Redistribution of welfare from the biodiesel production chain in Argentina

Growth to distribute or distribute to growth

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Degree Project 30 HEC
Master of Science in Sustainable Development

Uppsala - 2012
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Joaquín Daniel Pérez Martín

Supervisor: Mónica Campos, Center for Analysis and Synthesis, Lund University

Credits: 30 HEC
Level: Advanced E
Course title: Degree Project in Sustainable Development
Course code: 1GV038
Programme: Master Programme in Sustainable Development

Place of publication: Uppsala
Year of publication: 2012

Key words: biodiesel, welfare economics, welfare distribution, social welfare

Uppsala University
Acknowledgements

I would like to express my sincere gratitude to Swedish society for giving me the opportunity to take the Master Program in Sustainable Development at Uppsala University. The education I received and especially the interdisciplinary and intercultural experience was invaluable for me, personally and professionally.

I would also like to recognize and thank the great support received from my supervisor Mónica Campos, who perfectly guided me in a great ocean of topics, interests, doubts and ambitions. This thesis is just the final part of a big step: becoming the professional I once dreamt, from now on challenging new dreams will appear...

Regarding Buenos Aires...thanks, thanks and thanks for the support, for being there, for sharing and accompanying this experience with me and Flora: Osval & María, Ra & Re and also for Jorge, Dorina, Santi, Debo, Geri and Vale. And last but not least thanks to Lupe, Negro, Chula, Lucho, Nati and Juampi.

Lot of friends are now again spreaded around the World: Evo, Ale, Frie, Ceci, Chris and many others thanks for those share days, I’ll ever keep them.

Many many thanks to our little Buenos Aires in Maria Claret, Barcelona: Tris i Bel moltes gràcies!

And Flora...just thanks for giving me the light for all instants

Tack så mycket, thank you so much and muchas gracias!!
List of abbreviations
AUH – Asignación Universal por Hijo
EC – European Commission
EU – European Union
FAO – Food and Agriculture Organization
FFS – Fondo Federal Solidario
GDP – Gross Domestic Product
GHG – Greenhouse gases
GMO – Genetically Modified Organisms
HDI – Human Development Index
IHDI – Inequality adjusted Human Development Index
MDG – Millennium Development Goals
OECD – Organization for Economic Cooperation and Development
RED – Renewable Energy Directive
RR – Roundup Resistant
UNDP – United Nations Development Program
UN-ECLAC – United Nations Economic Commission for Latin America and the Caribbean
Abstract
In view of the dimension of its agricultural production, the biodiesel development policies adopted and the increasing global demand, Argentina became in the last years an important actor of the biodiesel market. The industrialization of the primary production within the agricultural sector is a strategic action towards adding value to the great exported volume allowing economic growth while boosting development and social welfare. Using Welfare Economics as a theoretical background, this study analyzes the socio-economic gains resulted from the biodiesel production chain, their distribution in regional and individual terms and the role of this industry as a driver to increase social welfare in Argentina. The recent development of the biodiesel industry has contributed to a general improvement of the society’s welfare adding an extra value to the great existing volume of soybean oil, by an average of USD 94 per produced ton in 2010. Moreover, although it is not a labor intensive industry, it has also contributed to the reduction of the unemployment rate creating direct and indirect job positions. While the big-scale biodiesel industries are mainly export-oriented the state has guaranteed market to the small-scale actors through local consumption quotas, however until now there is no redistribution scheme towards the geographical deconcentration of the income.
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1. Introduction

1.1 Background to the Problem

The global adoption of biodiesel as a diesel fuel replacement brought a new level of complexity in the social, economical, environmental and political discussions. While this new strategy contributes towards mitigating climate change, it is at the same time raising different socioeconomic implications among nations (Khanna et al. 2010). In this sense, as shown in Figure 1, the UN-ECLAC suggested a number of elements in order to assess the contribution of biofuels to the sustainable development in Latin American and Caribbean countries. The idea behind this is to include human beings as active actors and last objectives of sustainable development (Pistonesi et al. 2008).

![Figure 1 | Social, Economical and Environmental elements for assessing biofuels adoption policies | Source: Pistonesi et al. 2008, p. 48](image)

The adoption of biodiesel becomes crucial in order to achieve the Kyoto Protocol goals considering that up to 40% of the liquid fossil fuels contribute to 37% of GHG emissions (Demirbas 2008; IEA 2010; IEA Data Services 2010). Hence several countries in the World have set biodiesel blending targets for their transportation fuels contributing to an increasing demand while they have also promoted the development of their own industries (Khanna et al. 2010).

Between 2005 and 2010 the biodiesel global market grew at an annual average rate of 34% with a total increase of about 408%. In 2010 the global market of biodiesel totalized 22,5 million tons while forecast for 2020 expect to double the size of the market (see Figure 2). This increase will be mainly covered by first-
generation biodiesel while the development of second-generation\textsuperscript{1} feedstocks is likely to double its participation by 2020 reaching 22\% of total production in order to minimize the impact on food prices (OECD-FAO 2011).

![Figure 2 | Biodiesel production, trade and price trends | Source: author based on OECD-FAO 2011]

In 2010 the EU represented 39\% of the global market being one of the main drivers of the demand of biodiesel. The fact that the EU is the most important diesel consumer and has already established a biodiesel adoption policy were the main elements of this process (Gilberston et al. 2007; IEA Data Services 2010; OECD-FAO 2011). In 2003 the EC implemented a diesel blending scheme\textsuperscript{2} to secure the energy supply and to reduce GHG emissions\textsuperscript{3}. This initiative was the base for the creation of the main market of biodiesel promoting the global development of this industry (Gilberston et al. 2007; IEA Data Services 2010). Estimations made by the OECD and the FAO state that by 2020 the EU is expected to increase its market share up to 45\% (OECD-FAO 2011).

