Loss of food self-sufficiency and opportunities for agricultural complementarity among UNASUR countries[1]

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Abstract

One of the main goals of a country is to achieve a degree of food selfsufficiency. South America produces all the food products that are required to satisfy the caloric requirements as well as to have a balance diet; this is possible as it counts with all kind of crops, from tropical to temperate and cold weather. However, there exists a systematic loss of food self-sufficiency (more imports in relation to domestic consumption) among UNASUR countries in the last 50 years. This loss of food self-sufficiency has implications also in the quality of the diet. The higher dependence observed obeys to structural factors associated with the insertion in international markets (specialization as exporters of commodities) and with the lack of public policies in each country.

The paper analyzes agricultural complementarity among UNASUR countries and the likely trade diversion that would come with it, as many imports from outside the region could be done internally, since there is availability. This goal requires coordination in regional macroeconomic and agricultural policies, deepening the levels of economic integration. Food self-sufficiency is important because it lowers transportation costs (and therefore CO2 emissions) and saves currency, which could be used for importing advanced technology, among other benefits.

Key words: food self-sufficiency, UNASUR, agricultural complementarity

JEL Codes: Q11, Q17, Q18, Q57

1. Introduction

Human beings have a number of needs that have to be satisfied in order to live in full, understanding this as the state in which individuals can develop and pursue effectively their capabilities (Malinowski, 1939; 1970). In this sense, food plays an important role as it acts as the satisfier of a basic need, nourishment (Maslow,

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1943). This implies that an inadequate supply of food not only threatens the integrity of the individual, but also the sustainability of societies.

For this reason societies articulate as an entity made up of institutions that work to satisfy their own needs (Malinowski, 1939; 1970). An example of this articulation is the Union of South American Nations (UNASUR[1]), conformed by all the countries in South America which has the goal of building a space of integration to address the challenge of socio-economic inequality and to reduce existing asymmetries (UNASUR, 2015). This challenge is to be addressed by satisfying basic needs of its citizens. Consequently, UNASUR is the proper place to introduce, develop and implement common strategies aimed at the same goal.

From the perspective of nourishment, UNASUR may become an opportunity to build common strategies that encourage, through agricultural complementarity, food self-sufficiency. That is, the situation in which food needs are covered with domestic production (FAO, 2002).

This move implies a change in the food production system of South American countries, which until now have prioritized production for exports instead that for internal supply (Pengue, 2009). This trend has implied a gradual loss in food self-sufficiency and an increase in vulnerability to external factors, for instance, to international prices.

Therefore, agricultural complementarity, defined as the contribution each member country has in the production of food that is needed to achieve selfsufficiency of the block, becomes an instrument of cooperation and integration. Among the benefits of this cooperation one can list: a) improvement in transport and communications through regional investment in infrastructure; b) mutual assistance in the case of production problems – for example draughts, plagues, etc.; c) promotion of regional economies of scale and d) improvements in food security (Hubbard et al., 1992). Another benefit is the reduction in the currency that escapes the region.

Currently, a number of successful experiences of common strategies exist, promoted by supranational entities, oriented to food self-sufficiency. This is the case of the European Union, that has achieved that goal through the Common Agricultural Policy (Guinea, 2013). The EU actually produces more food than it consumes, avoiding in this way a supply side problem in recent decades (Candel et al., 2014).

For these reasons, similar strategies for UNASUR would strengthen its food sovereignty, improve the efficiency in the use of natural resources and would increase economic profitability. This would also help avoiding that food policies of developed countries, OECD members, affect developing ones. Something that is far too familiar nowadays (Brooks, 2014).

[1] UNASUR, conformed by Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela, is a new regional block. This article analyzes the region as a block, without forgetting each country differences.

However, the design of these strategies requires reliable information regarding agricultural products trade, between UNASUR countries, and with the rest of the world. This information needs to be available not only in monetary terms but also in nutritional terms. Only in this way one can get a wider vision of the role international trade plays on nutritional security of countries (D'Odorico et al., 2014).

Following that, this article analyzes the opportunity of agricultural complementarity that UNASUR has, with the goal of achieving food selfsufficiency.

2. Literature review

According to MacDonald et al. (2015), about one fifth of cultivated land in the planet is oriented to agricultural products for exports. This is the same fraction of the calories exported, whereas in monetary terms this trade implies 20% of world production of those goods. Only three goods represent 50% of the calories of agricultural products exported (wheat, soy and corn), although the monetary value is just 21%. China imports of agricultural products from Southeast Asia and South America represent 10% of world production in calories, although only 5% in monetary value. This trade pattern implies using land for foreign markets and not for supplying domestic demand. Still, some countries allocate more land for cultivating export goods: the USA allocates 35% and Australia, Argentina and Canada, more than 70% (MacDonald et al., 2015).

The debate on food self-sufficiency is still alive and carries a lot of importance. Works on food security, sovereignty or self-sufficiency have adopted usually a national and single product point of view. Amid (2007), for instance, analyzes the case of wheat in Iran from a market and prices perspective; Anderson and Strutt (2014) analyze how economic growth and demographic transition in China will make the country more dependent on food imports, modelling its evolution until 2030. The authors also analyze how prices and market instruments can distortion food provision. A result that was anticipated at the end of the 1980s by Yang and Tyers (1989). Cuesta et al. (2013) argue that public expenditure in Bolivia is not effective in reducing food insecurity. Farrow et al. (2005), on the other hand, show how spatial heterogeneity may play an important role as a determinant of the lack of access to food products in Ecuador, a problem particularly important in the central mountain range. Hassan et al. (2000), adopting a food security like perspective, analyze the case of wheat and cotton in Sudan, reaching the conclusion (based on a supposedly economic efficiency) that is the interest of Sudan to encourage cotton so that currency is obtained that can be used to import wheat. Giampietro et al. (2014), applying an innovative biophysical approach in the line of that presented in this study, analyze two national case studies, self-sufficiency of wheat in India and total food self-sufficiency in Mauritius islands.

Only a few studies analyze the productive possibilities and availability of food at regional level. Since the work of O´Hagan (1976) according to which most of the countries where in a situation of food self-sufficiency, things have changed

drastically and there are many countries and regions that have worsened in this respect. Despite this fact, there is a lack of studies with regional scope.

Among those few studies, one could highlight that of Blackie (1990), where selfsufficiency of corn in Eastern and Southern Africa is analyzed. This is one of the first studies making explicit the potential of trade diversion for one product, complementing in this way the previous work of Koester (1986). Blackie proposes to reduce trade with countries outside the region and increase intraregional trade, as a policy measure aimed at improving self-sufficiency in the south of Africa. It points, however, to the poor state of infrastructure as one limiting factor for the measure to be successful. Rooyen and Sigwele (1998) contributed to the debate by stressing some measures of agricultural policy that, if implemented jointly, would also improve self-sufficiency at a regional scale.

Some other studies address the imbalance found between developed and developing countries, with the former ones having surpluses while the latter would present deficits at an aggregate level (Mellor 1988). Mellor identifies the causes for that imbalance, as well as some policy measures that could be adopted to address the issue. However, there is no quantitative detailed analysis as the one presented in this paper.

Using both available surveys and FAO food balances, Asfaw (2008) checks the availability of fruits and vegetables for human consumption in Latin America and the Caribbean. The conclusion is reached that the region shows low levels of consumption despite the availability of the products in the region is high. This is one of the few studies that links the availability of food products with the nutritional state of its population, another element that is present in this article. Asfaw also shows the high heterogeneity found in the region and identifies income per capita and the level of urbanization as the main drivers for diet composition.

The focus of the region as food exporter comes with impacts attached. Ceddia et al. (2013) analyze the intensification of agriculture in South America, concluding that we would face a “Jevons´ Paradox” like situation; that is, improvements in efficiency would not lead to lowering the use of the resource (land) but the opposite would be true. In the case of intensification of agriculture, at the expenses of more deforestation occurring.

