FOOD, FEED AND FUEL
A CONFLICT IN THE USE OF AGRICULTURAL SOILS

Vittorio Amato*

Abstract

The debate on biofuels in last years has mainly focused on environmental and energy issues at least until they have begun to emerge concerns about the effects of such practices on the agricultural markets and on the prices of the main products. In other words, the use of biofuels has been intended, in the current opinion, as a solution with a particular value in the energy and environmental perspective rather than an issue of strictly agricultural relevance. It follows that the same policies for the promotion of this sector were intended mainly as energy and environmental policies. This is because on the one hand biofuels are potentially a very interesting alternative to fossil fuels, and for the other they contribute not only to solve a problem of energy supply -especially for countries depending on imports- but also a problem of environmental nature, due to the excessive emission of greenhouse gases, with the consequent effects of global warming and climate change. The paper analyzes the complex geography of production and consumption of biofuels and comes to the conclusion that what appears altogether overlooked is the combined effect of all the possible causes of the food crisis and rising prices. In particular, in the context of a reduction in cereal stocks for years at a global level, is not to be excluded that the impact of biofuels, seemingly minor from the quantitative point of view, together with the expectations of their growth, has been precisely at the origin of a large-scale speculative wave.

1. Introduction

As a preliminary point, it should be stressed that the debate on biofuels has focused mainly on environmental and energy issues, at least until it began to arise doubts about the effects of such agricultural practices on markets and prices of the main products. In other words, that of biofuels is intended, in the current opinion, as a solution with a value from the energy and environmental profile rather than a topic of strictly agricultural importance. It follows that the very promotion policies in this field were intended primarily as energy and environmental policies. This is because biofuels on the one hand are potentially a very interesting alternative to fossil fuels, (especially for transport fuel for which alternatives are struggling to emerge) and on the other contributes not only to solve an energy supply problem - especially for countries dependent on imports - but also an environmental problem. Namely the excessive emission of greenhouse gases with the consequent effects of global warming and climate change. Their validity and criticality should be assessed, therefore, precisely in connection to the energy and environmental contribution that they can give.

About it, though, it should be shed light on some aspects. First, the global energy demand is such that, even if it was to be used for energy purposes the entire production of crops which are today used to produce biofuels, this would result, however, in a modest contribution. After all, biofuels are only part (about 2%) of the largest set of the so-called bio-energy (or energy from biomass) that, in turn, is a part (about 70%) of the

so-called renewable energies. The latter, at present, cover a limited portion of global needs estimated at about 18% and this leads to point out that biofuels, today, contribute to only 0.3% of global needs. To look at biofuels as a "general" solution to the energy problem can be, therefore, misleading.

Similar reasoning applies to the environmental contribution that can be expected from biofuels. The IPCC reminds us that the share of emission of greenhouse gases attributable to the transport (the consumption of fuels for automotive purposes) does not exceed globally 15% of the total emissions. It is true that this share can reach and exceed 20% in most developed countries (for example, in the EU), but it is still a limited portion. The replacement of 20% or 10% of fossil fuels with biofuels over the next 10-15 years (targets that have given the US and the EU, respectively), while sounding very ambitious, will, at best, help to reduce emissions of 5%. To get an order of magnitude, consider that the only agriculture (excluding deforestation and therefore considering only crops and agricultural practices that result in emission) is given a quota of emission of 15%. From the point of view of the primary sector, then, an equally valid result in environmental terms could be obtained, in place of the production of biofuels, through a reduction of 30% of agricultural emissions of greenhouse gases or, to an even greater extent, increasing the so-called "carbon sequestration capacity" by agricultural activities using more conservative techniques. Finally, a very important point to emphasize is that, in terms of reduction of emissions, the real energy and environmental contribution that biofuels can provide is not at all univocal. This depends, in fact, both from the raw material used and from the process by which they are obtained and used.

Throughout the supply chain that goes from the cultivated field until the gas station, the production of biofuels, in fact, requires itself energy and, therefore, contributes in turn to increase greenhouse gas emissions. To understand the energy and environmental net contribution of these products it would be necessary to conduct a careful Life Cycle Assessment, case by case, based on the feedstock used and the final product obtained.