Although in the last years there was a significant growth of the biodiesel industry within the EU-member countries, the installed capacity is being highly underused except in France. With an average idle capacity of about 60\% the sector is lobbying towards an expansion of the local biodiesel blending percentage, a change in the tax guidelines while also opposing to the fiscal incentives that Argentinean has for this industry (CADER 2011; UFOP 2010). Moreover the US biodiesel industry has

\footnotesize{\textsuperscript{1} It refers to those biofuels based on residues or non-food biomass as a source of feedstock, avoiding also land use competition with food crops. On the other hand, first-generation biofuels use biomass extracted from food crops (Gonzáles 2008).

\textsuperscript{2} An up to date blending percentage adopted by each EU country is presented in the Appendix

\textsuperscript{3} The EC directive RED 2009/28 set up a minimum reduction for the use of biofuels of 35\% of GHG emissions by 2011, 50\% by 2017 and 60\% by 2018 (EU 2010; EU 2010a).}
being experiencing an inconsistent incentive policy that together with dumping accusations from the EU are deteriorating the local industry (EBB 2010). Brazil is the third most important biodiesel producer however its industry is entirely dedicated to supply the local market. On the other hand, its productive and trade infrastructure are not adequate enough to consider Brazil an important competitor in the global market in the short term (Barros 2010; CADER 2011).

Other countries like Indonesia, Malaysia, India, China and Nigeria are major producers of biodiesel raw materials like palm, rapeseed, sunflower and coconuts (FAOSTAT 2011). However Indonesia, Malaysia and Nigeria are only further developing the biodiesel industries based mainly on palm oil. At the moment these countries are struggling to increase their participation in the global market shares due to 2008 economic crisis that negatively affected the price of palm. Moreover together with different policy inconsistencies, a global negative perspective on the usage of palm oil, based on the social elements and the vast deforestation are also affecting these countries (Abila 2010; CADER 2011; Lacey 2011; Oniemola & Sanusi 2009; Schott 2009; Zhou & Thomson 2009).

Due to the vast stock and productivity of its natural resources, Argentina has a leading role in the global agricultural market being by 2008 the eleventh producer and third exporter (FAOSTAT 2011; WWF 2010). Representing the main economic activity of the country, primary production and processing industries in the agricultural sector contribute with 20% of total GDP, 55% of total exports while directly employ 11% of the economically active population (Anlló, Bisang, Salvatierra 2010; PNUD 2010; PROARGEX 2010). However Argentina mainly exports low-added value products as the agricultural production chain is characterized by a low level of industrialization of its primary production. In fact, only 20% of the agricultural exported volume is represented by industrialized final products, around 40% of the exports are grains while the remainder 40% accounts for manufactured non-final products that are exported to be manufactured and traded in destiny (Casini 2010; Kosacoff & Mercado 2009). Together with a competitive production⁴ and the increasing global demand of biodiesel mainly

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⁴ Considering the availability and proximity of feedstocks, the coastal position of the industry and the relative low production cost compared to the top-ten manufacturers (see Appendix for the top-ten list of production costs)
from the EU-member states, this industry is rapidly expanding since 2007 (Mathews & Goldsztein 2008).

Despite of the positive socio-economic performance that Argentina is going through after the crisis in 2001-2002, different reports still show a severe unequal welfare distribution in individual and geographical terms (CNCPS 2010; PNUD 2010). Therefore the promotion of the biodiesel industry represents an opportunity to add value to the vast and competitive export oriented soybean and soybean oil production (Chidiak & Stanley 2009). Based on the institutional structures and the legal and regulatory frameworks the value added by the industrialization process could be distributed among the society (Pistonesi et al. 2008).

In spite of the recommendation of UN-ECLAC to include social, economical and environmental elements in the biodiesel policy making process, most of the scientific research has been directed towards environmental aspects. However several studies recently published contemplate socio-economical issues in the research line. For instance, Schaffel & Lèbre La Rovere (2010) compare the applicability of an eco-social efficiency standard in the case of Brazilian biodiesel and bioethanol production. Findings suggest that only the Brazilian National Biodiesel Production and Use Program considers social elements through a Social Fuel Stamp that includes small-size or family farms as providers of castor or palm oil. Yet the Bioethanol Program still lacks of recognizable social elements. Despite of the difficulties on the implementation together with the pressure of the international demand that encourages intensive and efficient farming and processing industries, it is concluded that the social stamp can still succeed.

The study of da Silva César & Batalha (2010) analyses the challenges on the implementation of the Social Fuel Stamp in the Brazilian National Biodiesel Production and Use Program. By means of an exploratory and qualitative methodology the authors identified the main problems faced by the farmers and the industries conveying several suggestions and solutions. The authors conclude that the biodiesel production based on castor oil is impracticable in the short term.

A third study on the Brazilian production of bioenergy by Hall et al. (2009) compares the bioethanol and the biodiesel industries in terms of social exclusion. The case study compares an established, concentrated and large-scale bioethanol
industry with an emerging, dispersed and of various sizes biodiesel industry shaped by the government to include small farmers in the production chain. The main conclusions are similar to the previous papers on the Social Fuel Stamp. This attempt is beneficial despite its vulnerability to the international market pressure, while the certification is inefficient from a conventional economic point of view.

Finally, van der Horst & Vermeylen (2010) point out social implications arising from the development of biofuels industries. They conduct their research in three different scenarios: developed and developing countries with a self-sufficient market of biofuels and the case of international trade from developing to developed countries. The discussion is based on a literature review adopting environmental economic definitions to analyze whether negative implications are inherent characters of biofuels policies. The conclusion is that only through certifications of the supply chain together with an innovative social oriented policy-making process and strict regulations may result in ethical and green biofuels. The study also highlights the role of developed countries as importers in the biofuel markets increasing their economic availability by paying a higher price in order to compensate social certification for biofuels.

