 3rd most important producer and exporter of soybeans in the world (USA and Brazil are 1st and 2nd respectively), although it is the number one exporter of soybean oils and pellets. The Argentinean crushing complex is indeed composed by multi-product companies which adapt their output to different markets (e.g.: roughly speaking, beans for China, oils for Asia, pellets and biodiesel for Europe). It is expected to achieve the record production of 61 million tons of oilseeds during the 2009/2010 harvest\(^V\); Argentina produces around 18% of the world’s soybean total production, exporting as much as 94% of this product, 20% as beans and the remainder as derivatives. The crushing sector in Argentina is composed by 53 processing plants with a combined crushing capacity of around 156,000 tons per day. This industry employs 7,000 workers directly and generates a large number of indirect jobs as well.

The biofuel agribusiness in Argentina is growing fast. Total biodiesel supply for 2008 added up to 1.4 million tons and 2 million tons in 2009. By the end of 2010 year it is expected to

achieve the 3 million ton mark. It is primarily located near Rosario along the Parana River, although the Provinces of Buenos Aires and Córdoba have an important participation too.

Despite a sustained growth over the last 5 years, there exists a delay of several years with respect to other agricultural powers, due to some constraints and limitations, and more particularly to those of an institutional matter (Daziano et al, 2006), which, according to North (1990) are of key importance when developing a new sector. The present uncertainty in Argentina institutionally speaking is due to the National Biofuel law VI. It provides an institutional frame which is not encouraging for competitive large-scale production, which is every bit as important as how the firm develops in it. It states tax benefits only for companies composed by at least 50% governmental participation or at least 50% farmer (small producers) ownership, so reading in between the lines, there are no benefits for large-scale producers; there’s an implicit encouragement for the development of small and medium scale production, which not always generate a world-class product. It also leaves exports out of its limits, not mentioning them in any part of the law and only focusing on the domestic market. This causes a huge degree of uncertainty because export taxes already exist in Argentina VII for biodiesel (20%), but the unanswered question ahead is: will this situation remain the same? Or will export taxes increase to 31.5% as it happens with soybean oil, 35% as it happens with soybeans or 50% as it happens with crude oil? Government has already made interventions in other markets, and if it were to consider this business strategic (which it is), taking action within it would be nothing out of the ordinary. Currently, and due to the fact that not a single firm has been approved for producing and selling in the domestic market, the Government has issued a temporary permit until December 31 2011 for export companies to produce and sell in the domestic market to cover the 2010 and 2011 mandates.

One of the keys towards sustainable, efficient production will definitely be the access to world-class technology which is currently only available through imports; no local machinery producer has achieved a world-class product, and hence the machinery market for biodiesel production in Argentina, which started as a highly heterogeneous one, both in quality and price is now highly dominated by world-class export machinery. It is interesting to see that although many joint ventures and strategic alliances have happened between petrol and crushing companies around the world in this particular industry, this does not seem to happen in Argentina (Daziano, 2009), and the main cause is, again, the Biofuel Law.

As said before high scale production, based on imported hi-tech, is the most competitive in terms of costs, although, medium scale production could be viable when combining it with animal production of some kind. Small scale production also exists as a full integration, having the least competitiveness in comparison with the other models. Figure 2 shows the organisation of the different chains in accordance with the scale considered.

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VI Argentinean National Law number 26,093, sanctioned April 19th, 2006.
VII Until April 2009, export taxes affecting the Soybean complex in Argentina were: Soybeans: 35%, Raw Soybean Oil: 31.5%, Biodiesel: 20%. Crude oil: 50%.
As observed in figure 4, there could be two types of integration in the large scale, oil companies’ integration and crushing companies’ integration, which take over different links of the chain, although the petrol companies have not entered the market in Argentina. On the other hand, in the medium scale production it can be observed how this chain interacts with an animal production chain to form an integrated production system. Finally, the articulation of the chain in the case of the small scale production is clearly a vertical integration from the first to the last link.

After studying and observing many different production models, scales and technologies, analysing the interviews, a viability study will be described in the next chapter. Although these facts are very important, given that the biodiesel sector is still at an early stage, the most important variables when establishing this business are the organisational aspects, namely organisational design and practices, leadership and entrepreneurship.