Finally, a group of authors takes on the effects of trade and trade policies of regional blocks upon access to food products in developing countries. Brooks (2014) shows how policies implemented by OECD countries have had a negative impact on developing countries, especially through import tariffs and production subsidies at home, that lead to surplus exports, generating their own version of trade diversion. Candel et al. (2014) use a similar approach to analyze EU’s Common Agricultural Policy. They stress that food security is at the roots of the very existence of the EU, having as a result, an increase in the food surplus. On the other hand, Rask and Rask (2011) show how development at the world level is changing the diet everywhere, towards more meat products that imply a double energy conversion, increasing in this way cereal demand more than proportionally. This fact imposes further pressure upon resources and increases risk of future food provision.

Having in mind all these precedents, our focus here is the situation of South America. Altieri (1992) pointed that the model found in Latin America did not redistributed land in large quantities. Land reform is still a pending issue in most countries. Low productivity is one of the characteristics of the model and this implies environmental impacts attached. The region is rich not only in terms of biodiversity, but also in terms of cultural heterogeneity, with an important ethnoecologic knowledge.

Technical change in the region focused on climatic regions similar to the ones in developed countries where it came from; despite the fact that a large fraction of production takes place in areas with high slope and with ecosystems that differ largely with the reality in developed countries. The technical change implemented came with a higher degree of dependence on fertilizers, most of them coming from outside the region, a situation that persists nowadays, as shown by Llive et al. (2015). The use of fertilizers and agrochemicals in the region is heavily subsidized (Repetto 1985).

Other authors have a more positive view of the model of agro exports in southern countries. Bindraban and Rabbinge (2012) say, based in FAO (2011), that there are no problems to feed population at the world level in the next four or five decades. They base their optimism in productivity gains obtained through the introduction of multiple crops and land use systems, agroecologic practices, changes in the diet and the use of new inputs from biological origin.

Based on the previous theoretical and conceptual discussions on food sovereignty and sufficiency, our study is oriented to show the agricultural complementarity opportunities within UNASUR, as well as the trade diversion that will imply. South America is a mega diverse region that counts with all climatic floors for farming production. South America produces all the kinds of products needed to satisfy the caloric requirements with an adequate diet. South America could be self-sufficient in food, with no need of importing from other regions (see Section 5).

South America is also one of the largest producers of food in the world. Brazil and Argentina contribute with 7.5% and 4.2% respectively to world production. The European Union contributes with 13.4% (Villa Issa, 2013) (see **Table 1**). **Table 1**. Share of UNASUR to world production of the products analyzed, 2011

Group of food products	Rest of the World	UNASUR
Sugar	73%	27%
Meat	86%	14%
Cereals	93%	7%
Stimulants	67%	33%
Fruits	84%	16%
Legumes	51%	49%
Oil products	81%	19%
Tubers	96%	4%

Source: FAOSTAT, 2015

It is worth mentioning that the three largest producers of soy – USA, Brazil and Argentina – cover almost 90% of the world market. Brazil will be the country where soy will grow more, being able to offer 63 million tons in 2017, a figure that would imply 59% of world sales (Villa Issa, 2013).

According to Regúnaga (2013) South America's record in growth and innovation may make the region a strategic supplier to cover the growing needs of food products in the world. Production in the region has a great potential for growth due to the endowment of natural resources, in terms of available arable land, water and human capital.

The current paper goes beyond the concept of food security defined at the World Food Summit organized by FAO (FAO, 1996), that included economic access to food (through purchasing power and markets). We rather fall into the concept of food sufficiency that analyzes the relation between local availability of resources and its domestic demand, more oriented to the concept of food sovereignty (Altieri, 2009), the viewpoint of Burchi and De Muro (in press) or the 'food first view' (Maxwell and Smith, 1992; Maxwell, 1996). The paper does not pretend to make a thorough review on the topic; the interested reader can refer to Chaifetz and Jagger (2014), where the authors conduct a full revision of the concept of food sovereignty for the last 40 years. The used approach implies considering not only human nutrition in quantitative terms of calories, but also accounting for its quality, its composition in terms of nutrients and micronutrients (Hoddinott and Yohannes, 2002). This approach has another advantage; it allows us to focus on relevant food products from a nutritional point of view, depending on the case under analysis. This is why this paper uses a basket of 21 relevant products for the region in nutritional and commercial terms. The paper also deals with the issue at a regional scale, analyzing the evolution of the 12 countries that are member states of UNASUR.

Despite most of the countries were in a situation of food self-sufficiency in the 1970s (O'Hagan, 1976), this is not the case of South America in the last years, in which, as seen in Section 5, there is a loss in sufficiency in the region, especially in some countries and for some specific products.

The idea of improving food sufficiency in a region that is in the midst of a process of integration within the framework of UNASUR makes even more sense in the current context of high volatility of prices. This is of especial importance if we keep in mind that in contexts of high international prices as in the last years, the trend is that those increases are also transferred to domestic prices (Dawe et al., 2015). Moreover, trade barriers at world level tend to reinforce price volatility and the consequences are stronger upon more vulnerable countries (Rutten et al., 2013).

Another justification for seeking complementarity in the region is the growth in income per capita, which comes not only with an increase of direct consumption of food, but also of indirect consumption due to the change in the diet in favor of more meat products (implying a double energy conversion and more cereal consumption for feedstuff) (Rask and Rask, 2011). This evolution of income and diet make us think that current trends of loss in self-sufficiency in the region may

be exacerbated in a coming future. Therefore, the growth in world demand will be reflected in an increase in international trade of food products, inducing more environmental impacts such as more pressure on land, but also more CO2 emissions (Schmitz et al. 2012) as well as a reinforcement of current processes of land grabbing (Antonelli et al., 2015; Scheidel y Sorman, 2012).

3. Methods

According to the availability of data from FAOSTAT, the period of analysis goes from 1961 to 2011. 21 food products were selected because of their nutritional and commercial relevance for the region. These products were grouped in product categories as follows: sugar, meat (pork, chicken, and beef), cereals (rice, oats, barley, sorghum, and wheat), stimulants (cocoa and coffee beans), fruits (banana, apples, oranges/tangerine and grapes), legumes (beans and soy), oil products (palm and soy oil) and tubers (potatoes).

In order to obtain the trade flow between UNASUR countries and the rest of the world we calculated, for each country member, the share of the volume exported by country of destination and the share of the volume imported by country of origin. For this task, we used FAO database for external trade (FAO, 2015). The resulting percentages were applied to production values for each country as reported in FAO food balances (FAO, 2015). However, food balances aggregate avian meat under just one category of “poultry meat”. This is why we needed to disaggregate chicken meat according to FAO’s values for production and trade (FAO, 2015). In order to calculate the domestic supply of chicken meat for each country we accounted production plus imports minus exports. We also assumed that all domestic supply was oriented to human consumption. In this way, we got consistency between trade and nutritional information.

The following indicator of self-sufficiency was calculated assuming, as in the case of chicken meat, that the main destination of domestic production were their own domestic markets:

$$\text{Indicator of self-sufficiency} = \text{domestic supply } (t) \,/\, \text{domestic production } (t) \quad (1)$$

$$\text{Domestic supply } (t) = \text{domestic production } (t) + \text{imports } (t) + \text{variation of stocks } (t) - \text{exports } (t) \quad (2)$$

A value equal or greater to one for this indicators shows the country is selfsufficient for that particular product. On the other hand, values below one indicate the country only partially supplies its domestic consumption with domestic production, and therefore is not self-sufficient. In the case there is domestic supply but not domestic production we give the indicator a value of zero.

Food balances (FAO, 2015) for the 12 member countries of UNASUR were used to determine the alimentary pattern evolution over time. To obtain the same for UNASUR as a block we simply summed up values for food products per country and then divided that by total population of that year. All the caloric values used in this paper were calculated according to the transformation coefficients found in the food composition tables of FAO (FAO, 2001).