1.2 Problem

In view of the dimension of its agricultural production, the biodiesel development policies adopted and the increasing global demand, Argentina became in the last years an important actor of the biodiesel market. The industrialization of the primary production within the agricultural sector is a strategic action towards adding value to the great exported volume allowing economic growth while boosting development and social welfare\(^5\). In this context, the question that arises is how the creation and distribution of welfare originated from the biodiesel production chain is taking place.

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\(^5\) Social welfare refers to the state’s provision of education, health, housing and social assistance to protect and promote the economic and social well-being of its citizens. This is based under criteria of equality of opportunities, distribution of wealth and public responsibility for those unable to avail themselves of minimal conditions for a reasonable living standard (Kwok 2004).
1.3 Aim
This thesis has two main objectives:

- To analyze the socio-economic gains resulted from the biodiesel production chain and their distribution in regional and individual terms.
- To analyze the biodiesel production chain development as a driver to increase social welfare in Argentina.

1.4 Method
This study is based in Welfare Economics, assuming Pareto efficiency as a guideline to empirically analyze and discuss the creation and distribution of welfare derived from the production of biodiesel in Argentina. The empirical method applies literature review and figures from official statistics on socioeconomic indicators and the development of the biodiesel production chain.

1.5 Scope and Limitations
This study only concentrates in the biodiesel big-scale industry and not in the small-scale projects for self-consumption. Even though the biodiesel may be produced from different feedstocks, this thesis only considers the one based on soybean oil considering that is the only feedstock used in the big-scale industry.

1.6 Disposition
The background of the problem is introduced providing a global perspective as a base to understand the local implications arising from the main international driver forces. Chapter 2 presents the theoretical conditions to be used as guidelines in the empirical analysis. The empirical analysis is introduced by a description of the main socioeconomic indicators and a description of the biodiesel production chain in Argentina. This is followed by a discussion based on the aim of this thesis to finally bring the main ideas to the conclusion.
2. Theoretical Framework

Welfare Economics deals with the optimal allocation of resources as a mean to reach the maximum individual well-being in a society (Just, Hueth & Schmitz 2004). Welfare judgements require comparisons between sets of allocation to decide whether one allocation is better than or equally good as another one. The most widely used criterion for evaluating resource allocation is the *Pareto principle* that embodies a set of assumptions on value judgements. Under the *Pareto efficiency* criteria the assumption of *individualism* refers to the effects of an allocation on the individuals in a society. It also assumes *non-paternalism* meaning that individuals are the best judges of their own welfare and *benevolence* in where an increase in the utility of one individual is judged to be an improvement. The criteria restricts however attention on the process by which a particular allocation is achieved, that is, it assumes *process independence* (Gravelle & Rees 1992).

The Pareto principle establishes that a change from one state of the economy to another is desirable only if all members of the society are made better off, that is the *strong Pareto principle*. The *weak Pareto principle* refers to the situation when at least one individual is made better off without making anyone else worse off. The transition from one state to another is done through *Pareto improvements* until the *Pareto optimum* is reached in where there is none possibility of additional progress. Even though a society could achieve this optimal state it does not necessarily implies a fair and equitable income distribution among individuals. In other words any policy implementation can bring heterogenic effects among individuals in a society (Johansson 1991).

Therefore the *compensation principle* involves the idea that those individuals experiencing positive effects could compensate those ones suffering negative consequences (Johansson 1991). The principle applies not only when gainers actually compensate losers but also considering a potential compensation as a way to evaluate net benefits from a policy change representing a Pareto improvement (Johansson 1991; Just, Hueth & Schmitz 2004).

For a given allocation of resources, utility levels represent the welfare status of an individual in a society. An allocation $A$ describes the use of resources in an economy including consumption bundles, input supply, input use and output mix. Pareto efficiency implies that given the existing technology and endowments in an
economy there is no other feasible allocation making some individual better off and none individual worse off. Figure 3 presents different allocation sets generating different utility combinations on the utility frontier by maximizing $u_1$ subject to $u_2 \geq \bar{u}_2$ for different values of $\bar{u}_2$. The combinations on the utility frontier, $a_1$ and $a_2$, are Pareto efficient while the combination inside the frontier $a_0$ is Pareto inefficient. Hence the allocations $a_1$ and $a_2$ are said to be Pareto superior to allocation $a_0$ if those generate at least as much utility for all individuals as $a_0$ (Gravelle & Rees 1992).

Figure 3 | Utility frontier and Paretian social welfare functions | Source: Johansson 1991, page 73

Pareto superiority is an intuitive criterion for ranking allocations. However the criterion does not generate a complete ordering of allocations. For instance, the allocation sets $a_1$ and $a_2$ are Pareto efficient but nothing can be said about their superiority. A welfare preference ordering can be used to rank all alternative allocations. The preference ordering states that an optimal allocation is also a feasible allocation for which none other feasible allocation can be higher ranked. Social welfare functions are then defined as the allocation that maximizes $W$ over the set of feasible allocations. The assumption of process independence implies that the domain of a welfare function denotes the set of allocations already made. Other value judgments such as individualism and non-paternalism allow the representation of social welfare based on individuals’ own utility arising from their consumption bundles and input supply. A Paretian social welfare function embodies value judgments. While a Pareto optimal allocation maximizes a Paretian social welfare function subject to production and material balance constraints,
involving the assumptions of non-satiation and positive marginal products. In Figure 3, feasible utility combinations are those on or inside the utility frontier. The Paretian social welfare functions are represented by $W_1$ and $W_2$. Benevolence implies that the welfare functions are negatively sloped and that higher indifference curves correspond to higher welfare. According to Figure 3, welfare is maximized by $(a_1,W_1)$ over a set of feasible utility combinations on the utility frontier. Allocation $a_1$ is a Pareto optimal allocation.