6. Characterisation of three production models: their role and viability

6.1. Large-Scale Production

Globally, this production model is characterised by the existence of mainly two types of players, petrol companies and oilseed crushing companies. Nevertheless, in Argentina it is mainly composed by crushing companies located on the Paraná River (it is the main outlet for
agricultural commodities that go towards export markets) through the several ports on it, both public and private (Rosario, San Nicolás, Zárate, San Lorenzo and others). It is these types of players that are already using hi-tech machinery and are ready to cope with the big investments needed to install large capacity, world-class biodiesel plants, which can cost several million dollars (estimates vary from 19 to 22 million US dollars) and represent huge entrance and exit barriers to the business, due to high asset specificity. On the other hand, institutional hazard represents huge transaction costs that are dealt with by these types of producers through the governance structure of integration (North, 1990; Williamson 1985, 1993; Zylbersztajn, 1996).

Oil crushers will tend to integrate forward towards producing biodiesel taking advantage of the production know-how and the ownership of the main primary product, raw vegetable oil. The final product is most likely going to be sold on export markets, although if there should be further intervention from the government on the Biofuel Law an increasing percentage will be sent to the domestic market. Hence, it would appear to be the most risky in terms of institutional hazard.

Large scale producers are not likely to focus on animal production, since the crushers already know how to sell pellets without it and petrol companies will not have to deal with them since they start directly from oil. Given the assumption that the machinery they will use will be world-class, they should not have any problems when marketing glycerol either since it is a highly demanded product by, for example, pharmaceutical companies.

Regarding the role of leadership in this particular scale of production, given the mentioned players involved, it can be observed that it is clearly the sort defined as “by example leadership”. This sort of leadership happens because large firms’ business is mainly exporting and hence, they do not care that much about the constraints given by domestic regulations as medium and small firms do. This leadership is useful to prove that the product works, that there is a market for it and that it can be accessible. These firms are, in effect, the “tip of the arrow” in the sense that they are the ones that are the initiators of the business in the country. This example is what will encourage different other forms of business organisation, forms of governance, etc. to be developed. They are the ones that set the basis for the agribusiness net-chain to be developed, even when it is affected by a severely insecure institutional environment. This is clearly a marketing-type leadership, involving, as stated by Baumol (1990), the creation of opportunity.

6.2. Medium-Scale Production

In this scale of production the model will be different. Here the most common scenario would be that of several farmers getting together to gain scale of production and hence lower costs on both sides, by gaining economies of scale and by sharing costs and risk, reducing transaction costs. This is the main reason why hybrid forms exist according to Ménard (1996); they represent a shift towards cooperation and administrative controls in order to be able to adjust more rapidly and with greater coordination regarding these alterations.

This sort of production has very few examples in Argentina but it could prove to be a successful model. It is this type of players who have made investment after investment in the agricultural phase during the last 20 years (the last green revolution in Argentina), gaining their unique competitiveness in the production of agricultural commodities worldwide. If they join up they may be able to afford using hi-tech machinery, but it is expected that they use an
intermediate level of technology. This sort of production should be highly homogeneous in its player composition given that these medium-sized contract farmers work all over the agricultural area in the country, producing agricultural commodities (mainly soybeans) in a range from 15,000 to 100,000 tons.

The probable form of governance is that of the coordination (Daziano et al, 2007) with several farmers “pitching in” with their production and capturing a concordant rent for the sale of the product. In this sort of production, an interesting model appears: that of the integrated system which involves biodiesel and animal production. This model could be very well applied to parts of the country which are far away from ports and hence, have high freight costs and problems with availability of certain inputs, such as fuels.

Moreover, if one takes the case of the Argentinean North West (NOA after its Spanish initials), it is striking to find that this area ships out to other regions of Argentina more than 2 million tons of soybeans, at least 1 million tons of maize and a million calves; and on the other hand, ships in from other parts of the country almost US$ 110 million worth of beef with the consequent in and out freight charges during these operations.