In order to establish the domestic or imported origin of calories for human intake, the same indicator of self-sufficiency was used. However, this has the implicit assumption that the main destination of domestic supply is human consumption. This assumption was put to a test and we observed that for most of the products this value was over 75%. Moreover, products were the value was lower were less important in nutritional terms. This was the case for soy or sorghum.

4. International market integration

The economies of UNASUR countries have been oriented to exporting raw materials and agricultural products without adding too much value. They are exporters of cocoa beans but importers of chocolate bars; exporters of banana, but importers of child food products based on banana.

Comparative advantage is one of the basic concepts of the conventional theory of international trade. Under the assumption of perfect competition, countries tend to specialize in the production of goods and services with lower relative costs respect to the rest of the world. At the same time, countries tend to import goods and services with higher relative costs.

These trends, far from benefiting countries exporting commodities, deepen an unjust international division of labor. Countries producing commodities compete each other to sell their products in the same market, by lowering costs and prices in a so-called “race-to-the-bottom”. As all of them follow this path, the consequence is an intensification of the exploitation of natural resources, a worsening of current unequal exchange and a better off situation for central economies that get the resources they need at ever-lower prices (Schaffartzik et al., 2014).

Traditionally, the extraction of natural resources has been one the ways to express this unequal economic exchange: selling cheap commodities and buying expensive capital goods. Along with it, there is a sub valuation of social and environmental impacts (Bunker, 1984; Martínez Alier, 1992).

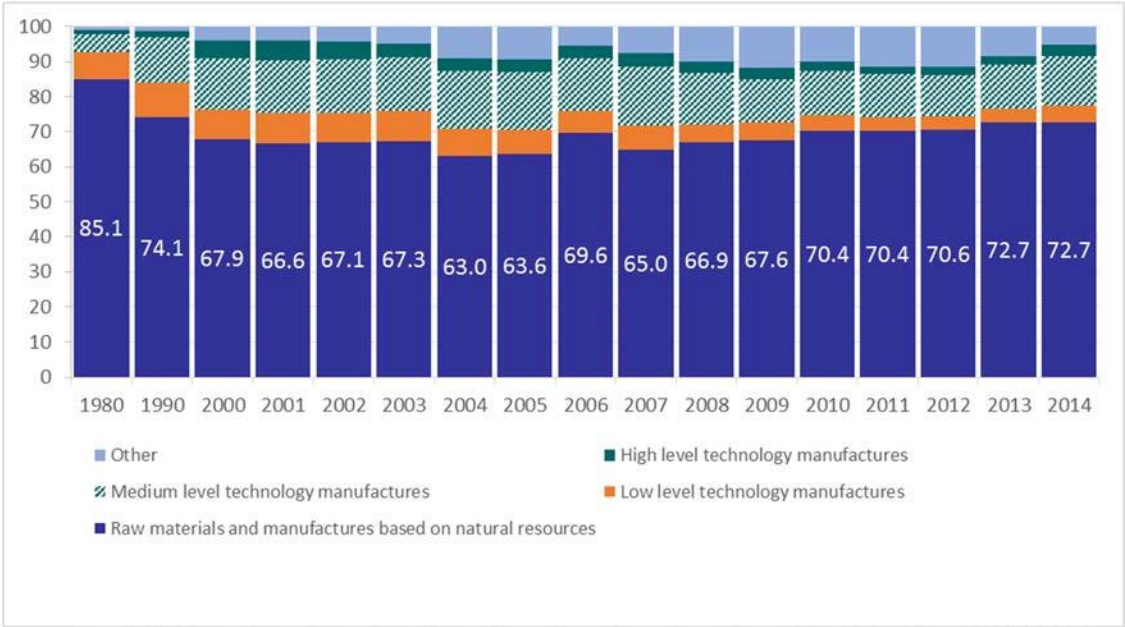
The 12 member states of UNASUR have a great dependence on exports of raw materials and food products. Primary exports of commodities represented 70.4% of total exports, in monetary terms, in year 2000, and they went up to 72.7% in 2014 (UN Comtrade Database, 2015). See **Table 2**. This implies that the region is under a process of re-primarization, where agricultural products are important, although very heterogeneous depending on the country (CEPAL- Badecel, 2015). See **Figure 1**.

Table 2. Export structure by level of technological intensity (1980-2014, % of total)

Year	Raw materials and manufactures based on natural resources	Low level technology manufactures	Medium level technology manufactures	High level technology manufactures	Others	Total
1980	85.1%	7.8%	5.2%	1.1%	0.9%	100%
1990	74.1%	9.9%	12.9%	2.0%	1.2%	100%
2000	67.9%	8.4%	14.6%	5.4%	3.8%	100%
2010	70.4%	4.4%	12.5%	2.7%	10.0%	100%
2014	72.7%	4.6%	14.2%	3.2%	5.3%	100%

Source: UN Comtrade Database (2015). Retrieved on April 20, 2015, http://comtrade.un.org/

Figure 1. Export structure by level of technological intensity of UNASUR (19802014, % of total)



Source: UN Comtrade Database (2015). Retrieved on April 20, 2015, http://comtrade.un.org/

A consequence of this re-primarization is the loss of relevance of industry in GDP. **Table 3** shows the evolution between year 2000 and the last figure available (World Bank, 2015), a clear example of the *Dutch disease*.

Table 3. Added value of industry as share of GDP in UNASUR, 1980-2013

Year	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Guyana	Paraguay	Perú	Suriname	Uruguay	Venezuela
1980	29.5	14.4	33.5	21.5	23.9	17.5	12.1			18.6		16.0
1990	26.8	18.5		19.6	20.6	21.7	10.3			10.3	28.0	14.9
2000	17.8	15.3	17.2	16.9	15.0	19.4	8.2			9.0	14.1	19.8
2010	18.2	13.9	16.2	11.8	13.9	14.0	4.1	12.4		17.4	15.1	13.9
2013	15.3	13.3	13.1	11.5	12.3	13.0	3.7	11.6		16.4	12.6	

Source: World Bank (2015). World Development Indicators. Retrieved April 20, 2015, http://www.bancomundial.org/

5. Loss of food self-sufficiency

The way the region is inserted in international markets affects its food selfsufficiency. There is self-sufficiency when a country can supply its domestic demand by itself, accounting for the nutritional needs of the population or variety of the diet.

FAO (2002: 9, *our translation*) has dealt with the issue in the following terms: "Self-sufficiency is achieved when alimentary needs are covered with domestic production, which is a general aim of national policies. It has the advantage of saving currency that can be used to buy products that are not manufactured locally, and protect countries from vicissitudes of international trade and volatility of food products' prices. It also ensures the supply of food needed to satisfy needs of local population".

The opposite of food self-sufficiency is food dependence: when almost all food products are imported. Following the indicator of self-sufficiency presented in Section 3 we see that UNASUR as a block is self-sufficient. Between 1961 and 2011 (the last year available), it maintained self-sufficiency in all products but potatoes, wheat and palm oil (See **Table 4**).

This result at continental level does not hold when we go down to the level of nations, where there is heterogeneity within countries, although a common trend is that of a gradual loss of sufficiency everywhere (See **Table 5**). Next, we highlight the main trends by country for the period of 50 years analyzed.

Argentina has not been sufficient in banana, cocoa beans and coffee. Since 1995 has also lost sufficiency in pork meat.

Bolivia was dependent on barley, apples and wheat. Since 1990, it also lost it for oats, and since 1995 for cocoa beans and grapes.

Brazil was never self-sufficient in barley, wheat, potatoes and grapes.

Chile is only sufficient in oats, beans, apples, grapes and pork meat, and partially in potatoes.

Colombia was self-sufficient in sugar, banana, coffee and beef. It has improved in the case of oats, but worsened progressively in chicken and pork meat, beans, oranges, sorghum, soy and grapes.