A competitive market in equilibrium is Pareto efficient. This situation referred as the First Theorem of Welfare Economics, which implies no market intervention. Individual choices are guided by market prices and the fact that all decision makers face the same relative prices means that in equilibrium they all place the same relative valuation on goods and inputs thereby no reallocation of goods and inputs can achieve a Pareto improvement. All gains from mutually advantageous trade at the equilibrium prices have been exhausted.

However, the Second Theorem of Welfare Economics states that before allowing any Pareto efficient allocation a suitable redistribution of initial endowments towards social equity is desired. Under certain circumstances it may be possible to resolve the conflict between efficiency and equity by governmental intervention by redistributing initial endowments among individuals and then letting the market allocate resources efficiently. Therefore by transferring shareholdings between individuals and letting them trade in competitive markets the welfare optimum can be shifted. In this way issues of efficiency, distribution and fairness can be separated (Gravelle & Rees 1992; Just, Hueth & Schmitz 2004).
3. Empirical Analysis

After the socio-economic crisis in 2001-2002 that included the devaluation of the local currency, peso ($), Argentina has been going through a positive performance characterized by a steady economic growth. The socio-economic indicators presented in Table 1 show that after the crisis Argentina went through a normalization process of its socio-economic system overcoming the performance of the best pre-crisis year, 1998 (Kosacoff 2007).

Mainly by a reindustrialization export oriented process in a trade surplus context, between 2003 and 2010 the annual average growth rate of the real GDP reached 7.6% totalizing an increase of 79.5%. This was achieved in a welfare redistribution context with a consequent reduction in comparison with both the post and pre-crisis situations of poverty, unemployment and inequality indicators (BCRA 2011, CEPAL 2011a; INDEC 2011; Kosacoff 2007; Kosacoff 2010).

However this process went by an inflationary context that totalized 143% of price’s increases threading it sustainability mainly due to the high uncertainty for new investments and the loose of competitiveness (Kosacoff 2007).

Table 1 | Main social and economic indicators | Source: author, based on CENDA 2011; CIFRA-CTA 2011; INDEC 2011; MEFP 2011

<table>
<thead>
<tr>
<th>1998</th>
<th>2002</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDP at constant prices (US$)</td>
<td>$299 billion</td>
<td>$104 billion</td>
</tr>
<tr>
<td>GDP per capita (US$)</td>
<td>$8.279</td>
<td>$2.738</td>
</tr>
<tr>
<td>External debt/GDP (%)</td>
<td>38%</td>
<td>166%</td>
</tr>
<tr>
<td>Total exports (US$)</td>
<td>$26 billion</td>
<td>$25 billion</td>
</tr>
<tr>
<td>Manufactured exports in US$ (%)</td>
<td>51%</td>
<td>41%</td>
</tr>
<tr>
<td>Manufactured exports in quantity (%)</td>
<td>47%</td>
<td>49%</td>
</tr>
<tr>
<td>Unemployment (%)</td>
<td>13.7%</td>
<td>19.7%</td>
</tr>
<tr>
<td>Inflation rate (%)</td>
<td>0.2%</td>
<td>26%</td>
</tr>
<tr>
<td>Average real salary (1998=100)</td>
<td>100</td>
<td>83</td>
</tr>
<tr>
<td>Salaries/GDP (%)</td>
<td>37%</td>
<td>31%</td>
</tr>
<tr>
<td>Urban poverty (%)</td>
<td>25%</td>
<td>58%</td>
</tr>
<tr>
<td>Gini index</td>
<td>0.502</td>
<td>0.533</td>
</tr>
<tr>
<td>Gap between 10% richer and 10% poorer</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The post-crisis years were characterized by an active presence of the state with an aggregated social investment that totaled 28% of the GDP in 2009, a record

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6 In January 2002 the executive branch of the government acquire extraordinary authorities to implement policies on behalf of the National Law 25.561 that declared the public emergency in social, economical, administrative, financial and currency exchange issues. Although this law expired in December 2003 it was extended until December 2011 by the National Law 26.204 (National Law 25.561/2002; National Law 26.204/2009).
amount since 1980 (CNCPS 2010). Also the promotion and implementation of new policies regarding a variety of relevant issues were sanctioned. For instance, concerning social policies, in 2009 the government launched a social program (AUH) for citizens under 18 years in socially excluded families conditionally to the completion of the educational and the health programs. Considering that 70% of the households covered by this program belong to the 20% poorer population the inequality, poverty and extreme poverty indexes experienced a reduction of 3%, 30% and 53% respectively. This was done with an investment of 0,9% of the GDP covering 9% of total population and represents the most important social investment program in Latin America (Agis, Cañete, Panigo 2010; ANSES 2010; ANSES 2010a; Neri et al. 2010).

Despite of the historical political and economical instability⁸, long term plans are also being promoted like the Agri-food and Agri-industrial Participative and Federal Plan (PEA²) and the recently launched 2020 Strategic Industrial Plan (PEI 2020). While the first one aims to increase the milk, meet and grain production by an average of 50% the latter pretends to double the industrial domestic product and exports by 2020 (CEPAL 2011; MAGyP 2011; Romero 2002).

In spite of the positive socio-economic trend, Argentina is essentially a very unequal country in individual and geographical terms as it is presented in the 2010 UNDP National Human Development Report and the Argentina Millennium Development Goals Report 2010 (CNCPS 2010; PNUD 2010). According to the UNDP, Argentina is ranked as the 56th country in the World in terms of income per capita. However when it comes to welfare distribution, Argentina is ranked⁹ as the 122nd country in the World in terms of equality (UNDP 2011). Regarding geographic distribution, while Buenos Aires City showed in 2010 a HDI of 0,764, Formosa, a province in the North East region presents only a HDI of 0,677. Also

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⁷ It includes education, culture, science and technique; health; drinkable water and sewer system; housing and urbanism; social promotion and assistance; social pensions; employment and Other urban services.