Must then be highlighted the problems triggered in the use of agricultural products throughout the production chain which are not necessarily mutually exclusive. Some applications, in fact, are complementary being some based on by-products of the others. This is particularly true, and it is matter of great importance, in relation to the feed uses (intended for animal feeding) and fuel (energy) of most of the crops used as biofuels. In fact, the fuel production is not an alternative to the production of feed; the two things can go together since the energy use extracts only a part of the product while the rest can be addressed at least for animal feed. Being each other's by-product there is no real competition between fuel and feed, but the real competition exists, conversely, between fuel and food exactly as exists between food and feed. This is clearly true in a first and gross approximation; in fact, the feed obtainable from corn or soybeans after extracting the raw material for the fuel use is not the same, having lost important nutrients; therefore, it has less nutritional and economic value and must be properly integrated. Nevertheless, must be kept in mind that in the production reality of these chains, the flexibility and technological advances achieved make the ratio of substitution and complementarity between different uses anything but trivial.

In the light of these considerations, is quite legitimate to ask whether the side effects of negative type that the development of biofuels may have generated (and may in the future generate) in agricultural markets are indeed a necessary price to pay to get an

environmental and energy benefit that, although strategic and of global interest, is far from certain, and not necessarily of great magnitude. Basically, it is quite questionable whether the policies of promotion of biofuels are indeed policies that contribute to the increase in the overall well being of a nation and/or the entire world population.

2. Geography of the productive chains

Whether and how the factors that are concatenated in the growth of the biofuel industry generated cascading effects in agricultural markets, it depends substantially on the price transmission system and the substitution and complementarity relations between different products. In other words, what must be taken into consideration is the structure of the production chains. The answer about the pursuit of incentive policies in the production and use of biofuels cannot, therefore, be given in the abstract, but must necessarily be dropped in the specific of the agro-energy supply chains that arose.

The first thing to note is that the geography of the bio-fuels industry, globally, is made mainly from three supply chains: firstly, ethanol from sugar cane in Brazil, then ethanol from corn in the United States and finally biodiesel mainly in Europe (but mainly in Germany, which produces more than 50%). These are, in fact, the only productive chains that currently show a certain quantitative significance and the rest, to the state, has very limited size and, consequently, could not have played any role in the performance of the markets and agricultural prices worldwide.

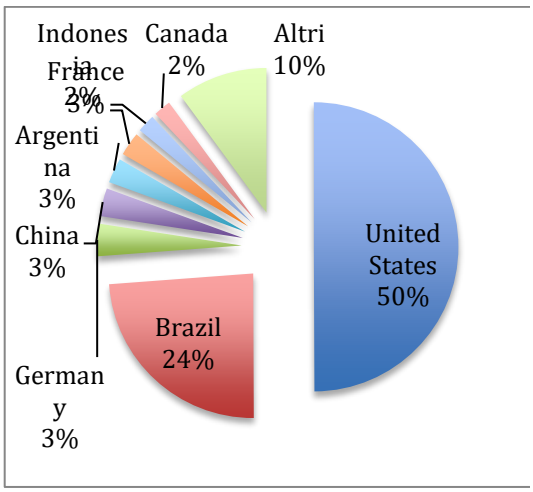

Figure 1: Percentage shares in the production of biofuel.

(Source: elaboration on data United States Energy Information Administration)

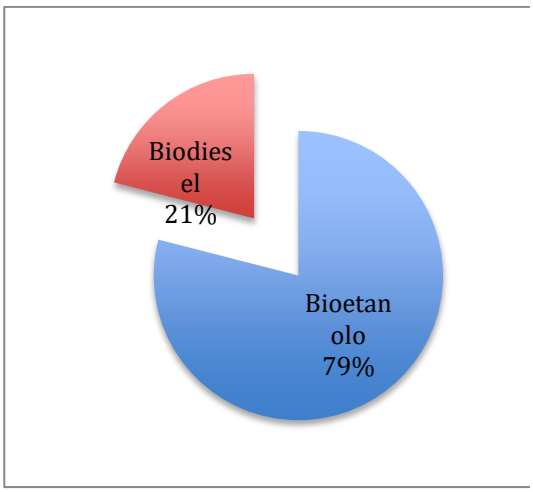

Figure 2: World percentage of biodiesel and bioethanol

(Source: elaboration on data United States Energy Information Administration)

It is appropriate, therefore, to analyze in more detail, which are the countries, the agricultural products and the trade relations that, even in recent years, have generated and consolidated these three chains.