A medium-sized biodiesel plant (40,000 tons/year, around 11-12 million US Dollars) with a high technological level would generate around 40,000 m³ of bio-diesel and roughly 160,000 tons of soybean pellets. Considering a sensible mix for a bovine feed lot, the project would need around 150,000 hectares, which for that area are not an impossible thing to obtain. With this feed, one could be able to produce around 40,000 tons of beef annually (feeding approximately 200,000 heads of cattle annually). These figures clearly show that the main business is that of producing cattle near where the biodiesel plant will be located, hence cutting down enormously on freight costs and using the entire production of protein pellets coming from this factory. To make a long story short, soybeans and maize are closer to processing facilities and feed-lots and steers are nearer the market where they will finally be consumed. The limitation that arises is meat processing and packing facilities that can cope for this increase in local production. Moreover, strategically speaking, biodiesel produced locally could prove itself considerably useful, considering that practically all of the road freight runs on diesel engines, that petrol is produced and refined in the South of the country and that oftentimes important fuel shortages (particularly of diesel) happen in many parts of the country, especially in the inlands. This could be a small step towards some degree of fuel independence. Summarising, this may not be the most cost-efficient structure but it could surely play an extremely important role because of the above mentioned reasons.

Regarding the role of leadership in this particular scale of production, and given the involvement of the type of players mentioned before, it can be observed that it is a more of an entrepreneurial and organisational leadership, or as defined by Huxham and Vangen (2000) a collaborative leadership. In this case the coordinating entity (a firm or an association of producers) is the one that exercises said leadership. It is this coordinating node the one that has the responsibility of making such a complex network function. All of the members of the net have to necessarily rely on the coordinating node, hence the issues of trust and collective action become exceedingly important. It is clearly an attitude-type of leadership, involving, entrepreneurship as defined by Baumol (1990), not necessarily creating the opportunity, but certainly responding to existing circumstances to take advantage of them, but at the same time embracing risks in the face of uncertainty, coming mainly from the institutional environment.

VIII The Argentinean North West includes the provinces of Jujuy, Salta, Catamarca and Santiago del Estero and has been historically the least developed area of the country with some of the lowest average income levels.
A collaborative leadership role is process oriented, the relevant stakeholders must be identified in order to bring them to the table and together, build this multi-organisational relationship that will respond to coordination and development, unity creates strength. Moreover, this model could be afterwards replicated for such other crops as sunflower, rapeseed and maize, producing biodiesel or bioethanol while raising livestock.

Nevertheless, for this model to succeed it will be very important to overcome a natural characteristic of the Argentinean farmer, namely its reluctance to work collectively. Low stocks of social capital in Argentina have historically been a problem whenever a network of farmers is built (Palau, 2005) and overcoming this will be a key issue.

6.3. Small-Scale Production

Small-Scale production is that which is thought for self-consumption. It is based on the availability of primary products (i.e. soybeans) at the direct place of production and the search for some degree of energetic independence following the previously mentioned energetic scenario in the country.

As a consequence, the FAA (Federation of Argentinean Agriculturists) built up a plan for biodiesel production at farm level (from rapeseed in this case). Applying an institutional leadership, they encourage farmers to produce their own biodiesel as a means towards fuel independence, but the outcome has not yet been very satisfactory.

The levels of technology and scale are low, with plants processing around 10 tons of soybeans per day with the use of presses, obtaining 1 ton of biodiesel and around 8.5 tons of expellers. Given that the technological level is low, the price of the machinery is relatively cheap, hence entrance barriers are not high. Of course, when this sort of model fails, selling this highly specific machinery does not become an easy task.

The real issue with this sort of technology is that it does not produce a world-class product. The quality level of the product makes it unfit for marketing. The product itself could be harmful for engines. Not to mention by-product hazard, unrefined glycerol should be disposed of correctly if it cannot be sold, and since its quality does not allow it to be sold, disposing of it creates another cost in order to do it properly. One positive fact is that in producing biodiesel, the export tax differential is favorable. Clearly the governance here is a vertical integration, since the producer owns the soybeans, the blender and consumes the output himself.

It cannot be clearly stated that such a model would be one that sets an example, since its lifespan does not seem to be very long. Such a model does not seem to be viable in the long run. Even so, many small producers could get together and build a net to produce on a medium scale model, which could prove being a much more successful business.