⁸ Since 1950 Argentina suffered 5 different economic crises that together lasted 13 years and 4 different dictatorships that totalized 15 years (PNUD 2010; Romero 2002).

⁹ It considers a built index that includes two different elements weighted by 50% each: Income Gini Coefficient and the IHDI - loss due to inequality in income. The HDI is an average of human development achievements in three basic dimensions: health, education and income. When it is adjusted following the distribution among the citizens it is called IHDI (UNDP 2011a).
those provinces with the lower HDI are as well indicating a higher inequality within their population (PNUD 2010).

As it was mentioned, the agricultural sector and its processing industries represent an important activity for Argentina in socio-economic terms. However due to the low industrialization, Argentina had by 2008 the lowest average export value (452 US$/tn) over the top ten agricultural exporters that had an average export value of 1,026 US$/tn. On the other hand Belgium, the tenth most important exporter, traded with an average value of 1.494 US$/tn. (Anlló, Bisang, Salvatierra 2010; FAOSTAT 2011; Kosacoff & Mercado 2009; PNUD 2010; PROARGEX 2010).

Industrial production of biodiesel in Argentina is almost totally manufactured using soybean oil as a feedstock. Soybean production does not receive any governmental subsidy implying market competitiveness (Tomei & Upham 2009). However soybean oil and biodiesel industries are benefited by a cross subsidy represented by differentials and decreasing export tariffs for soybean, soybean oil and biodiesel (Daziano & Senesi 2011; Nardi et al. 2008). As it is seen in Table 2, along the value chain the export tariff decreases representing an economic incentive for local industrialization (Garriga & Rosales 2008).

<table>
<thead>
<tr>
<th>International price (US$/tn)</th>
<th>Export tariff</th>
<th>Local price (US$/tn)</th>
<th>Fiscal revenue (US$/tn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>soybean</td>
<td>$ 409</td>
<td>35%</td>
<td>$ 266</td>
</tr>
<tr>
<td>soybean oil</td>
<td>$ 914</td>
<td>32%</td>
<td>$ 622</td>
</tr>
<tr>
<td>soybean oil by-products</td>
<td>$ 343</td>
<td>32%</td>
<td>$ 233</td>
</tr>
<tr>
<td>biodiesel</td>
<td>$ 896</td>
<td>14,1%</td>
<td>$ 770</td>
</tr>
</tbody>
</table>

Table 2 | January – December 2010 average international prices, export tariffs, local prices and fiscal revenues for soybean, soybean oil, soybean oil by-products and biodiesel | Source: author based on SIIA 2011

The implementation of export tariffs for the soybean chain was put into practice in 2002 to increase the fiscal revenues and reduce the local price of food after the devaluation of the Argentinean currency (Resolution 11/2002). During the last years the fiscal policy has been directed to further sustain and even increase these tariffs\(^\text{10}\). On the other hand the biodiesel export tariff was implemented in 2007 by 5% and it was raised in 2008 up to 14,1% (Resolution 126/2008).

\(^{10}\) In March 2008 the implementation of a mobile export tariffs scheme dependent on the international price of the commodities generated a great political conflict between the farmers and the government, finally in July 2008 this scheme was abolished by the Congress (Barsky & Davila 2008; Tomei & Upham 2009).
Despite of the negative effect in the farmers, the soybean oil and the biodiesel industries incomes, this measure does not implies unprofitability while represents an incentive to locally add extra-value to the primary production. It is also a welfare distribution strategy through the redistribution of the fiscal revenues and the reduction in the domestic prices of soybean products that are then transferred to consumers in the agri-food chain (Garriga & Rosales 2008; Tomei & Upham 2009).

In this sense, in 2009 the government implemented a welfare distribution scheme, called Solidarity Federal Fund (Fondo Federal Solidario), based on the export tariffs revenues derived from the soybean production chain. By this 30% of these revenues are distributed among the provinces to be invested in sanitary, health, educational, housing and roads infrastructures in rural or urban areas. Each province may expend up to 70% of the funds while they are forced to redistribute at least 30% among the municipalities (Decree 206/2009).

Argentina became part of the biodiesel market in 2006\textsuperscript{11} when the regulation and promotion regime for the production and use of biodiesel was applied by the National Law 26.093\textsuperscript{12}. By this, significant tax exemptions for a period of 15 years were established while the implementation of consumption quotas to blend with fossil diesel created the domestic market (Lamers, McCormick, Hilbert 2008; Mathews & Goldsztein 2008). Since then the investment in the biodiesel industrial infrastructure reached more than US$ 700 million, while there were recently announced investments in the order of US$ 60 million to set up the sodium methylate industry, an input used in the biodiesel production process (CARBIO 2011; La Capital 2011).

The blending scheme entered into force in January 2010 by adding 5% of biodiesel to the fossil diesel (B5). In September 2010 the blending percentage rose up to 7% (B7) and in 2012 the proportion is expected to increase again up to 10% (B10). Taken measures are expected to achieve targets on GHG-emissions in accordance with the Kyoto Protocol but also to replace the increasing imports of diesel fuel by

\textsuperscript{11} After ratifying the Kyoto Protocol by the National Law 25.438 in 2001, the Environmental Policy and Sustainable Development Secretary created the National Bioenergy Program in order to achieve the protocol goals (National Law 25.438/2001; National Law 26.093/2006).

\textsuperscript{12} This law also includes a regime to promote the production and use of ethanol and biogas (National Law 26.093/2006).
locally produced biodiesel (Lamers, McCormick, Hilbert 2008; Mathews & Goldsztein 2008; Resolution 828/2010).

During 2010 the biodiesel industry exported US$ 1.358 million, representing 2% of the total traded amount. While 96% of the 1.3 million tons exported were sent to the EU-member countries the local consumption reached 508.275 tons. However with the fully enforcement of the local quotas and the implementation of the GENREN program the domestic market is expected to raise up to 1,2 million tons in the following years (CADER 2011; INDEC 2011; Resolution 554/2010).