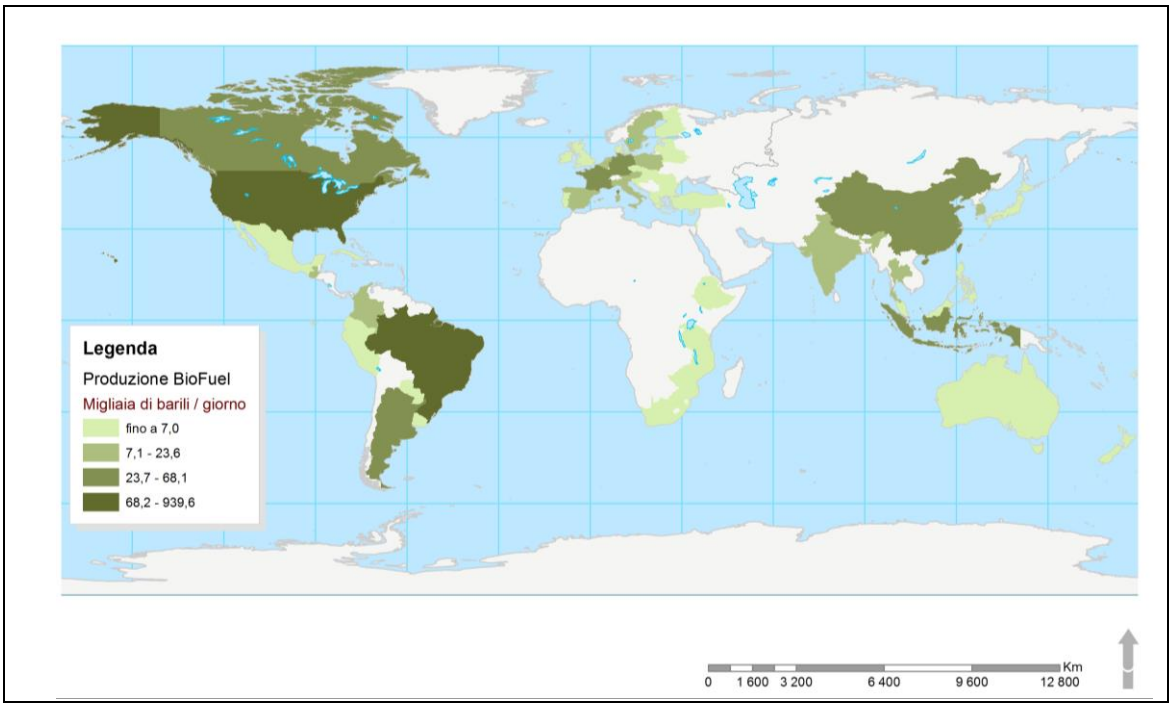

Figure 3: Biofuel production by country

(Source: elaboration on data United States Energy Information Administration)

3. Geography of productions

The production of biofuels worldwide is heavily concentrated in a few large areas attributable to the US, Brazil, and the EU and, if we consider separately bioethanol and biodiesel, this concentration is even more pronounced, being the expression of different agricultural specialization of the various countries. This concentration and specialization is not only a "dimensional" illusion, namely linked to the size of their respective economies and agriculture. So much so, that big countries and agricultural powers such as China, Russia, Australia and Argentina, show, on the contrary, limited developments in biofuel production quantities.

What led the United States, Brazil and the EU to be the absolute leader in this field is, rather, due to specific energy and environmental policy decisions, albeit with different timing and mode. The picture that emerges from the data available in the OECD-FAO dataset is quite clear and can be summarized in a few points:

- The production of bioethanol is clearly prevalent than that of biodiesel (respectively, 79% and 21% of the total).
- The share of US, Brazil and EU is very high, especially for bioethanol (approximately 95%) but also for the bio-diesel (about 80%).