Ecuador is only self-sufficient in banana, cocoa beans, coffee and beans, but is dependent on soy oil, oats, wheat and grapes and over the time has lost it in pork meat, barley, corn and apples.

Guyana is self-sufficient in rice, sugar and banana. For 14 products does not register data to calculate the index.

Paraguay presents a high degree of dependence, worsening for coffee, oranges, potatoes and grapes.

Peru is self-sufficient only in coffee and beans. It has improved in rice, oats and grapes, but worsened in the case of palm oil, sugar and barley.

Suriname has shown self-sufficiency for rice, banana and oranges, but sugar and chicken meat show a strong increase in dependency.

Uruguay is self-sufficient for rice, beef, barley, apples, oranges and soy. The indicator worsened for oats, pork meat and sugar.

Venezuela was self-sufficient only for banana, although in recent years it has improved oranges and sorghum. However, the current high dependency is increasing for sugar, beans and corn.

As a summary, despite the region is self-sufficient in general terms, most of the countries show a loss in sufficiency over time, especially for rice, wheat and sugar.

There are two main explanations for this situation. On the one hand, developed countries keep subsidizing agriculture, which induces huge distortions in cost structures of its farmers. Paradoxically, some imported products are cheaper than local production, despite the long distances these products need to make. On the other hand, UNASUR countries not only lack a policy of direct subsidies, but they also lack trade barriers that avoid the massive entry of subsidized imported food products.

Table 4. Food self-sufficiency in UNASUR by product

Product	1961	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2011
Apples	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Banana	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Barley	1.00	0.87	0.77	0.77	0.55	0.47	0.55	0.48	0.60	0.60	1.00	1.00
Beans	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Beef	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Chicken Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cocoa beans	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Coffee	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Corn	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	1.00	1.00
Grapes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Oats	1.00	0.85	1.00	1.00	1.00	1.00	1.00	0.91	1.00	0.86	1.00	1.00
Oranges, tangerines	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Palm Oil	0.89	0.95	0.99	0.71	0.96	1.00	0.97	1.00	1.00	1.00	1.00	0.98
Pork Meat	0.99	0.99	1.00	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Potatoes	0.99	1.00	1.00	0.99	0.98	1.00	1.00	0.97	0.96	0.97	0.96	0.98
Rice (Elaborated)	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	1.00	1.00	1.00	1.00
Sorghum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Soy	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Soy Oil	0.49	0.53	0.77	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sugar non refined	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Wheat	0.90	0.88	0.75	0.89	0.77	0.81	0.93	0.65	0.93	0.85	1.00	0.95

Source: FAOSTAT, 2015

Table 5. Food self-sufficiency by group of products per country

Country	Product Group	1961	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2011
Argentina	Sugar	0.89	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Cereals	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Stimulants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fruits	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00
	Legumes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Oil products	-	0.08	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Tubers	1.00	1.00	1.00	0.98	0.94	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bolivia	Sugar	0.68	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84
	Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00
	Cereals	0.72	0.74	0.70	0.70	0.68	0.74	0.72	0.77	0.71	0.78	0.80	0.75
	Stimulants	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.89	0.92
	Fruits	0.99	0.99	0.99	0.99	0.98	1.00	1.00	0.98	0.97	1.00	1.00	1.00
	Legumes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.97	1.00
	Oil products	0.00	0.00	0.00	0.33	0.42	0.54	1.00	1.00	1.00	1.00	1.00	1.00
	Tubers	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	0.97
Brazil	Sugar	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Cereals	0.88	0.97	0.99	0.92	0.87	0.89	0.79	0.89	0.80	0.86	1.00	1.00
	Stimulants	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Fruits	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Legumes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Oil products	0.96	0.83	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Tubers	1.00	1.00	0.99	0.99	0.98	1.00	0.99	0.93	0.94	0.94	0.88	0.90
Chile	Sugar	0.18	0.41	0.66	0.70	0.16	0.87	0.68	0.84	0.71	0.58	0.38	0.36

	Meat	0.96	0.97	0.95	1.00	0.97	0.97	1.00	0.93	0.92	1.00	0.98	0.99
	Cereals	0.89	0.82	0.80	0.67	0.61	0.81	0.91	0.72	0.60	0.74	0.65	0.69
	Stimulants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fruits	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Legumes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.42	0.25	0.34	0.16
	Oil products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.13	0.04	0.09
	Tubers	1.00	0.99	0.97	0.98	1.00	1.00	1.00	0.98	0.98	0.96	0.93	1.00
Colombia	Sugar	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.99	0.98	0.98
	Cereals	0.83	0.86	0.82	0.87	0.78	0.70	0.82	0.53	0.49	0.47	0.33	0.36
	Stimulants	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Fruits	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Legumes	0.98	1.00	1.00	1.00	1.00	0.58	0.92	0.61	0.34	0.36	0.34	0.39
	Oil products	0.83	0.50	0.86	0.90	0.57	0.68	0.87	0.85	0.90	1.00	0.77	0.84
	Tubers	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.99	0.94	0.96
Ecuador	Sugar	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.87	1.00	1.00	0.96	0.92
	Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.99	0.99
	Cereals	0.97	0.98	0.89	0.83	0.62	0.65	0.72	0.81	0.73	0.66	0.65	0.62
	Stimulants	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Fruits	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Legumes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Oil products	0.86	0.82	0.64	0.29	0.64	0.69	0.86	0.87	0.84	1.00	1.00	1.00
	Tubers	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	0.96	1.00
Guyana	Sugar	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Meat	0.61	0.69	0.79	0.83	1.00	0.99	0.82	0.67	0.53	0.94	0.94	0.91
	Cereals	1.00	1.00	1.00	1.00	1.00	1.00	0.74	1.00	1.00	1.00	1.00	1.00
	Stimulants	1.00	1.00	1.00	1.00	1.00	-	-	-	-	-	0.00	0.00
	Fruits	0.80	0.84	0.82	0.84	1.00	1.00	1.00	1.00	0.93	0.94	0.71	0.69

	Legumes	-	-	-	0.00	-	-	-	-	0.00	0.00	0.00	-
	Oil products	0.00	0.00	-	0.00	0.00	0.00	-	-	-	0.00	0.00	0.00
	Tubers	0.00	0.00	0.00	-	-	-	-	0.00	0.00	0.00	0.00	0.00
Paraguay	Sugar	1.00	0.86	1.00	1.00	1.00	0.94	1.00	0.96	0.98	1.00	1.00	1.00
	Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Cereals	0.64	0.86	0.83	0.91	1.00	0.83	1.00	1.00	1.00	1.00	1.00	1.00
	Stimulants	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.67	0.80	0.27	0.00	0.00
	Fruits	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.95	0.86	0.93	0.95	0.99
	Legumes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Oil products	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Tubers	0.44	0.90	1.00	1.00	1.00	0.50	0.50	1.00	0.08	0.07	0.05	0.17
Peru	Sugar	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.77	0.83	0.74	0.90	0.88
	Meat	0.97	0.94	0.94	0.99	0.99	0.98	0.98	0.98	0.99	0.99	0.98	0.98
	Cereals	0.66	0.65	0.70	0.52	0.37	0.54	0.46	0.40	0.55	0.52	0.50	0.48
	Stimulants	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Fruits	0.95	0.91	0.97	1.00	0.92	0.96	0.97	0.92	0.94	1.00	1.00	1.00
	Legumes	1.00	0.98	0.93	0.77	1.00	0.85	1.00	1.00	0.76	0.88	0.57	0.61
	Oil products	0.00	0.00	0.00	0.02	0.12	0.21	0.40	0.29	0.21	0.09	0.15	0.20
	Tubers	0.99	0.99	0.99	1.00	1.00	1.00	0.99	0.98	0.98	0.97	0.97	0.98
Suriname	Sugar	1.00	1.00	1.00	0.91	0.47	0.54	0.20	0.48	0.40	0.19	0.23	0.23
	Meat	0.59	0.59	0.53	0.73	0.71	0.77	1.00	0.51	0.44	0.40	0.39	0.37
	Cereals	1.00	1.00	1.00	1.00	1.00	1.00	0.89	1.00	0.89	0.84	1.00	1.00
	Stimulants	-	-	0.00	-	-	-	-	-	-	-	-	0.00
	Fruits	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Legumes	-	-	-	-	-	-	0.00	-	-	-	-	-
	Oil products	-	-	-	1.00	1.00	1.00	0.33	0.20	0.00	0.00	0.00	0.00
	Tubers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Uruguay	Sugar	0.30	0.68	0.45	1.00	0.97	0.87	1.00	0.17	0.09	0.08	0.09	0.09