All through 2010 the biodiesel industry added value to the soybean oil industry by around US$ 94 per produced ton as it could be seen and compared with previous years in Table 3. As a result this industry contributed to the Argentinean gross production value by around US$ 170 millions. However this was only possible through the implemented cross subsidy and had a fiscal cost that totaled US$ 309 millions. In fact during this year the biodiesel industry was profitable only due to the taxes exemptions and the cross subsidy as the soybean oil’s price, that represents around 80% of the production cost, was US$ 18 higher than the biodiesel’s price (Daziano et al. 2008; Demirbas 2008; Molina 2008).

<table>
<thead>
<tr>
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<tr>
<td>2007</td>
<td>$ 774</td>
<td>24%</td>
<td>$ 588</td>
<td>$ 79</td>
<td>$ 828</td>
<td>5%</td>
<td>$ 787</td>
<td>-148</td>
<td>$ 119</td>
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<td>2008</td>
<td>$ 1.111</td>
<td>32%</td>
<td>$ 755</td>
<td>$ 87</td>
<td>$ 1.182</td>
<td>14%</td>
<td>$ 1.015</td>
<td>-196</td>
<td>$ 173</td>
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<tr>
<td>2009</td>
<td>$ 773</td>
<td>32%</td>
<td>$ 526</td>
<td>$ 49</td>
<td>$ 784</td>
<td>14%</td>
<td>$ 673</td>
<td>-142</td>
<td>$ 99</td>
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<tr>
<td>2010</td>
<td>$ 914</td>
<td>32%</td>
<td>$ 622</td>
<td>$ 54</td>
<td>$ 896</td>
<td>14%</td>
<td>$ 770</td>
<td>-172</td>
<td>$ 94</td>
</tr>
</tbody>
</table>

Table 3 | Local average prices during the last four years for soybean oil, other inputs for biodiesel production and biodiesel and the fiscal cost and the value added resulted | Source: author based on Daziano et al. 2008; INDEC 2011; SIIA 2011

Regarding labor demand, the entire biodiesel chain engaged only 0.3% of the 2010 economically active population, reaching about 51.700 people as the number of employments. Around 1.100 of these employments directly corresponds to the biodiesel industry (Bisang & Sztulwark 2007; Chidiak & Stanley 2009; INDEC 2011a; Mazany 2011; Peirone 2011).

13 This National program uses biodiesel and other renewable sources of energy to generate electricity.
14 It represents the money that the state did not collect due to the industrialization of the soybean oil that it is charged with a higher export tax than the biodiesel.
15 It considers those workers involved in the biodiesel industry and the proportion of workers from the soybean and soybean oil industries that correspond to the amount of feedstock used for the 2010 biodiesel production.
In order to provide an overview of the sectors integrating the biodiesel production chain: the soybean, soybean oil and biodiesel production are separately presented in the following sections.

3.1 Soybean Production

Soybean production reached 53 million tons in 2010, representing 56% of total agricultural production. Since 1980 this production has significantly increased by 1405% leading Argentina to be nowadays the third biggest producer and exporter of soybean in the global market (FAOSTAT 2011; SIIA 2011). However 85% of this augment happened since 1996\textsuperscript{16} due to the adoption of the RR soybean\textsuperscript{17} in a context of lack of governmental intervention and policy regulations that allowed markets forces to act as drivers in the agricultural development (Tomei & Upham 2009).

Driven by the RR-technology, farmers have adopted new innovations and technologies together with equipment, production inputs and new agricultural and managerial practices reinforcing market competitiveness and production efficiency (Bisang & Sztulwark 2007). This process has statistically shown steady and increasing yields at higher annual rates, 43% greater compared to the previous years before 1996\textsuperscript{18} (SIIA 2011). Despite of the inclusion of the soybean RR-technology is a break point in the last thirty years of Argentinean agriculture as it is shown in Figure 4, the technological adoption process cover all grain and oilseeds crops (Bisang & Sztulwark 2007).

\textsuperscript{16} Since 1996 the soybean production has been annually increasing by 2,624,389 tons while the grown area did the same by 945,717 ha per year, these increases are 332% and 235% respectively bigger than before the RR technology adoption, the complete statistical analysis is available in the Appendix (SIIA 2011).

\textsuperscript{17} After fourteen years since the adoption of the GMO RR-soybean different implicaions both positive and negative, were approached by many authors, a list of advance readings, in Spanish and English, is suggested in the Appendix

\textsuperscript{18} Complete analysis is available in the Appendix
The RR-technology adoption process brought higher prices of land reaching a total increase of about 235% with a yearly boost of 615 US$ per ha while at the same moment the soybean production costs went through a reduction of 23% (SIIA 2011). In this context where higher investments are needed new investors are emerging with a high degree of concentration of the production and a biased distribution at a national level (Giancola et al. 2009; Lousteau 2008).

Therefore while the number of farms considering all kind of activities decreased by 43% between 1988 and 2008 soybean farmer’s productive structure reveals an unequal distribution as it is shown in Figure 5. Taking into consideration the 78,500 farmers that grow soybean in Argentina just 2% of them concentrate about 50% of the total amount produced (INDEC 2011; Lousteau 2008).
In terms of geographic distribution the soybean production is highly concentrated around Rosario city\(^{19}\) in Santa Fe province, where almost all the processing industries and a great number of harbors are situated. In fact 300 km\(^{2}\) around this city concentrates 56% of the national production, an amount that represents 75% of the addition of the exported soybean and the grain equivalent of the exported soybean oil and biodiesel (Gramicci 2011; SIIA 2011).