7. Challenges and uncertainties towards the future

Despite a promissory start to the biofuel business in Argentina, some factors may affect its success in the future, notably those of an institutional nature.

First off, a key constraint is the National Biofuel Law. As previously stated, its shortcomings cause a weak institutional scenario, which is very difficult to foresee and also to adapt to as
temporary permits to supply the domestic market have been issued only for 2010 and 2011, and the process by which they were extended is still unclear.

Secondly, Government intervention could wipe out the business as a whole if export duties were to be increased or exports were to be closed because then, the economic equation just would not add up, being the whole business so dependent on export markets.

In third place is the high (not to say extreme) dependence of the argentine biofuel business on the European market. During 2009, the EU asked for all of its potential suppliers to extend a report on how sustainable their production of biofuels was. Argentina as a country did not prepare said report, a fact that has put its position as supplier for the EU in jeopardy. Luckily, there is still room for private certifications of sustainability (a process which is still under review by the EU), and towards the future, this may be the road the argentine suppliers will have to take to enter this market.

In line with this fact, AAPRESID (Argentinean No-till Farmers Association) has launched a no-till farming certification recently. This environmental certification of the no-till farming production process will become a mechanism of summarised, precise information that will constitute the basis for better agricultural management (productive and environmental), and at the same time will allow the consumer to know the characteristics of the productive process, through scientifically based knowledge measured on the field. This is important because Argentinean production has a large percentage of no-till agriculture, almost 90% of the soybean harvested area. Conservation agriculture in general and no-till farming in particular offer a productive alternative that makes it possible to maintain yields, reduce costs and, at the same time, have a less aggressive impact on the environment –mainly on the soil resources. That is, in the present state of knowledge, no-till farming represents a real and concrete alternative, environmentally and productively superior to the tilling system.

Finally, out of all the important biofuel producers, Argentina is the country that is spending the least on the development of new technologies on 2nd and 3rd generation biofuels. This fact puts the country in a clear disadvantage against competitors and also affects its future as a global supplier.

All of these facts can change the status of competitiveness for the biofuel business in Argentina and they should not be overlooked when planning towards the future. In the end, soybeans and maize will not and cannot be the chosen feedstocks for biofuel production in the future, and so, the evolution of biofuel production in Argentina has to take all of the above cited factors into account.

8. Discussion: leadership and entrepreneurship in the biodiesel industry

As regards leadership in the sector, and as previously stated when reviewing the productive models, one would find two different types of leadership within this sector. Large firms (basically crushing and petrol companies) would have a marketing-type leadership, involving, as stated by Baumol (1990), the creation of opportunity. These firms are, in effect, the “tip of the arrow” in the sense that they are the ones that are the initiators of the business in the country.

On the other hand, the medium scale producers, using hybrid governance, would exercise an entrepreneurial and organisational leadership, or as defined by Huxham and Vangen (2000) a
collaborative leadership in order to produce and market competitively. In this case the coordinating entity (a firm or an association of producers) is the one that exercises said leadership. It is this coordinating node that has the responsibility of making such a complex network function. It is an attitude-type of leadership, involving, entrepreneurship as defined by Baumol (1990), not creating the opportunity, but certainly responding to existing circumstances to take advantage of them. Nonetheless, for this model to succeed it will be very important to overcome the low stocks of social capital in Argentina for farmers to work collectively.

Finally, small scale production has an example of institutional leadership, based more on idealistic than purely business reasons. Moreover, it is a strategic solution to help ensuring fuel supply in a situation of repeated shortages.

A comparison between the three models can be observed in Table 1. As previously discussed, large scale producers have a high technological level, whereas medium scale models’ is intermediate, with small scale production having thus far low or very low technological level. The sector, as a whole, faces institutional uncertainty, but organisational uncertainty will be low for large and small scale, and medium for medium scale production. Meanwhile, with high asset specificity being common to all models, different governances appear: in large scale production, crushers predominantly show integration for inputs, but market for outputs, while petrol companies’ governance is market for inputs and integration for outputs; medium scale production shows a governance structure based on contracts for inputs, although market, contracts and integration appear when considering outputs; small scale production, is clearly an integration on both sides, although some market appears when selling expellers. Target markets are also different, with large scale supplying for both domestic and export markets, medium scale concentrating on the domestic market and small scale producing for self consumption. The biggest challenge for each model is also different, even though they all face institutional constraints.