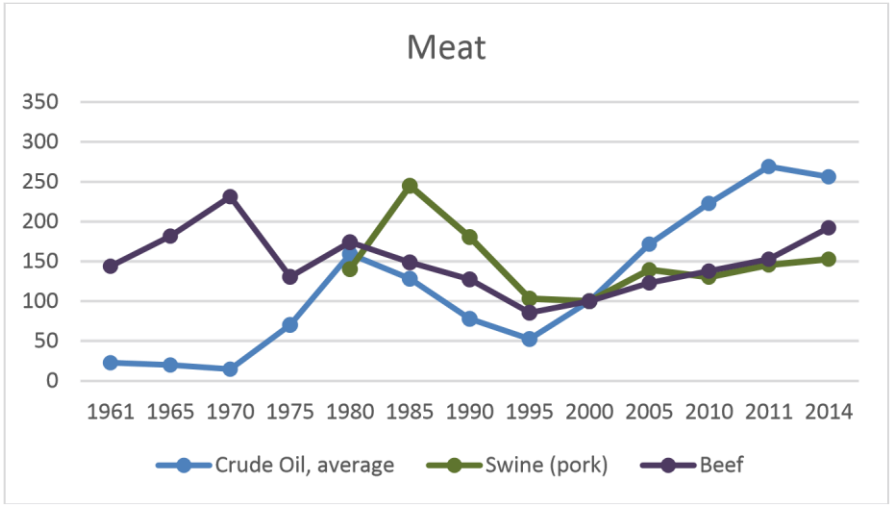
	Meat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Cereals	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Stimulants	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fruits	0.86	0.90	0.89	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Legumes	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	1.00
	Oil products	-	-	-	0.17	0.83	0.67	1.00	1.00	0.25	0.00	0.00	0.00
	Tubers	0.76	0.91	0.84	0.88	0.72	0.97	0.89	0.89	0.63	0.88	0.74	0.67
Venezuela	Sugar	1.00	1.00	1.00	0.98	0.50	0.70	0.75	0.55	0.74	0.73	0.38	0.38
	Meat	0.95	0.96	0.99	0.99	0.96	1.00	1.00	1.00	1.00	0.90	0.83	0.84
	Cereals	0.50	0.57	0.49	0.42	0.33	0.37	0.51	0.48	0.55	0.65	0.40	0.39
	Stimulants	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.76	0.75
	Fruits	0.97	0.97	0.98	0.98	0.98	1.00	1.00	1.00	0.97	0.99	0.95	0.93
	Legumes	0.59	0.48	0.27	0.34	0.21	0.16	0.39	0.11	0.10	0.45	0.36	0.32
	Oil products	0.40	0.40	0.63	0.80	0.50	0.29	0.12	0.36	0.31	0.21	0.10	0.08
	Tubers	0.76	0.89	0.86	0.90	0.89	0.93	1.00	0.66	0.71	0.87	0.87	0.88

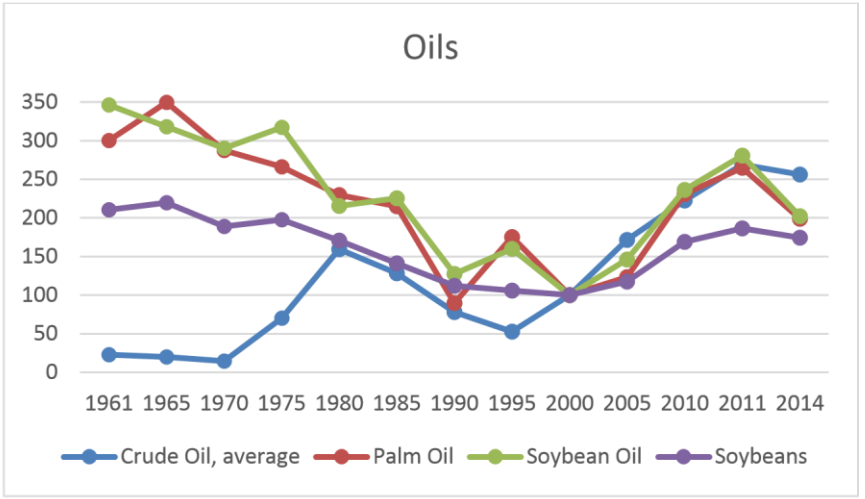
Source: FAOSTAT, 2015

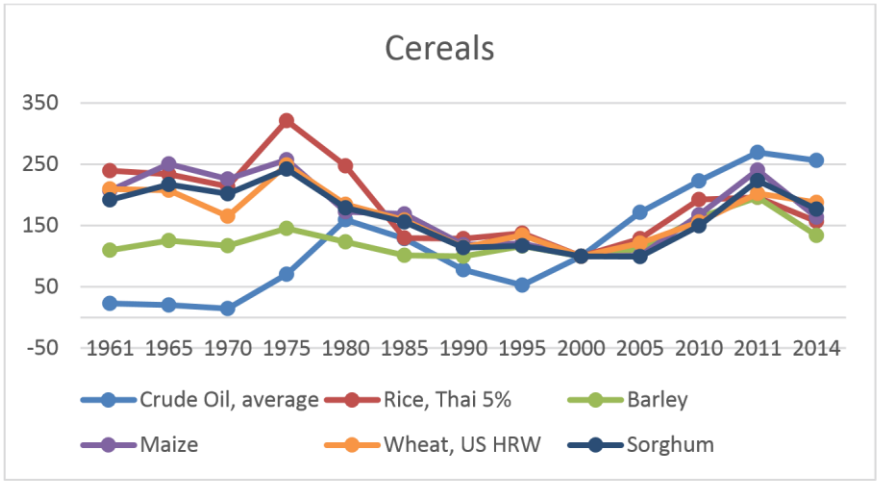
In some occasions, like in the last cycle of high prices for commodities (that ended in June 2014), the loss of food self-sufficiency can be explained by the dynamics of the *Dutch disease*: the traded good by excellence (oil or minerals), through its high prices, appreciates the real exchange rate. This eases imports, so the production of tradable goods for domestic consumption (especially agricultural products) are continuously under pressure by similar imported goods, that are cheaper because of the exchange rate. After two decades of adjustment (macroeconomic first and structural afterwards), the agricultural sector has been under constant pressure. This has not been compensated by the appropriate policies in terms of access to technology, funding or subsidies for inputs. This is free trade of comparative advantages in play.

