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INFLUENCE OF GM SOY EXPANSION ON THE ARGENTINIAN FOOD AND NUTRITION SECURITY

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Abstract

The rapid expansion of Argentinian soy production, led by the increase in the international soy demand for food feed and biofuel production, deeply influenced the entire Argentinian society economy and environment. Genetically modified soy has become a strategic product for the Latin American country, strongly supporting the entire economy and the welfare state thanks to the income derived from soy production and export taxations. The influence of the GM soy production strongly modified in particular the economic, and social structure of the rural areas creating new supply chain agents and making the “contract agriculture” the dominant model. Among the many consequences of this rapid expansion of the soy supply it is increasingly argued that the Argentinian Food and nutrition security can be affected, in particular the access to cheap and good quality beef. The Argentinian ban on beef export reflects the attempt to support the internal supply of beef, thus guaranteeing a low price for the consumers. One of the main factors influencing the reduction of beef supply, however, is its substitution with the more profitable GM soy.

The goal of this paper is to analyse the joint effects of the GM soy production in Argentina and of the change in the country price and income levels, on the Food and Nutrition Security for the Argentinian population, considering three different categories of food: vegetables, animal origin products and, within this category, beef.

A Structural Equation Model (SEM) was adopted, where food consumption (calories from animal and vegetal origin food plus calories from beef) have been related to the food prices indexes, the income pro-capita and the expansion of soy cultivated areas.

The statistical analysis showed that the present model of agricultural production, based on export- oriented GM soy production is affecting negatively food security, in particular the consumption of beef, one of the staple food in Argentinian diet. A substitution effect where beef is substituted with vegetable and other animal origin products emerged as a possible explanation of the results obtained in the three different models.

Further study should better examine these substitution effects and how the overall diet composition changed in quality as well as quantity and how much the change in Food and nutrition security affected the different ranks of the Argentinean population.

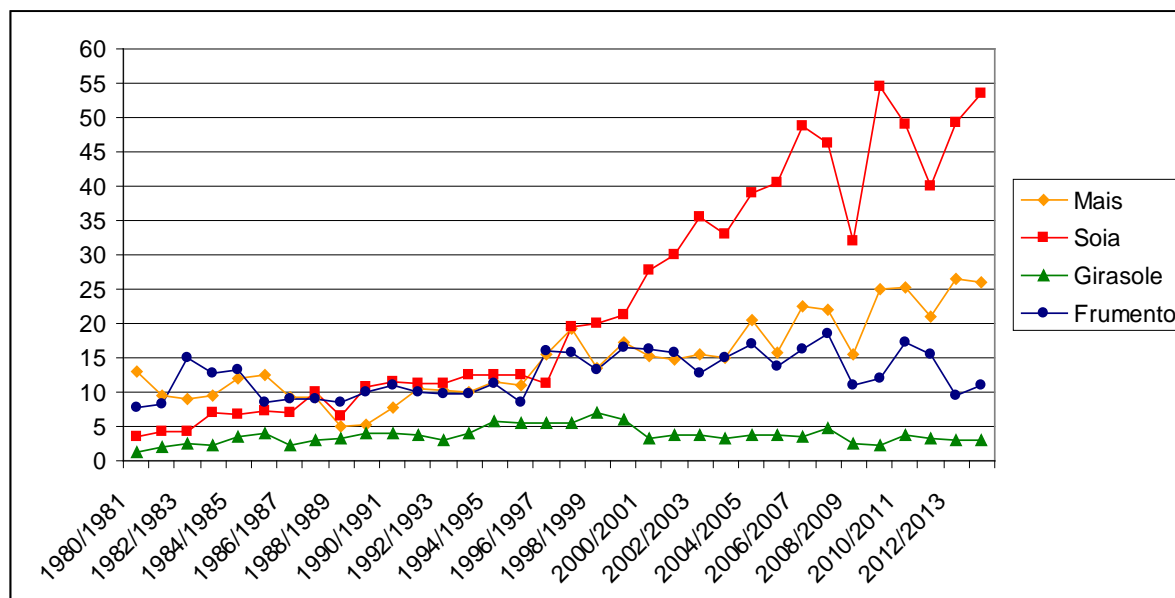
The present study represents a first, relatively simple approach to understanding the complex dynamics affecting the local as well as global consequences of a very fast and still growing expansion of the soy cultivation in Argentina. Considering its strategic role in the country present uncertain economic situation, further analysis should better focus on adopting more complex methods of analysis where the Argentinian institutional, economic and social context should be taken into consideration.