- More than 75% of global production of biofuels is concentrated in Brazil and the USA in almost equal proportions. The great part is made up of bioethanol (in the two countries, the share of biodiesel is about 0.1 to 6% of the total, respectively).
- About 11% of world production of biofuel is made from the biodiesel manufactured from the EU (which, by itself, generates more than 60% of the world production of biodiesel).
- In the EU, biodiesel production is highly concentrated in Germany (about 50%) and France (15%). These same two countries also hold the highest bioethanol production quotas.

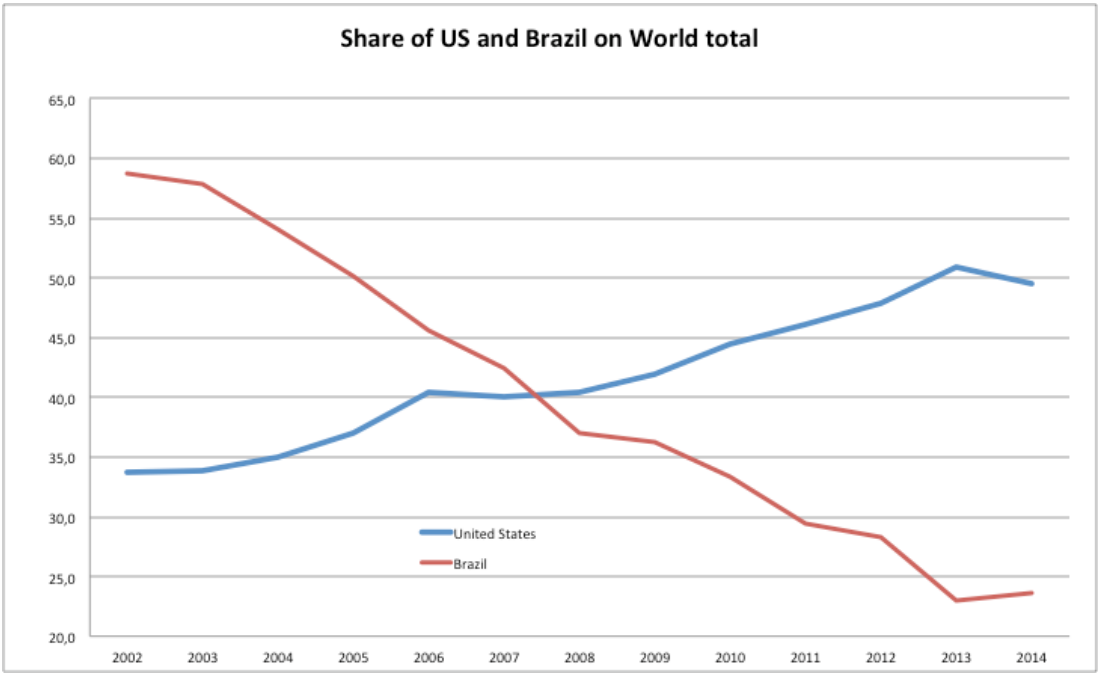

Figure 4: Share of US and Brazil on World total

(Source: elaboration on data United States Energy Information Administration)

The clarity of these data in terms of high concentration and specialization is likely, however, to conceal significant changes in production scenarios observable over the years. First, since 2006 the US has surpassed Brazil in the production of bioethanol. In the latter country, as is known, production has been consolidated over time as early as the seventies and has continued to grow even in recent times though at fairly limited rates.

Conversely, the production of bioethanol was negligible in the US until the end of the nineties and has grown sharply in the very years closer to us. It follows, then, that the US started to be firmly the leading bioethanol producer in the world. The EU leadership in biodiesel production has consolidated in recent years, but it is less clear whether in the near future, Europe's share will strengthen further as in the case of bioethanol for the United States since they have recently undertaken a significant development also of biodiesel production (about 15% of the world total) and part of this production is exported to the EU itself.

More generally, although the respective global levels are still very low, several other major agricultural countries face in these productions (both bioethanol and biodiesel) with high growth rates: in particular, China, Australia and Argentina, in addition to Canada, India, Colombia, Indonesia, Thailand. In all these countries, in addition to domestic demand, to be a matter of interest is the presence of important outlet markets linked to exports.