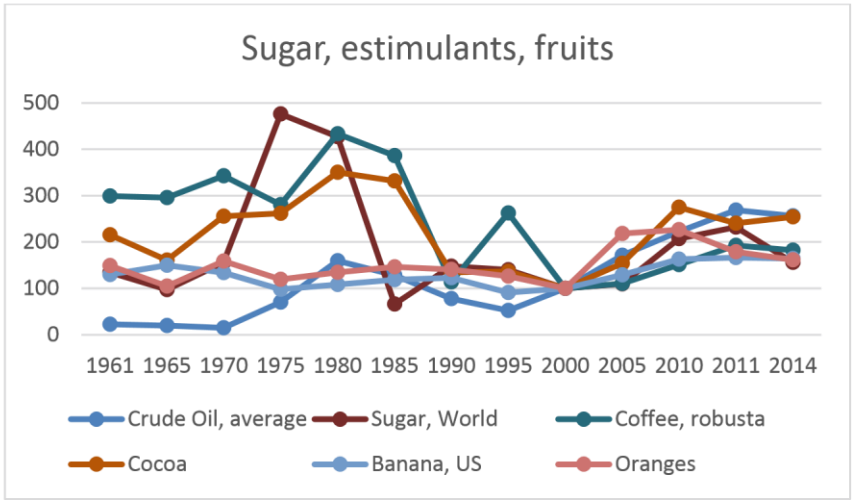
The evolution of international prices in real terms (USD of year 2000) is shown in **Figure 2** (2000 = 100). We have grouped products and we represented an average of international crude oil price, for reference. When looking at the long term, we see meat has remained stable over time. However, oils (soy and palm) decreased gradually until the recent boom in commodities. After 1980, its evolution is totally aligned to that of crude oil. The same happened with cereals, all them evolving similarly. Fruits (oranges and banana) have been very stable through the period, until 2000, whereas sugar, coffee and cocoa have experienced a downward trend, with a high degree of volatility. In summary, the products in which South America is specialized for exports show decreasing or stagnant real prices over the long run (worsening the terms of trade), despite the recent boom experienced in commodities. In real terms, prices are very similar to those of 1961.

Figure 2: Evolution of international prices, index number, and year 2000 = 100









Source: World Bank, 2015b; IMF 2015

6. The link between food self-sufficiency and nutrition

Conventional economics would tell us that if a product is cheaper in international markets than it is domestically, a country should import that product. Under this reductionist logic, based exclusively in monetary variables, we can omit fundamental aspects of the issue. One of them is the link existing between food self-sufficiency and nutrition, due to the cultural diversity (genetic and gastronomic) of a country. In this way, importing food products may have direct impacts in terms of losing genetic diversity, which could lead to even changes in the diet, associated to the spread of malnutrition or overweight.

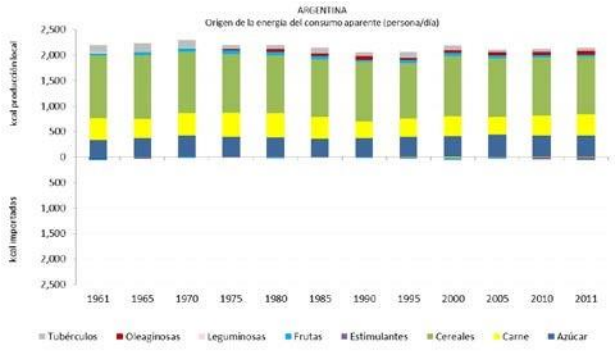
Apparent consumption, measured as calories intake per person and day, increased in almost all the UNASUR countries in the period 1961-2011. The only exception being Argentina, where calories intake went from 2.263 kcal/person/day in 1961 to 2.191 kcal/person/day in 2011, explained mainly by a reduction in the consumption of wheat and beans.

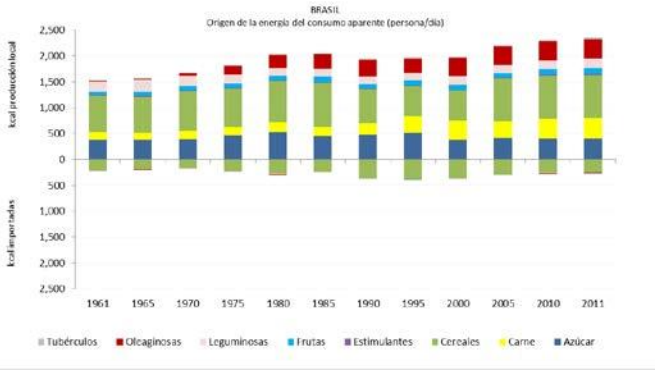
Along with the increase in calories intake one can see a change in the diet of population (see **Figure 3**), which would follow the so-called Bennet's Law (Bennet, 1941). According to Bennet, carbohydrates intake would be reduced as income per capita grows, and protein-rich products such as meat would increase its consumption.

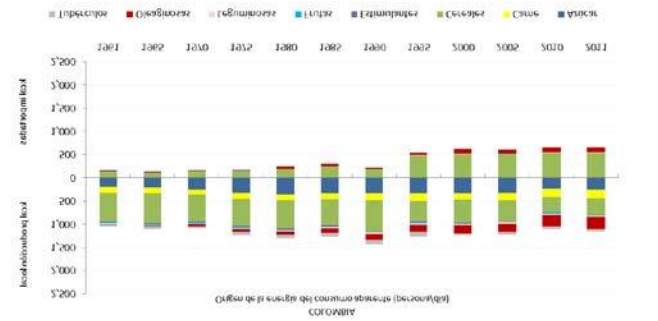
Meat is, after oils, the category of product with a higher growth rate in caloric intake in almost all UNASUR countries. Meat grew faster in Chile (2.35%), Suriname (2.17%), Brazil (2.13%) and Ecuador (2.11%). However, meatexporting countries show the opposite trend, like Argentina (0.02%) and Uruguay (-0.5%). In this case, it reflects a change in which chicken meat is growing at the expenses of beef.

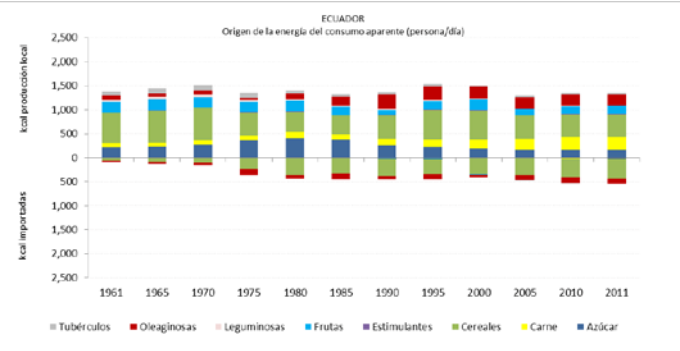
On the other hand, calories intake from cereals has grown below 1% in every country of the region. Some countries have even reduced its consumption, as in Argentina (-0.16%) or Chile (-0.03%). The same happened with tubers, like potatoes. Despite being native to the region, potato consumption went down in several countries such as Ecuador (-1.78%), Argentina (-1.59%), Bolivia (0.69%), Uruguay (-0.48%) and Chile (-0.42%).

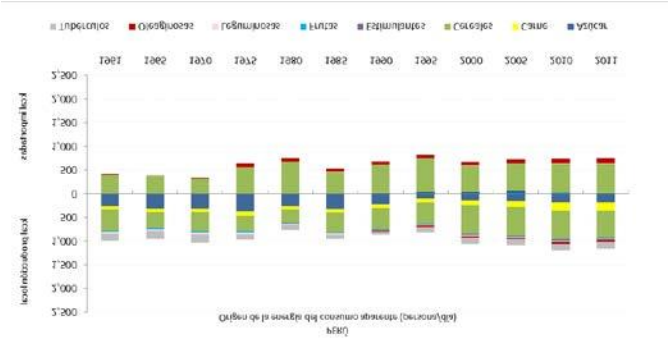
Figure 3. Origin of the energy from apparent consumption per person per day, selected countries (1961-2011)