1. Introduction

The rapid expansion of Argentinian GM soy production led to an impressive growth of soy cultivated areas and production when compared to other crops (see graph.1 e 2).

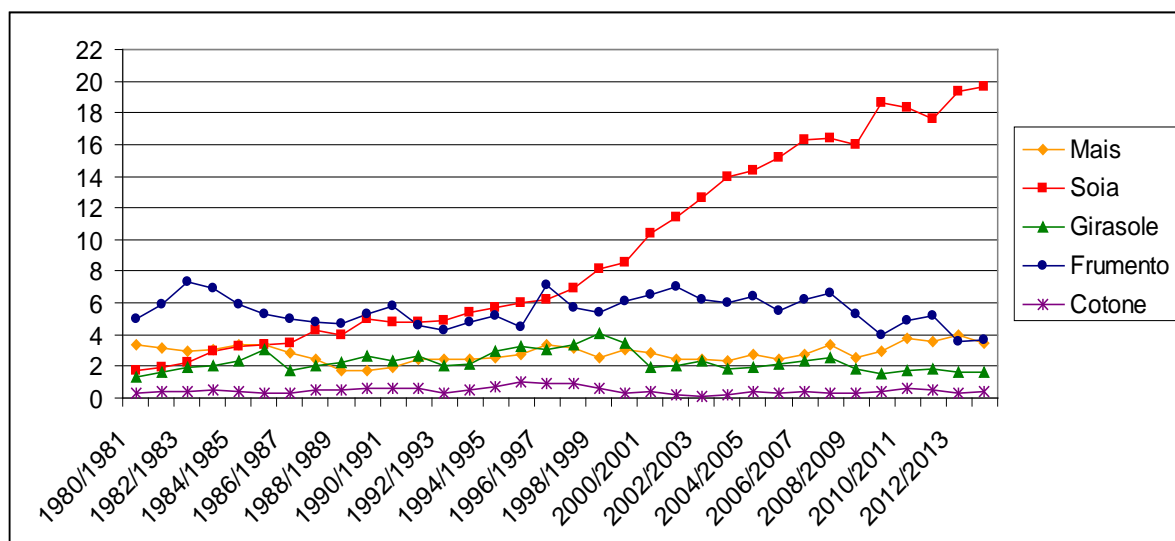
The increasing international demand for soy used as food, feed and biofuel production is the main driver, making Argentina one of the main world soy exporter see graph.3.

Graph 1 - Main crops Production in Argentina (million t)

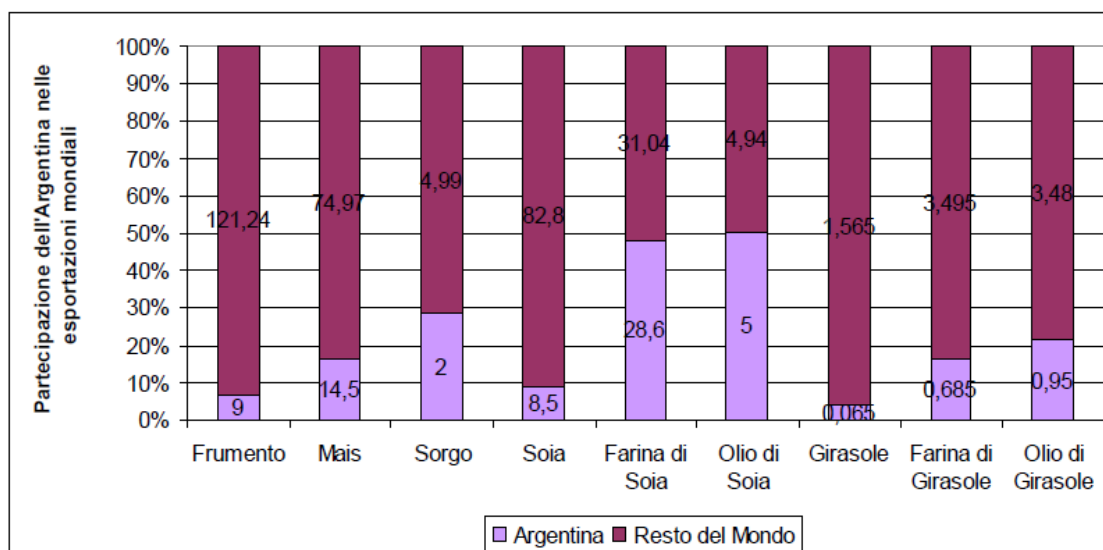


Source: USDA

Graph. 2 - Crop cultivated areas (millions ha)