### 3.2 Soybean Oil Production

Argentina has a modern and competitive export oriented soybean oil industry being the fourth bigger producer and the main exporter of this commodity (Andreani 2008; Oliverio & López 2010). Jointly with China, Brazil and United States produce almost 80% of the World supply (Caparella 2010; FAOSTAT 2011). Together with a great amount of available feedstock Argentina also has a favorable geographical location to export soybean oil to the main markets, the Chinese and the Indian. This industry is characterized by having only 43 mills with an average crushing capacity of 3,487 and a maximum of 20,000 tons per day. Over the top four countries of this market Argentina has the smallest number of mills and with the highest crushing capacity per day (Andreani 2008; Oliverio & López 2010).

There is a high degree of concentration within the industry. The leading companies: Bunge, Cargill, Molinos Río de la Plata, Vicentin, Louis Dreyfus and AGD produce in only 18 mills 90% of the soybean oil production. Due to the high crushing capacity these companies operate at relative low processing costs allowing international competitiveness (Andreani 2008; CIARACEC 2011). In addition, the operational capacity, the production and the exports of soybean oil are also very much geographically concentrated: 86%, 95% and 94% respectively are located around Rosario city, Santa Fe province (Andreani 2008; SIIA 2011).

Although this industry is clearly export oriented, due to the local demand of soybean oil for biodiesel production since 2007 a reduction\(^{20}\) in the exported volume has been experienced as it can be seen in Figure 6 (SIIA 2011).

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\(^{19}\) A map is available in the Appendix

\(^{20}\) Although in 2010 Argentina has consumed a record amount of soybean oil to produce biodiesel, it is important to mention that also suffered severe commercial conflicts with China, the main importer of soybean oil. Because of this during 2010 Argentina exported to China only 12% of the volume exported in 2009 (SIIA 2011).
3.3 Biodiesel Production

Since 2006, when the promotion and regulation regime for biofuels was approved providing fiscal and market incentives, the biodiesel production capacity raised from 130,000 tons up to 2.4 million tons in 2010 (see Figure 7).

The construction of three new biodiesel plants is already announced, by this in 2011 the operational capacity is expected to increase by almost 600,000 tons and the average annual production per plant will raise 11%. Around 30 new plants are projected to be built, with these new investments the established operational capacity is expected to double (CADER 2011; Carballo et al. 2009).
Argentina became the fourth most important manufacturer in the international market after Germany, France and Brazil and the first exporter in 2010. A production of 1.8 million tons, 54% higher than the obtained in 2009, was obtained using 73% of the operational capacity (CADER 2011; INDEC 2011a; Kantor 2011).

Together with the soybean oil industry, the biodiesel industry is highly concentrated in a small region in the province of Santa Fe that presents 75% of the operational capacity. The international competitiveness of the biodiesel industry depends on the already mentioned cross subsidy that this industry is benefited with, the size of the plants and the regional concentration of raw materials suppliers (Andreani 2008; CADER 2011).

The biodiesel industry consists of small-size independent companies, big-size independent companies and big-size soybean oil companies, the latter usually combine both production processes in one industry and no transportation is needed. The small-size independent companies, with an average production capacity of 35,600 tons per year, are oriented on the domestic market while the other companies are principally export oriented with an average production capacity of about 200,000 tons per year (CADER 2011).

As mentioned before, in 2010 the exported volume totalized 1.3 million tons for which most of it went to the EU-member states. For 2011, an increase of about 19% in the exported volume is expected to occur despite of a non-tariff barrier recently established by the EC. The domestic market demand will expand in the following years based on the fully completion of the local quotas, the implementation of the already mentioned GENREN program, an increasing consumption of fuels associated with economic growth and a raise of the diesel blending percentage. However, the main attraction for the development of this industry are the external markets, mainly the EU (EU 2010; EU 2010a; Hilbert et al. 2010; Joseph 2010; Lamers, McCormick, Hilbert 2008).

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21 The EC normative RED 2009/28 imposes for the consumption of biofuels a minimum reduction of GHG by 35% while it also set up a default value for biodiesel based on soybean by 31% establishing a non-tariff barrier. Therefore the National Bioenergy Program presented a study based on local conditions before the EC showing results that Argentinean biodiesel reduce 70% of GHG emissions accomplishing not only the EU 2011 target but also the one set by 2018 (Demirbas 2008; EU 2010; EU 2010a; Faaij & Domac 2006; Hilbert et al. 2010).
4. Discussion

A general increase in the individual well-being of the Argentinean society has happened since the last socio-economic crisis in 2001-2002. This was achieved not only by the performance of many economic sectors but especially by the role that the state had in the promotion, regulation and redistribution of the income. Regarding the role that the recent development of the biodiesel industry had in the improvement of the society’s welfare, an extra value to the great existing volume of soybean oil has been added, as it was mentioned by an average of USD 94 per produced ton in 2010. Moreover, although it is not a labor intensive industry, it has also contributed to the reduction of the unemployment rate creating direct and indirect job positions. Also by adding one extra processing step to the soybean oil production without needing great amount of imports this industry is contributing to sustain the existing trade surplus, which is essential for an export oriented economy. In fact the balance of trade of this industry will even improve in the next years as there were announced investments for developing the sodium methylate industry in Argentina, an input for the biodiesel production process that is nowadays being imported.

However this development process was possible only due to a great fiscal investment represented by a cross subsidy that reaches 172 USD per ton in 2010 allowing the industry to be profitable. Therefore Argentina is showing a clear intention in developing this industry that is in many cases around the World being subsidized. Nonetheless considering that the soybean oil price is experiencing a great volatility and the biodiesel price is extremely linked to it, the amount of subsidies to assure profitability could vary intensively.

In this sense, a research conducted by Wassell and Dittmer (2006) argued that subsidization of biodiesel production is a necessary measure in order to equilibrate it production cost with fossil diesel. The authors also conclude that subsidizing biodiesel is economically efficient because the external benefits that the use of biodiesel entails in terms of environmental impact reduction are in monetary terms higher than the cost of the subsidies.