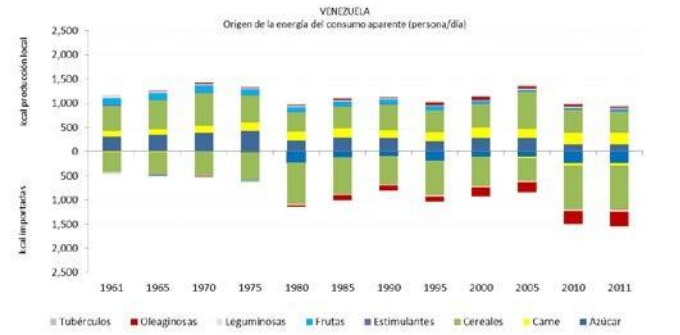










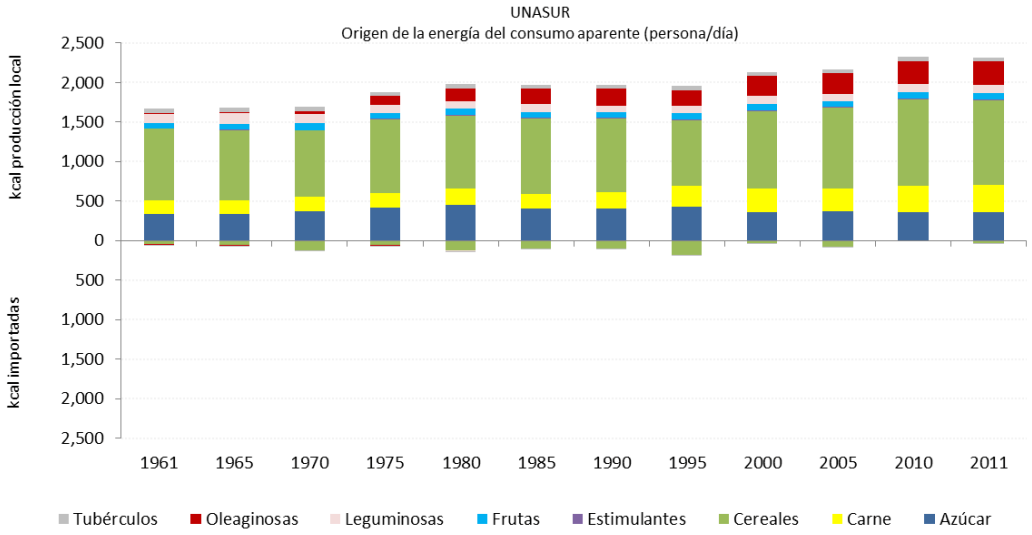


Source: FAOSTAT 2015

The previous results are also seen when looking at UNASUR as a block. Meat calorie intake went up at a yearly growth rate of 1.35%, while cereals and tubers evolved at 0.28% and -0.16% respectively in the period analyzed.

Concerning the origin of the calories, we see in **Figure 4** that UNASUR has the potential to provide for all the food needed by its population. One of the reasons for that is the great agroecological diversity present in the region. Argentina (with cereals, legumes and sugar exports) and Brazil alone (with legumes and sugar exports) are able to supply most of the requirements of the rest of UNASUR countries.

Figure 4: Origin of the energy of apparent consumption per person per day, UNASUR (1961-2011)



Source: FAOSTAT 2015

7. Opportunities for complementarity

UNASUR countries imported 11.4 million tons of food products from other regions in year 2011. Only three products represented 79% of the imports: wheat (54%), corn (15%) and sugar (11%). These are by no means sumptuary imports (see **Table 6**).

Table 6: Volume of imports and exports of UNASUR from and to the rest of the world in tons, 2011

Products	Imports	Exports
Apples	59.446	1.631.110
Banana	33	7.701.114
Barley	485.883	1.817.855
Beans	175.973	245.798
Beef	89.967	1.866.354
Chicken meat	89.999	3.881.606
Cocoa beans	98.744	299.595
Coffee	30.058	2.792.599
Corn	1.728.074	20.704.822
Grapes	56.871	1.657.175
Oats	583	113.908
Oranges, tangerines	81.964	7.763.135
Palm Oil	352.696	314.839
Pork meat	50.151	863.003
Potatoes	442.410	4.112
Rice (Elaborated)	37.247	1.908.966
Sorghum	850	616.067
Soy	142.439	50.205.977
Soy Oil	183.503	5.695.885
Sugar, non refined	1.212.210	24.837.520

Wheat	6.155.400	7.357.300

Source: FAOSTAT, 2015

The region produces these three main products with a surplus, which is exported. Trade complementarity between member countries could lead to the region not importing any of them. If only Brazil would import all the wheat it needs from other member countries, UNASUR imports would be halved, as Brazil is currently importing about 6.5 million tons. Argentina, on the other hand, is producing 8.5 million tons per year. **Table 7** shows the opportunities for complementarity between UNASUR countries. It lists the tons for each product a country was exporting in 2011 outside the region. This is the potential for complementarity, about 11 million tons per year.

Table 7. Trade complementarity within UNASUR by product (tons) and country

Product	Argentina	Brazil	Chile	Colombia	Ecuador	Peru	Uruguay	Rest of the World
Apples	23,558		35,888					
Banana					33			
Barley	485,374							509
Beans	175,973							
Beef		87,621					2,346	
Chicken meat	16	89,983						
Cocoa beans					98,744			
Coffee		30,058						
Corn	1,726,750	1,324						
Grapes	12,414		44,457					
Oats			583					
Oranges, tangerines	30,158	51,806						
Palm Oil		104,995		114,525	95,317			37,859
Pork meat		49,151	1,000					
Potatoes	1,828		1,277			625		438,680
Rice (Elaborated)		32,711					4,535	
Sorghum	850							
Soy	1	142,438						
Soy Oil	183,503							
Sugar, non refined		1,193,210		19,000				
Wheat	3,654,203	2,325,705					175,492	

Source: FAOSTAT, 2015

Exports account for 65% of Argentina's wheat production. Argentina is also the second exporter of corn and Brazil is the third producer. However, complementarity is not working. Venezuela, for instance, is a large importer of corn, but it buys it from the USA instead of buying it from Argentina.

The same happens with sugar. Brazil is the first world producer, with Argentina and Colombia in the top of the list. However, the region as a block is importing sugar from elsewhere.

If production and trade policies would be in place in favor of complementarity between countries, the amount of food imports in UNSAUR would be reduced from 11.4 million tons to just less than half a million tons, leaving only barley, palm oil and potatoes as food imports.

This last result on potatoes is shocking, especially if one takes into account that potatoes are native to the Andes (actually, the name is *papa*, and the current name potato is a mistake made by Spaniards, who mistakenly took it from Antille's *batata* or sweet potato, a mistake that continued in all the European languages

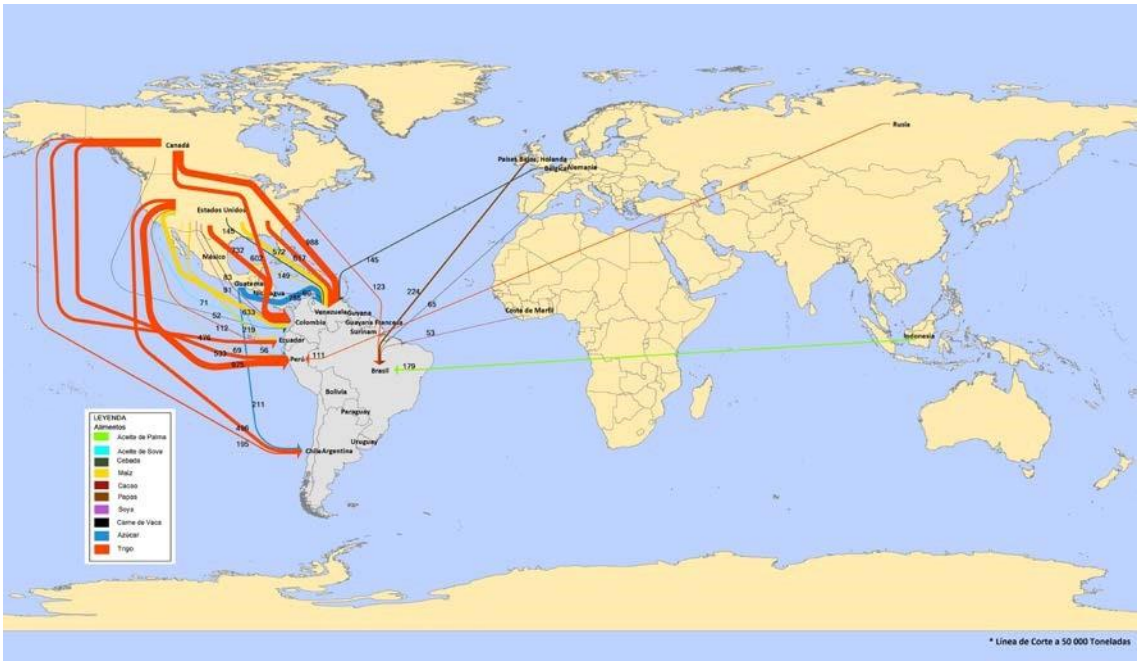
until today). Only Argentina, Peru and Chile export significant amounts of potatoes. This is clearly an opportunity for the Andean countries of the region to expand production of a native product that is currently imported, especially because the varieties produced in the region are adapted to extreme conditions and high altitudes that keep plagues away.