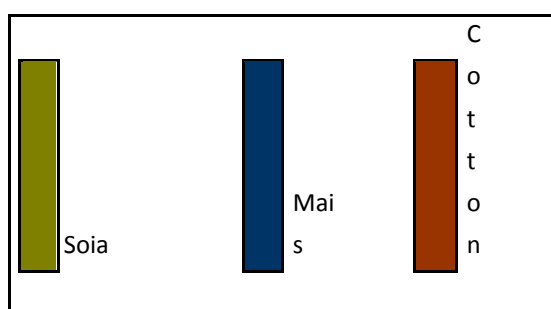
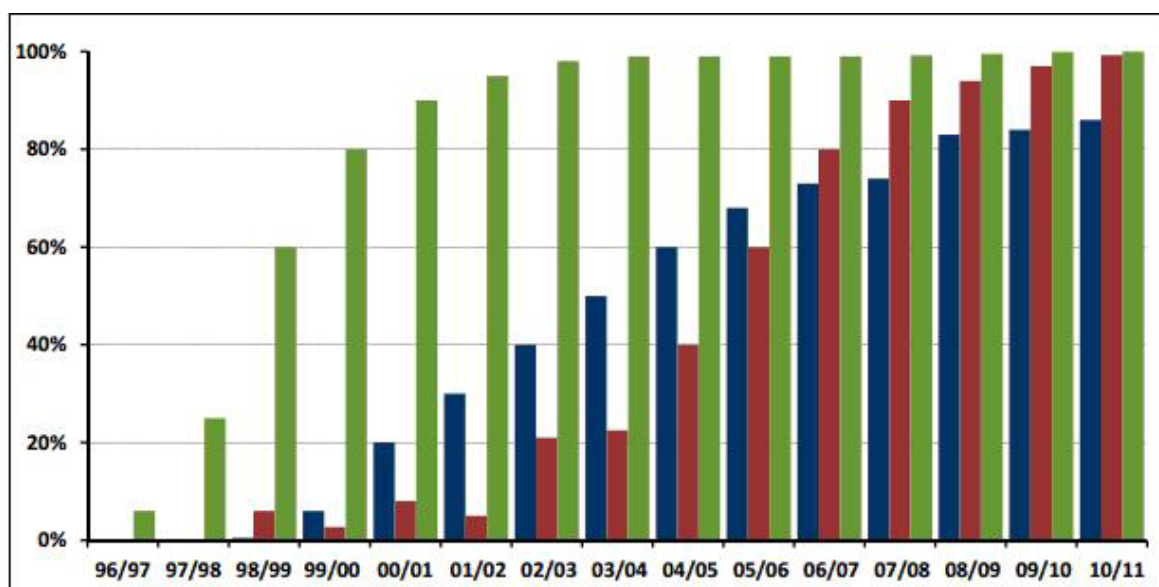


Source: USDA

Graph. 3 Argentina share of the world total export of cereals and oilseeds 2010-2011 (millions of t)

Source: Bolsa de Comercio de Rosario, 2013a.

The absolute majority of the soya cultivated in Argentina is Genetically modified (see graph.4)

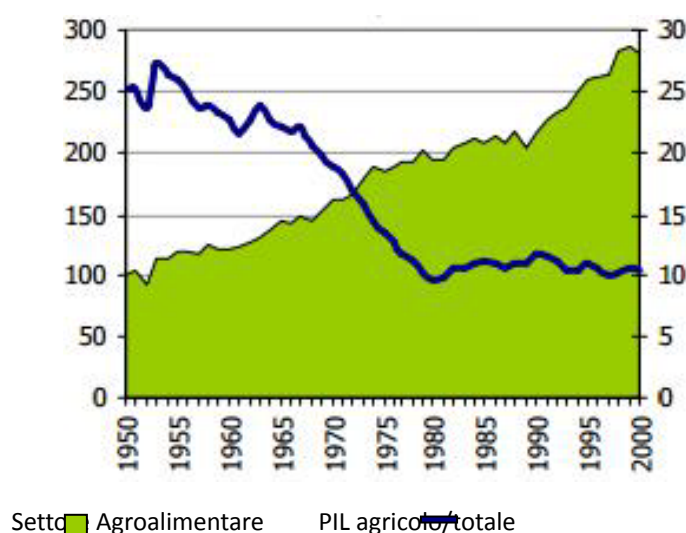
Graph..4 - Evolution of GM crops shares on the total cultivated area - year 2010.