Together with the intention of industrializing the great amount of agricultural production, Argentina has commit in 2001 with the Kyoto Protocol goals by the
National Law 25.438 while also needs to secure an increasing supply of energy to guarantee industrial development and economic growth.

Biodiesel global market forecasts show that while the production is expected to grow the external trade will decrease from 10% to 7% of the volume in the following ten years. In view of the export-oriented role that Argentina has, further development of the local market seems indispensable to take the most of the great fiscal cost that this industry entails.

Nogueira (2010) concluded in his article “Does biodiesel make sense?” that the rationality of biodiesel production is based on the selection of an effective production system. In this sense taking into account the high concentration of soybean, soybean oil and biodiesel production around Rosario city the local biodiesel production chain could be defined as a rational production system considering this aspect.

Although the concentration of the production is necessary to allow efficient industries it is not desirable for the distribution of the income, both in individual and geographical terms. Therefore due to the imperfect market conditions the government implemented a redistribution scheme towards social equity based on the tax revenues collected from the export tariffs of soybean and soybean oil among all provinces as an attempt to deconcentrate the income. However at the moment the soybean industry has not been included in this distribution scheme.

The great demand of soybean in the last decades nowadays partly represented by the biodiesel industry shaped a large-scale capital intensive agriculture that brought a great unequal distribution of the production among farmers. In fact due to the high increase in the price of land a radical change in the type of the economic actors involved in the soybean production took place. Regarding this imperfect market conditions no measures have been adopted at the moment.

Although as it was mentioned this sector is export oriented and characterized by big scale industries Argentinean government has allocated in the small number of mid size industries the local consumption quota as a mean to protect them from the international competition.
5. Conclusions

Argentina has based its recent economical recovery in a reindustrialization export oriented process obtaining revenues resulted from the international trade. With the recuperation and reestablishment of the state intervention capacity the government has been implementing a set of measures towards the improvement of social welfare and equality.

The development and expansion of the biodiesel industry has provided socio-economic benefits contributing to the general socio-economic recuperation. By adding one processing step to the vast soybean oil production this process has resulted in a higher value of the production while has also slightly contributed towards increasing job opportunities. Moreover, following the soybean and soybean oil regional distribution, the biodiesel industry is highly concentrated in regional terms. However this expansion process has happened in a strong subsidization context to sustain and even to maintain the sector profitable.

The soybean and the soybean oil sectors were originally developed in a liberalism context during the nineties following the First Theorem of Welfare Economics, which implies no market intervention. However at the moment the state has not take measures regarding any kind of reallocation of the benefits towards an improvement of society’s welfare.

On the other hand the biodiesel industry is being developed since 2006 in a context where a set of intervenes like tax exemptions, export tariffs and local consumption quotas were established as a mechanism to support, regulate and distribute the benefits of this industry among the society.

Therefore as the Second Theorem of Welfare Economics states, in a conflict context between efficiency and equity, the state may and should intervene the markets towards social welfare. Therefore as a mean to increase social welfare and boost the distribution of income in individual and regional terms from the gains derived from the biodiesel industry is desirable to include the biodiesel in the FFS redistributive scheme.

There is a great potential for the biodiesel industry in Argentina in the local and international market, mainly the EU. While the local demand could double its volume by 2011 the international market is also expected to expand for Argentina due to competitiveness and the environmental performance of the soybean-based
biodiesel. However with a high idle capacity in the EU-member countries, Argentina should carefully manage the lobby that the European industrials are exerting against the Argentinean incentives for the biodiesel industry. Further developments of this industry should concentrate in second generation biodiesel, like algae or non-food crops like jatropha. These alternatives are already being developed in Argentina at research and small commercial scale. Also regarding social, agricultural and environmental standards during the whole productive process, certifications could be a necessary step towards an eco-social efficient biodiesel production.
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Appendix

EU present blending percentages by country

Figure 8 | EU biofuels blending scheme (% energy, unless otherwise specified), June 2010 | Source: adapted from www.ufop.de

Biodiesel production costs

<table>
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<tr>
<th>Rank</th>
<th>Country</th>
<th>Production cost (USD/litre)</th>
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<td>Indonesia</td>
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</tr>
<tr>
<td>2</td>
<td>Malaysia</td>
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<tr>
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</tr>
<tr>
<td>10</td>
<td>Spain</td>
<td>$1.71</td>
</tr>
</tbody>
</table>

Table 4 | Production costs of the top ten potential biodiesel producers | Source: author based on Johnston & Holloway 2007
Complete statistical yearly increase of soybean production, area and yield

Production

Figure 9 | Lineal regression for soybean production 1980-1996 | Source: author based on SIIA 2011

\[ f(x) = 608885.78x - 1200678.158,86 \]
\[ R^2 = 0.91 \]

Figure 10 | Lineal regression for soybean production 1997-2010 | Source: author based on SIIA 2011

\[ f(x) = 2624389.52x - 5225866.700,56 \]
\[ R^2 = 0.81 \]
Figure 11 | Lineal regression for soybean area 1980-1996 | Source: author based on SIIA 2011

Figure 12 | Lineal regression for soybean area 1997-2010 | Source: author based on SIIA 2011

Figure 13 | Lineal regression for soybean yield 1980-1996 | Source: author based on SIIA 2011
Statistical analysis on production and land cost

Figure 14 | Lineal regression for soybean yield 1997-2010 | Source: author based on SIIA 2011

Figure 15 | Soybean production costs and land cost since 1980 in Argentina | Source: author based on SIIA 2011
Geographic concentration of soybean production

Figure 16 | Regional distribution of soybean production around Rosario city, Santa Fe province | Source: Gramicci 2011 based on SIIA 2011

Additional readings suggested for a broaden understanding of the RR soybean adoption process


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