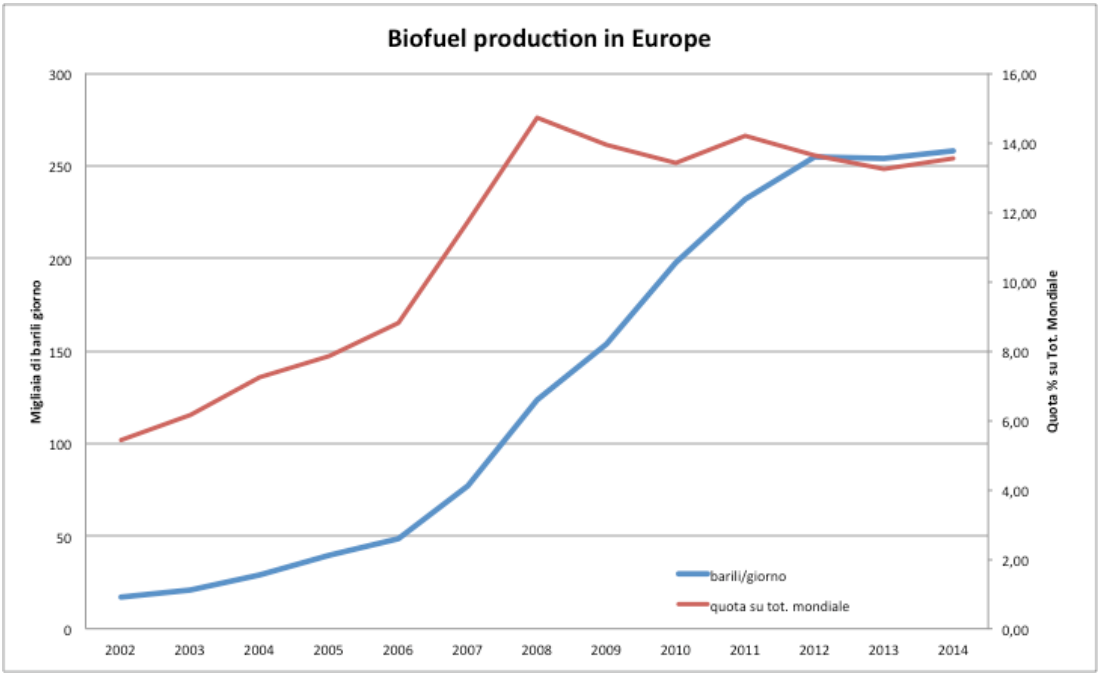

Figure 5: Biofuel production in Europe

(Source: elaboration on data United States Energy Information Administration)

In Europe, the balance of forces now appears consolidated with Germany and France than before and more than others have focused on these sectors, though with differentiations outlined above, but it should be emphasized that the increased presence of these countries is not necessarily attributable to a higher agricultural matrix. About production of corn seeds and oleaginous Italy and Spain, for example, have surfaces and volumes which would allow similar performance in the production of biofuel. It is rather the industrial component (energy, but also automotive and food industries) and the entire agroenergetic supply chain to have organized the first in this direction, accompanied by national policies to promote the sector. Therefore, if and how much the biofuel market will be growing in the coming years is unlikely that these relations of force can be changed in the short to medium term.

4. The raw materials

The high concentration by country determines also a strong crop specialization because, at present, there are few crops that contribute significantly to the production of biofuels. They are, essentially, only two significant crops about the bioethanol, namely

the sugar cane in Brazil and corn in the United States. The proportions between the two have remained in time substantially constant at around 75% and 20% while the remaining 5% is represented by other crops (cassava, sugar beet, wheat, barley, etc.). As for the production of biodiesel, rapeseed (prevalent in the EU) it is now about 85%, so it has the majority compared to other vegetable oils (soybean and sunflower, 13%, palm oil, 2%).