Source: ArgenBio, 2011.

This trend deeply influenced the entire Argentinian society, economy and environment.

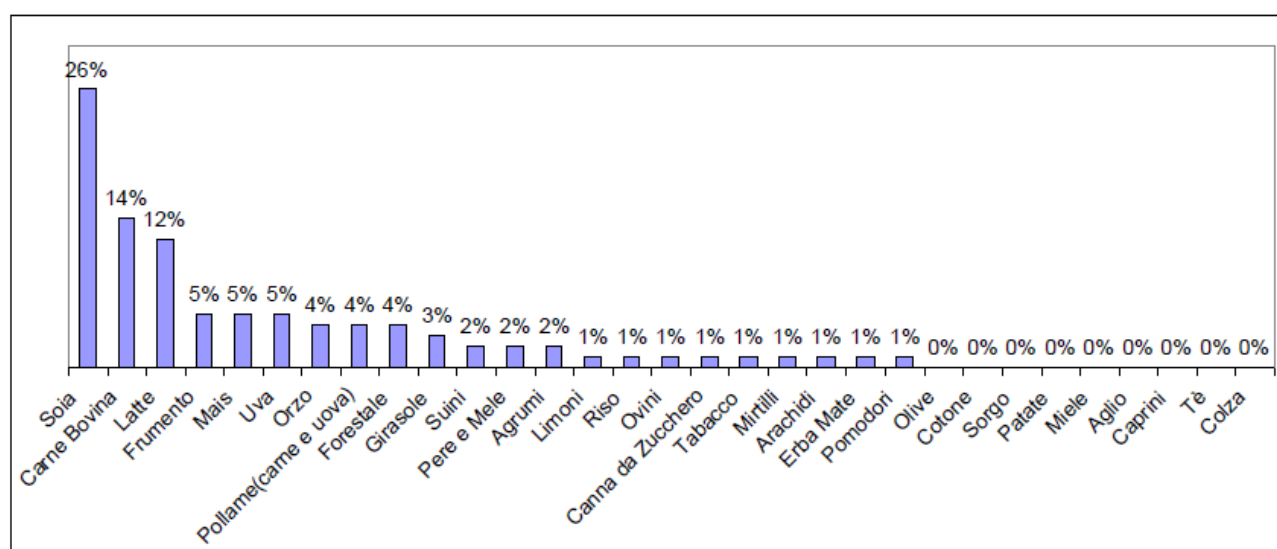
It provided Argentina an opportunity for economic growth and improvement in the farming and soy processing sector competitiveness.

Graph. 5 - Agro-food sector added value growth index (base 1950 = 100) and agriculture sector share of the total GDP - years 1950 - 2000-



Source: IICA, Instituto Interamericano de Cooperación para la Agricultura. 2012.

Graph.6- Main food supply chains share of the total agriculture value added - year 2007



Source: CEPAL, 2010.

An empirical analysis of the relation between soy cultivation expansion, beef consumption and in general food security in Argentina is still lacking, even if the debate on these issues is still “hot”. In particular the consequences of

high barriers to beef export, in order to increase the internal supply of beef, reduced by the competing soy cultivation.

2. Goal

Being fully aware of the strategic relevance of soy for Argentina the goal of this study is to provide a first contribution to a discussion on the evaluation of the influence of soy cultivation expansion on the Argentinian food security, with a focus on beef consumption.

3. Materials and Methods

A description of the main statistics and literature related to the changes in the technical, social and economic structure of Argentina, consequent to GM soy expansion, provided the framework for a Structural Equation Model (SEM) analysis where three dependent variables related to food consumption, measured in terms of calories from beef, other animals and vegetal origin food have been related to the food prices indexes, the income pro-capita and the expansion of soy cultivated areas.

4. Results

The context analysis showed that the expansion of soy cultivated areas took place at the expenses of land used for cereals and pastures for beef production.