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<th>Variables</th>
<th>Large Scale</th>
<th>Medium Scale</th>
<th>Small Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology level</td>
<td>High</td>
<td>Intermediate</td>
<td>Low, Very low</td>
</tr>
<tr>
<td>Governance (inputs)</td>
<td>Integration (crushers) Market (petrol companies)</td>
<td>Contracts</td>
<td>Integration</td>
</tr>
<tr>
<td>Governance (outputs)</td>
<td>Market (crushers) Integration (petrol companies)</td>
<td>Market, Integration (biodiesel) Contracts, Integration (feed)</td>
<td>Integration Maybe market when marketing expellers</td>
</tr>
<tr>
<td>Asset Specificity</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Uncertainty</td>
<td>High Institutional Low Organisational</td>
<td>High Institutional Medium Org.</td>
<td>High Institutional Low Organisational</td>
</tr>
<tr>
<td>Target Market</td>
<td>Export &amp; Domestic Domestic (biodiesel) Domestic (Feed)</td>
<td>None, self-consumption</td>
<td></td>
</tr>
<tr>
<td>Leadership type</td>
<td>Marketing-type Attitude-type Institutional (1 case)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biggest Challenge</td>
<td>Institutional Hazard Collective action, social capital</td>
<td>Product &amp; By-product quality</td>
<td></td>
</tr>
</tbody>
</table>

Source: Own production, based on interviews.
9. Conclusions and implications

Argentina is currently going through some crises as regards consumer products availability and inflation. The energetic crisis is heavily affecting not only industrial production, but also transport. Added to this, the current situation of very limited beef exports is due to a huge internal consumption, decrease in the number of heads and a lack of strategy for the sector. These situations could be given a solution if the right decisions were made on certain critical strategic points.

The argentine biodiesel scenario shows the existence of three models. One of them, large-scale production is extremely competitive in terms of costs, mainly as a follow-up of the highly competitive soybean crushing sector, probably to a point where probably no other cluster in the world will be able to produce soybean biodiesel so competitively. In order to provide for export markets, it is necessary to do it with large-scale plants (60,000 tons annually and above) with world-class technology. Meanwhile, a key driver for medium and small scale producers is fuel independence, although their approaches towards producing are different. Medium scale models will become competitive if they establish themselves in key places of the country where they can become strategic nodes of both animal production and biodiesel (feed-lot right next door to biodiesel) under the paradigm of “Biofuels as animal production’s by-product” and not the other way around. Hence, cost efficiency becomes much less important, particularly because freight prices are almost inconsequential. As for the small-scale production, it is highly inefficient in the use of raw materials and its products could carry some quality and environmental hazards. Its only reason for existing would be a strategic one, given the country’s energetic scenario. Its best solution is to team up with other small producers to form some sort of medium-scaled venture. Otherwise, this model is destined to disappear.

Organisationally speaking, all of the models tend towards integration and/or contracts in order to reduce uncertainty and mitigate contractual risk. This, as observed in section 4, is due to the highly uncertain institutional environment that rules the biofuel agribusiness, lacking any policies that encourage competitive production and leaving many holes regarding how the law will be enforced.

This is one of the highest potential sectors in Argentina and it will only be achieved through great coordination and organisation by the actors. With a more certain institutional environment and continuing with these levels of leadership and entrepreneurship we could definitely be seeing Argentina as a key player in the global bio-fuel business in the near future.

Nevertheless, all of the constraint factors (notably institutional ones) can change the status of competitiveness for the biofuel business in Argentina and they should not be overlooked when planning towards the future. In the end, soybeans and maize will not and cannot be the chosen feedstocks for biofuel production in the future, and so, the evolution of biofuel production in Argentina has to take all of the above cited factors into account.

As future research agenda, the issues that to be addressed should be: a) the limitations caused by the lack of collective action and low stocks of social capital; b) the elaboration of an Argentinean biodiesel strategic plan, based on providing a world-class product for a global market; c) Regional economic impact of applying the medium-sized model in different areas of the country.
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