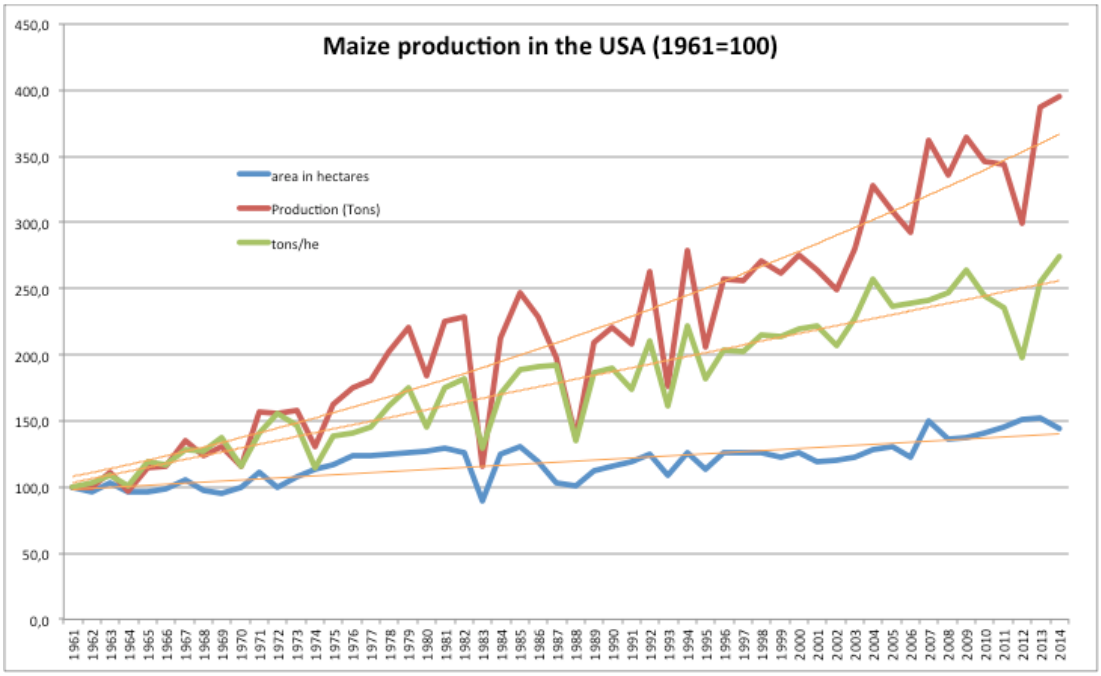

Figure 6: Maize production in the USA

(Source: elaboration on data Faostat)