Tab. 1 Cattle stock in Argentina - n. of heads

2003	2004	2005	2006	2007	2011	2012
52.960.51	54.164.89	54.349.90	55.545.9	55.889.96	47.972.66	49.865.86
2	6	7	42	4	1	6

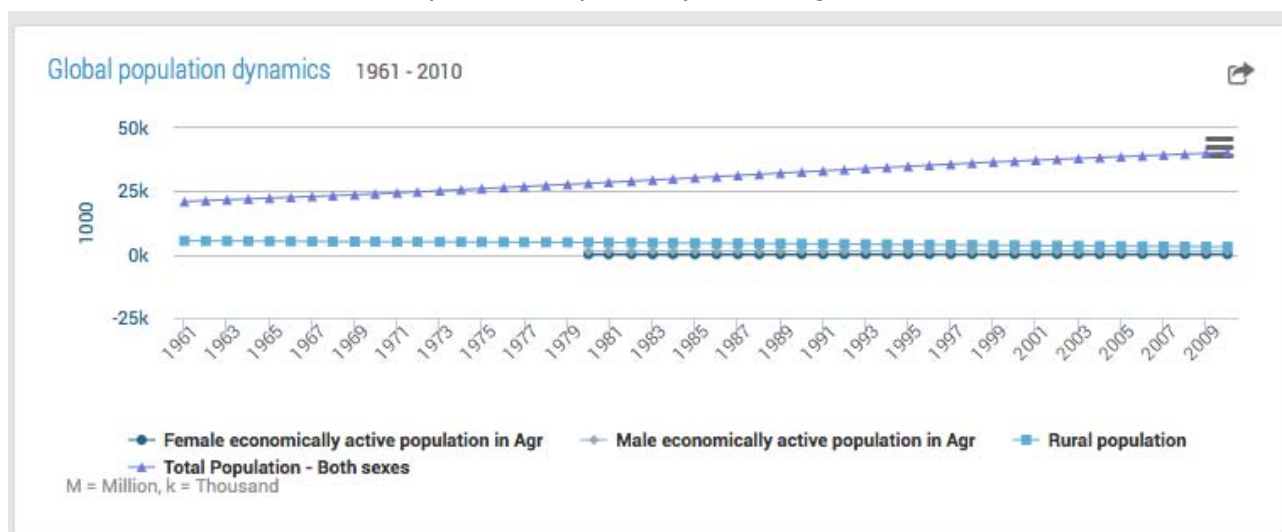
Source: INTA

The n. of cattle decreased fueling a growth in the beef price which led to a reduction in the amount of beef consumed per-capita, which in 2012 amounted to 54.9 Kg, while in 2007 was 68.7 Kg (CICCRA, 2012).

Since the introduction of GM soy and other oil seeds, the total agricultural land for cattle reduced by 15 million ha, until 2010 (Rearte, 2011). The expansion of soy cultivations in the Pampa region is shifting the cattle farms from the traditional Pampa areas to the Northwest. Soy cultivation in the Pampa is reducing the layer of soil threatening the fertility of this area.

Other structural consequences of the soy expansion relate to their strong contribution to the farm size (INDEC, 2013) and mechanization increase. Most of the soy farms range between 500 up to 20,000 ha. This led to a migration of small farmers from rural to urban areas increasing the n. of unemployed marginalized population, potentially affecting their food security.