Ecuador would be one of the countries benefited from such an integration. Ecuador could provide the region with 100.000 tons of cocoa that is currently imported from outside UNASUR countries. The same occurs with palm oil. Ecuador (with about 100.000 tons) along with Brazil and Colombia (with similar amounts) could provide for about 90% of the palm oil that is currently imported in the region. The third product with which Ecuador could contribute is banana, although to a lower extent.

In the case of meat, the current 90.000 tons of imported beef could be provided by Argentina, Brazil and Uruguay. Brazil and Chile could provide for pork meat imports.

Figures 5 and **6** show the traded volumes and origins of the 11.4 million tons UNASUR countries import from other regions in 2011 and the outcome if complementarity was implemented in the region.

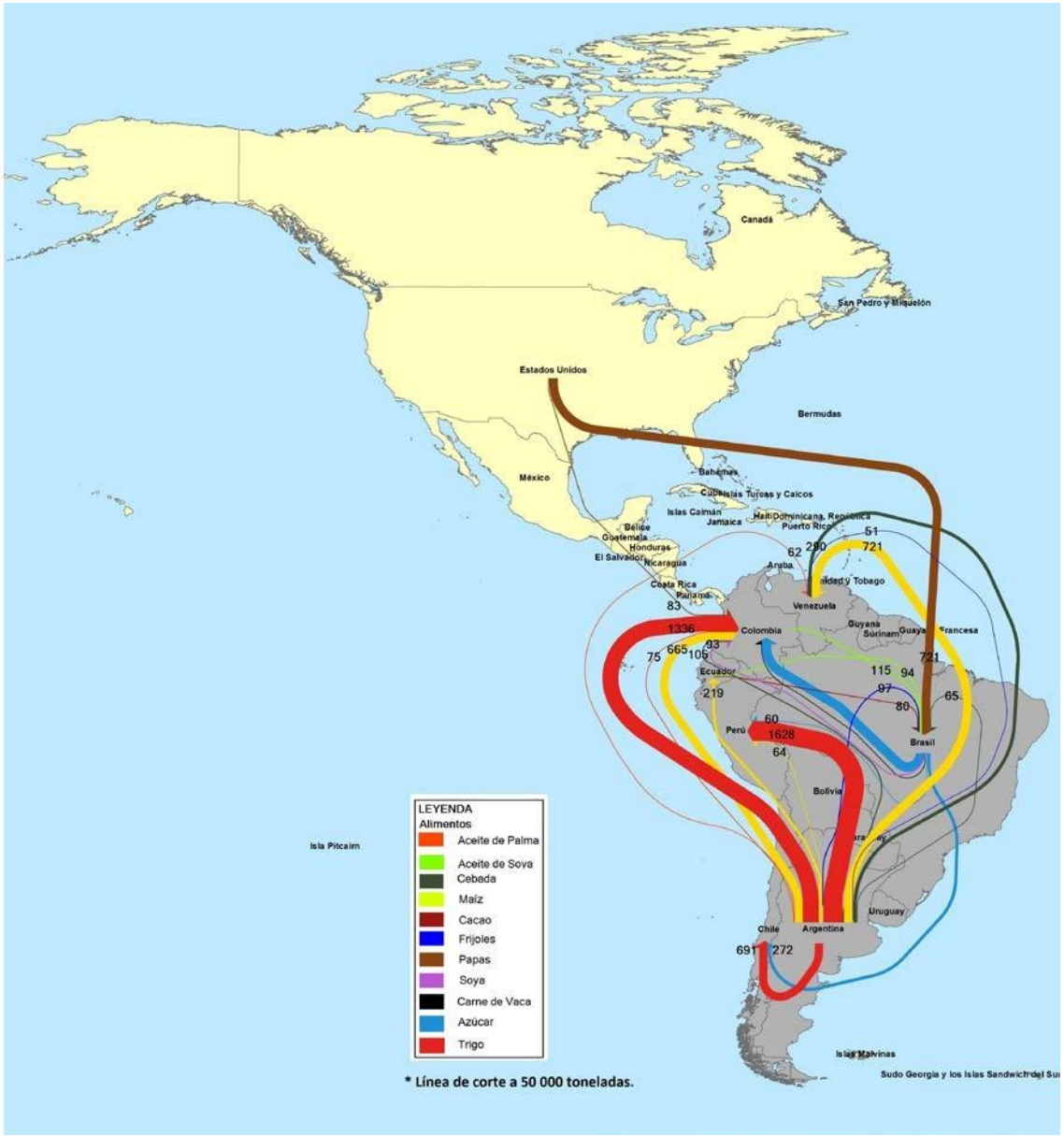
Figure 5: Flow of trade volume for UNASUR in 2011



Source: FAOSTAT 2015; **Elaborated by:** Belén Liger

In economic terms, supplying UNASUR with products from the region could have implied a trade diversion or substitution (extra-regional to intra-regional) of about 4.865 M USD in 2011. With no doubt this increase in regional trade would favor the cause for economic integration that is the ultimate goal of UNASUR. Another positive aspect of this complementarity would be the reduction in the transportation needs, with the consequent reduction in CO2 emissions. Finally,

within a context of climate change, scarcity of arable land and water resources, the region would gain in food self-sufficiency, a beneficial outcome for its population that would be less exposed to international price variability. **Figure 6:** Flow of complementarity volumes, UNASUR 2011



Source: FAOSTAT 2015; **Elaborated by:** Belén Liger

8. Conclusions

Regional integration projects like UNASUR need to consider strategies that aim to reduce food dependency. Food self-sufficiency is not just an idealistic goal; it has practical reasons as well. In economic terms, it helps saving huge amounts of currency that remain in the region and can be used for importing machinery and technological products not available in the region.

From an ecologic perspective, it avoids emissions due to unnecessary transport of food products for long distances. It also helps reducing energy use, mainly fossil fuels.

The most important outcome is, however, that food self-sufficiency makes countries less vulnerable: to draughts and other natural disasters in other regions; to food price rises (often caused just by speculation) and to the use of food and trade policies as a means of foreign policy by nations from the North.

However, the region is not exploiting this opportunities for complementarity. We have identified a potential of 11 million tons, with an equivalent of 4.865 M USD for this complementarity in 2011. However, during the period analyzed the region has lost food self-sufficiency. The countries are not articulated and there is no regional planning of imports, giving too much importance to carbohydrates and very little to proteins. A consequence of this behavior is that the region has become more vulnerable to international markets. How this could be changed?

There is an urgent need of integration and coordination of policies. Agreements on common prices could be a start, as is done in other regions of the world. This integration would not only reduce exposure and vulnerability to developed economies, but it would also bring benefits in economic terms, by reducing transportation costs and by encouraging new activities such as logistics.

This food complementarity needs to go hand in hand with policies oriented to changing the diet, focusing on nutritional aspects and recovering the use of some traditional products and practices. South American complementarity leading to improving food self-sufficiency becomes then an imperative.

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