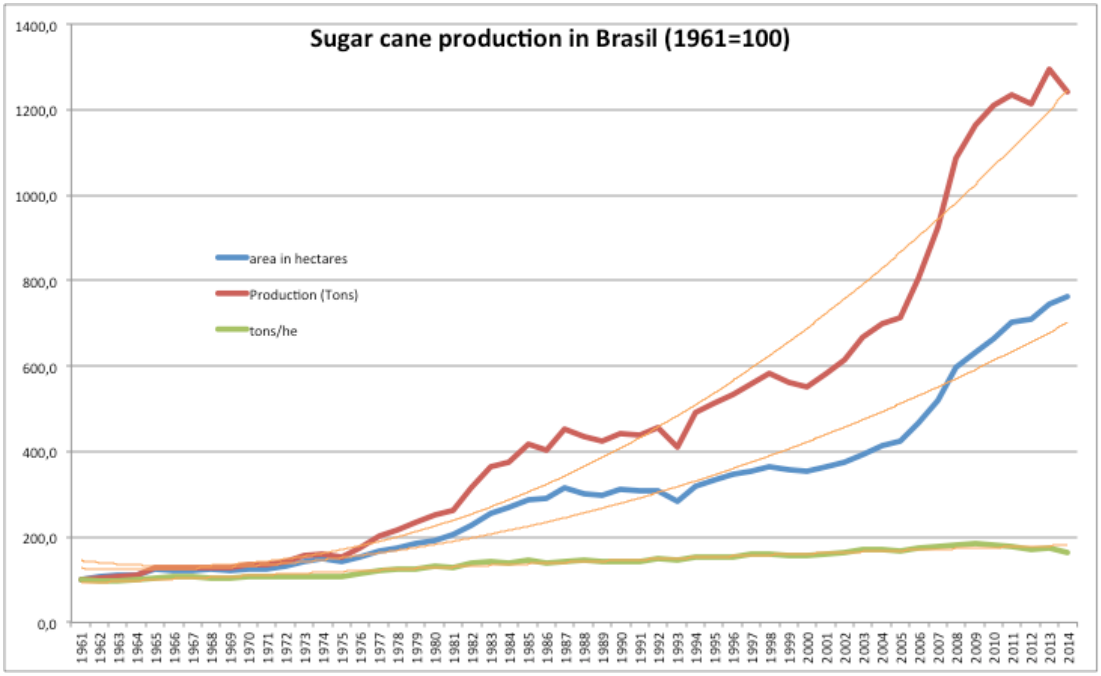

Figure 7: Sugar cane production in Brazil

(Source: elaboration on data Faostat)

Basically, therefore, the agricultural matrix of the biofuel business concerns mainly three crops: sugar cane, corn and rapeseed which are typically industrial crops, with multiple uses and weak relevance, at least in a direct way, for what concerns human nutrition. This means that none of these crops is essential to the livelihoods of populations in conditions of underdevelopment because even corn has, by now, a share of marginal use as food worldwide. It is also true that maize is a crop of major importance for animal feed, and that the sugar cane is the most important crop, and economically advantageous, to produce sugar. Difficult to think, however, that their fuel use may endanger the existence of entire populations and food self-sufficiency. Even in this case, however, only photographing the existing scenario may provide a misleading representation of reality. In fact, in recent years (and even more in the future) it has grown the use of other crops such as soybeans (in the US, Brazil, Argentina and the EU itself) and palm (in the countries of Southeast Asia) regarding biodiesel, whereas, especially in the European Union, it is expected to grow the involvement of the wheat and barley crops to produce ethanol, as well as cassava in the case of the southeast Asian countries. It comes, in these cases, of crops whose implications in the food supply, particularly in some geographical areas, may be more relevant and direct.

The different agricultural matrix in the production of biofuels in the various countries involved, not only explains the relative specialization (bioethanol in the US and Brazil, bio-diesel in the EU), but above all generates very important implications about the evolution of this sector and the competitive performance of its protagonists. Although there is no differentiation of the product, since the final product is indistinguishable (bioethanol or biodiesel, that is), there is a substantial difference in the production process, from the field to the distributor, precisely in relation to the involved agricultural matrix. For each crop, in fact, you can associate a different economic convenience, a different energy efficiency and a different environmental impact, and, finally, different implications in terms of food self-sufficiency. In particular, in terms of economic convenience, are more profitable those crops that produce greater quantities of substance useful for processing into fuel namely high yields.

In general, it is possible to establish a ranking of crops with which to associate the country of reference namely the one which makes the most use to produce biofuels, but this ranking of economic convenience also results in a ranking of competitiveness among countries. In terms of cost, the Brazilian ethanol (obtained from sugar cane) is more competitive than that from corn of Use or that of the of EU from wheat, as well as the biodiesel from rapeseed or soybean of EU and US. This reveals that only protectionist policies to restore economic convenience for the bottom of the league crops (thus for of EU and the US) can keep alive, in the long run, or in the presence of international trade, supply chains based on a non-competitive agricultural matrix.

5. International Trade

Of the consolidation of positions on the biofuels market and related competitive advantages is already possible to find some evidence in international trade. This, in fact, is still very weak for biofuels, especially in the case of bioethanol, because of the major barriers and existing technological issues at various levels. However, two trade flows

are already established and prevailing today: that of bioethanol from Brazil to the United States and that of biodiesel from various countries of origin (mainly United States) to the European Union. In the latter case, in recent years they begin to operate also Asian countries, especially with the production of biodiesel from palm oil. The OECD-FAO data shows that, in the case of ethanol as much as 80% of global net exports is the prerogative of Brazil (about 3 billion liters of exports), while the rest is all to the advantage of China; much less concentrated are the destinations (net imports) that still see the United States in first place with 38% and Japan in second with 17%: together they contribute to 55% of the world's net imports.