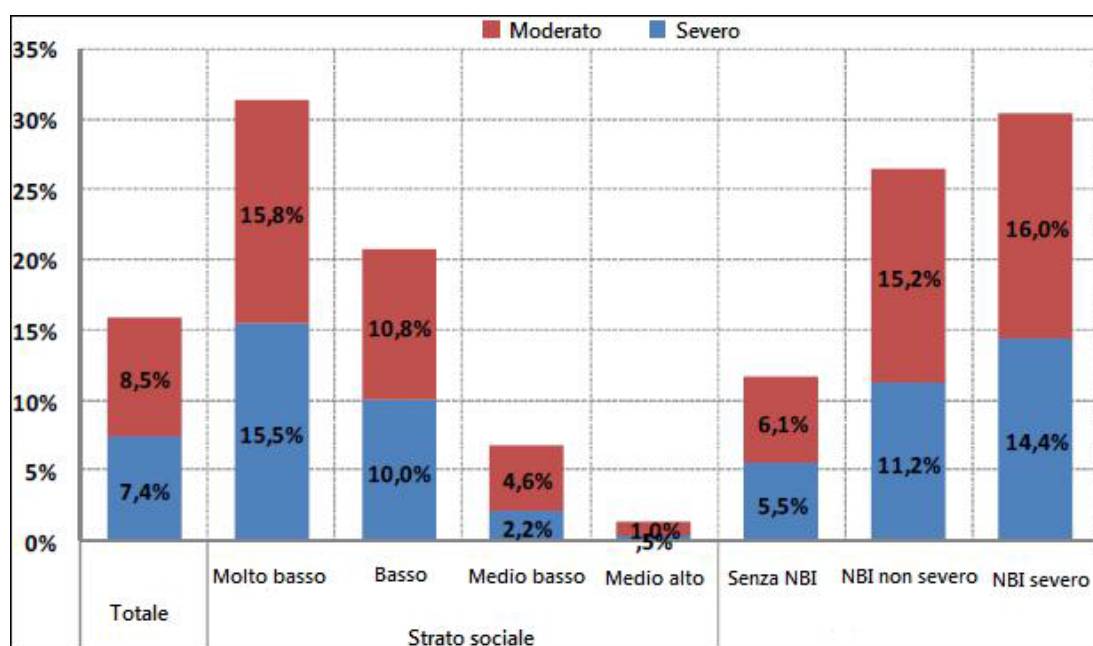
Graph. 7 Global Population dynamics in Argentina



Source: World Bank

In 2011 more than 30% of the lower income ranks of Argentinian society suffered from severe to moderate levels of Unsatisfied Basic Needs (UBNS).

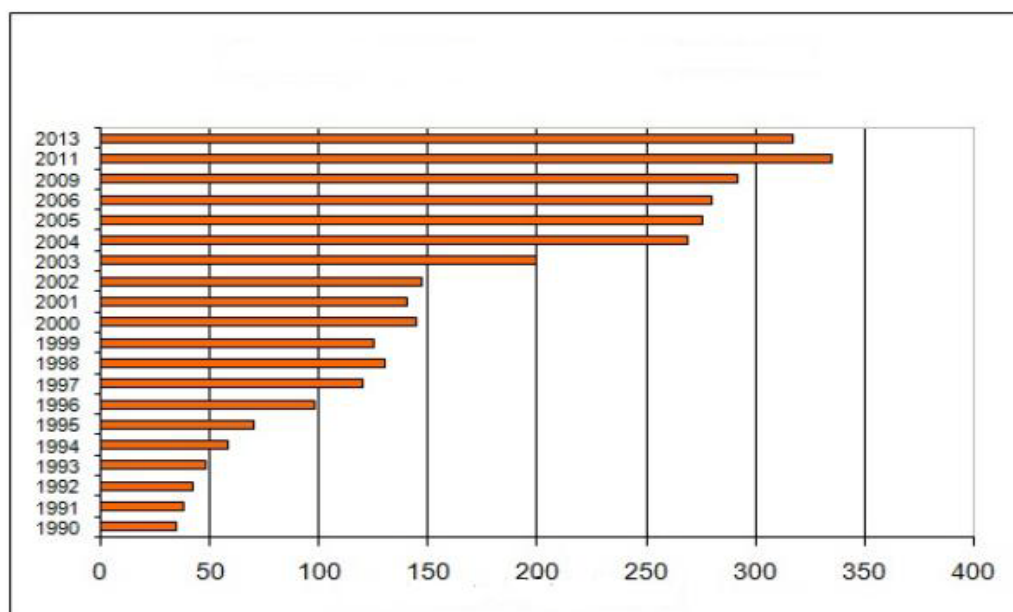
Graph.8 - Unsatisfied basic Needs. % of family with children - year 2011.



Source: Salvia, Tuñón, Musante, 2011

The income generated by soy-export taxation is significantly supporting the Government Budget including social welfare programs. Programs to encourage soy for human consumption have been adopted as a way to compensate for losses in food security. This could increase the Argentinian dependency on soy production and export. From the environmental point of view, the advantages related to the no-tillage system applied to the GM soy cultivation are partially offset by the strong increase in herbicides, often sprayed from airplane, polluting both the land and the air and by land erosion. The reduction in bio-diversity and the consequences on the people health are currently creating opposition from the civil society, mainly communities living in rural areas affected by air spraying.

Graph- 9 - Pesticides use in Argentina (millions l)



Source: Red Universitaria de Ambiente y Salud (REDUAS), 2013.

Statistical analysis

Table 2 Properties of the structural model

				S	C	R	
				Esti			P
				mate	E	R	W
Kcal Animal (No Beef)	<	Soy Cultivated area (ha)			1	1	
	-				.	.	.
	-		1.59	3	1	1	2
	-		2	8	4	6	5
	-			6	8	3	1
Kcal Beef	<	GNI/Capita			.	-	.
	-			0	.	.	5
	-		.005	0	9	6	4
	-			8	9	3	9
	-				9		
Kcal Beef	<	Soy Cultivated area (ha)		1	.	-	*
	-			.	8	.	*
	-		10.2	2	.	8	*
	-		91	7	0	1	*
	-			8	5	6	

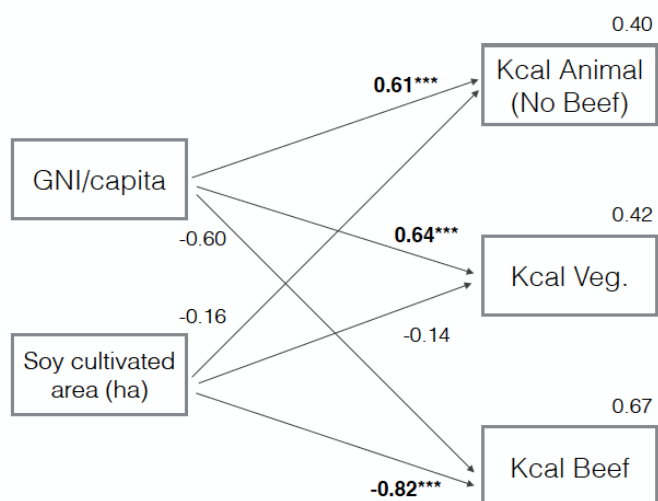
	<			4			
Kcal Animal (No Beef)	-	GNI/Capita	.034	0	2	6	*
	-			8	5	1	*
	-				0	3	
	<			4			
Kcal Veg	-	GNI/Capita	.040	0	5	6	*
	-			0	1	3	*
	-			9	6	6	
	<			1	1	-	.
Kcal Veg	-	Soy Cultivated area (ha)	1.56	5	.	1	3
	-		3	4	0	4	1
	-			1	1	0	1
					4		

*** statistically different from zero at the 0.001 significance level (two-tailed)

** statistically different from zero at the 0.01 significance level (two-tailed)

* statistically different from zero at the 0.05 significance level (two-tailed)

Scheme 1) SEM results



The statistical analysis showed that the expansion of areas cultivating GM soy is negatively and significantly related to the consumption of calories from beef, while the consumption of calories from non-beef animal origin food and vegetables is not significantly related. The Argentinian income per-capita is, on the other hand, non significantly related to the consumption of beef origin calories, while is positively and significantly influencing to the calories consumed of vegetable and non-beef animal origin food.

5 Discussion

The main effect of the last decades increase in export-oriented GM soy areas on the Argentinian food security seems to be a reduced access to beef consumption; this seems to mainly affect the Argentinian food sovereignty, given the important role played by beef in their diet. These findings are supported by the consumption of calories from vegetable and other non-beef animal origin products, which seem not to be significantly affected by the expansion of soy cultivated areas. Programs encouraging the substitution of meat and cereals with soy can have played a role. The variation in the income/capita seems not large enough to influence the consumption of beef, while is influencing positively the consumption of other food categories. The results of the context as well as statistical analysis led to hypothesize that in the long run, the positive contribution of soy to the Argentinian economy can be partially offset by the dependency on incomes generated by the export of soy and environmental impacts related to use of pesticides and land consumption/erosion; this can further increase economic and social inequalities and instability not only reducing access to beef, but also the overall food security of increasingly large shares of the population. Further analysis should then involve a more detailed consideration of the relation between soy production, income distribution and the consequences for the lowest income ranks of the population in terms of food security. Other aspects to be analyzed involve the consequences of environmental problems on the natural capital (loss of land and biodiversity) and population health. In general strategies to avoid the “resource curse” due to overspecialization in soy production should be examined.

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