Conversely, in the case of biodiesel, the largest share for exports it is for to the United States with 38%, but significant are the values of Indonesia, Argentina and Malaysia. The EU is the main destination (41%; about 0.5 billion liters of imports), followed by Japan. These are data that should not be certainly emphasized, because it is still quite low volumes. Than, say, other energy products such as oil and natural gas, exchanges are still limited although there appears to be quite clear productive specialization. In particular, compared to the volumes produced it is the bioethanol business that seems underdeveloped. The ratio of net production and exports, by volume, accounts for a mere 2%. This value is quite low when compared with energy products, but also with many agricultural products and with the same biodiesel, which has a ratio of 13%.

Among the reasons for this limited development of trade there is certainly to consider the presence of high trade barriers especially regarding the ethanol and in countries where the growth of domestic demand leaves ample space to the product coming from the outside (the USA, first and foremost, but also the EU). On the other hand, precisely the development of a nascent industry driven by domestic demand would justify trade barriers that the US and EU put on bio-ethanol from Brazil, where the industry is now well established and widely competitive.

6. The impact of biofuels on agricultural markets

Given the state and prospects in the brief description field you can go back to the original question, namely whether and to what extent the strong growth of biofuels is or is not responsible for the growth of prices of agricultural products. As mentioned earlier, the answer would seem to be yes, because there is no doubt that this growth increases the demand for agricultural commodities and thus tends to increase, other things being equal conditions, the relative prices. The real problem, though, is to understand how strong is the impulse for further price rises.

In relation to the latter, in an attempt to simplify, it can be said that are substantially emerged two theses, whose conflict has fuelled a debate on the guidelines to be followed, debate that has turned of even very harsh tones.

A first position can be brought back to the point of view that emphasizes the competition that exists between food use and fuel use of these agricultural products. It reiterating the moral leadership of the first, it stresses that the growth of fuel use has created a crisis of food supply in the use plausibly at the base of the sharp rise in

agricultural prices observed globally. On this front, can be counted several international institutions (World Bank, International Monetary Fund, the same FAO) as well as influential politicians; all, in some way, united by the belief that the biofuel promotion policies pursued by the United States and the European Union have played a role in making unstable world agricultural prices and cause it to rise and, therefore, convinced that such policies should be promptly and seriously modified. About it suffices to say that the International Monetary Fund estimates that biofuels have caused 70% of the increase in maize prices and 40% of soybean.

The second position, which even the EU has become a spokesman, is based on the assumption that the causes are much more macroscopic and complex than the "contingency" represented by the growth of biofuel production, scaling up the impact of the growth of the latter on agricultural prices but certainly not denying it. In this perspective, the impact of biofuels is seen as a minor effect compared to much more important phenomena that would have contributed to the surge in prices. The real "imputed", then, would be other: the growth of food demand in emerging countries that, among other things, is accompanied by a change of diet that most favours meat resulting in a growing demand for animal feed; a decrease in supply, mainly cereals, in some major producing areas (Australia, Russia and Canada) due to unfavourable climatically years which, however, may in part be attributed to a structural change of the climate itself because of the greenhouse effect (the very thing that biofuels would help to contain); the rise in oil prices which is reflected on agricultural costs and therefore on prices; speculation, because in these markets, given the difficulties of the financial markets, have been poured huge amounts of resources and considerable speculative interests.

Is interesting to note the US government also shares a very similar position to that on several occasions expressed by the European Commission. Mischievously one can think that both governments consider it appropriate to defend their highly favourable decisions for biofuels just resizing its role in the so-called food crisis. To some extent, it is surprising the strong divergence of views on this matter, because the same international organizations, which also should not have to defend political or government interests, have, in turn, every interest to point out as wrong national policies guilty rather than their own analysis and their tools not always effective.

In conclusion, what seems altogether underestimated is the combined effect of all possible causes of the food crisis and the rise in prices. In particular, in a context of reduction in cereal stocks for years on a global level, it is not inconceivable that the apparently minor impact from the point of view of biofuels, together with the growth expectations that accompany them, it was precisely the origin of the primer of a speculative wave of large size.

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