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EC AGRICULTURE
Commentary

# Complementarity of Biofuels and Food Production

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**Received:** September 01, 2019; **Published:** September 30, 2019

The energy sector is in turmoil and extremely difficult to predict any outcome, given the huge number of variables. This is particularly the case in the transportation sector where for decades the automobile industry was complacent and contented with commutative innovative changes. However, in recent years this has began to change dramatically and is witnessing a paradigm shift away from fossil fuels e.g. electric vehicles, biofuels, hydrogen, etc, catapulted by concern with climate change and the environment.

Electric vehicles are at the core of the automobile industry drive to change in response to such challenges. This poses serious questions: which sources will be used to generate such fuel sustainably? Many alternatives are being pursued but none is a clear winner. For example, in 2018 global renewable energy (RE) contributed to a mere 2,376 GW; and 169 countries have adopted some kind or RE targets [1]. Liquid biofuels (primarily biodiesel and bioethanol), are currently one of the commercial alternatives, but represent just about 3.5% of demand, concentrated in a few countries (e.g. Brazil and USA and to a lesser extent the EU).

Biofuels development have not been excepted of controversy and continue to be clouded with political uncertainties, due to multiple factors e.g. concern with land competition, food prices, increasing demand for food and feed, low progress in finding niche markets (aviation and maritime transport), and awareness that biofuels can replace only a small fraction of oil-based fuels.

Dealing with food and fuel can be very emotive, because for many people, the use of land to produce fuel instead of food is ethically wrong, particularly when so many people go hungry or are undernourished. Misinformation, misconceptions, and vested interests have been an integral part of biofuels development. There are solid scientific reasons to challenge this misrepresented view of reality.

The underlying reasons why this situation does not go away are numerous, ranging from failure of the scientific community to communicate the implications to the wider audience, to resistance of established views to accept evidence-based facts and persistence of negative reporting (this seems more rewarding). For example, the media has compounded this perception by emphasising the negative implications of biofuels. For far too long the emphasis has been on conflicts rather than the potential mutual benefits of food and fuel production.

Also, the narrowness of the debate e.g. the focus in just a few feedstocks (maize, sugarcane, cereals), and the geographical dimension [although biofuels can be produced in many countries, just a few (Brazil and USA)], are the key players. These countries have a huge potential for increasing food production without causing any food and fuel conflict; while at the same time they waste a huge amount of food [2-4].

The development of biofuels is limited by many factors, but not necessarily by these so often emphasized, such as direct land use competition or food price impacts.

## Land use and biofuels

Currently approx. 4% of crop land is dedicated to biofuels (2% cereals, 32% maize, 6% sugarcane), compared to 96% for other purposes. Land productivity has increased significantly e.g. land use to feed one-person/year was 0.45 ha in 1961 and 0.19 ha in 2015. On a global basis, this would require only 1.7 billion ha (1/3 of current land) to feed 9 billion people in 2050. In 2017/18 world production of cereals was 2,613 Mt, outpacing food demand (See figure 1). Therefore, the heated debate on the use of land for biofuels production, has been overstated, and simplistic, given the amount of land dedicated for biofuels compared, for example, to animal feed.

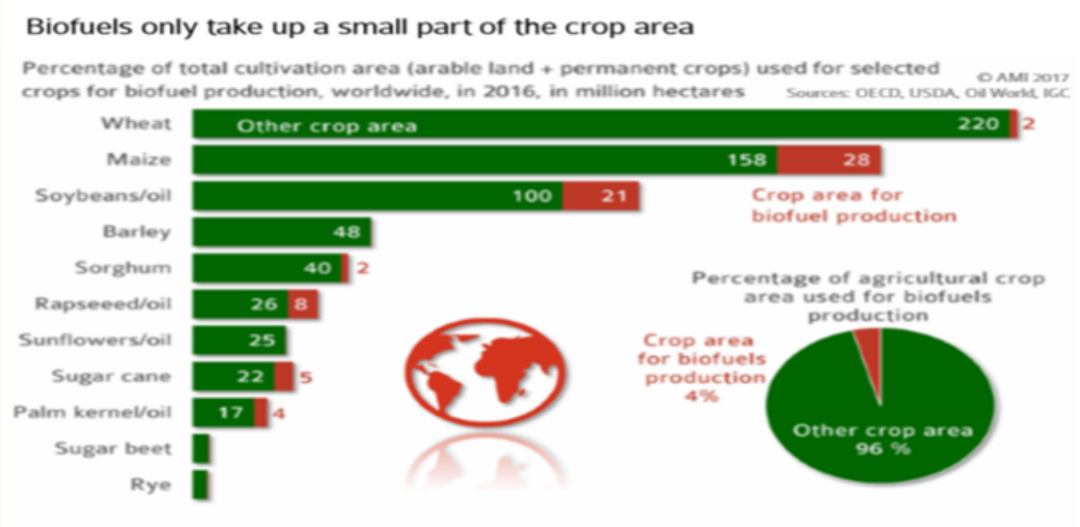


***Figure 1:*** *Land use in the production of biofuels in 2016 (Mha).*
*Source: UFOP Supply Report, 2018 [5].*

A god example is the USA where according to Dale., *et al*. [6] about 80% of the land is dedicated to produce animal feed, not food. The same source indicates that "using less than 30% of total US cropland and pasture, about 400 billion litres of ethanol can be produced annually without decreasing food production or agricultural exports". This could also be achieved merely by increasing soil fertility, with significant reduction on GHGs.

## Grain production for animal feed not biofuels

By far the biggest human use of land is pasture, for animal feed production rather than food. Figure 2 shows different uses of grain consumption from 2010/11 to 2017/18. In 2017/18, 936 Mt (44%) were used as animal feed compared to 635 Mt (33%) as food, and 169 Mt for biofuels or 8%.

There is also a huge disparity of grain per capita/person e.g. Oceania, 1082 kg/person; USA, 976 kg/person; EU, 724 kg/person, to just 129 Kg/person in Africa. As for meat consumption, there is also a huge variation in (kg/person/year), e.g. 95 kg in the USA; 70.7 kg in the EU; 63kg in Oceania, and just 4.2 kg Africa. Globally, meat production increased from 56Mt in 1965 to 253Mt in 2015 [5]. This huge disparity results in unhealthy diet and food waste, and undernourishment and poor diets in others.

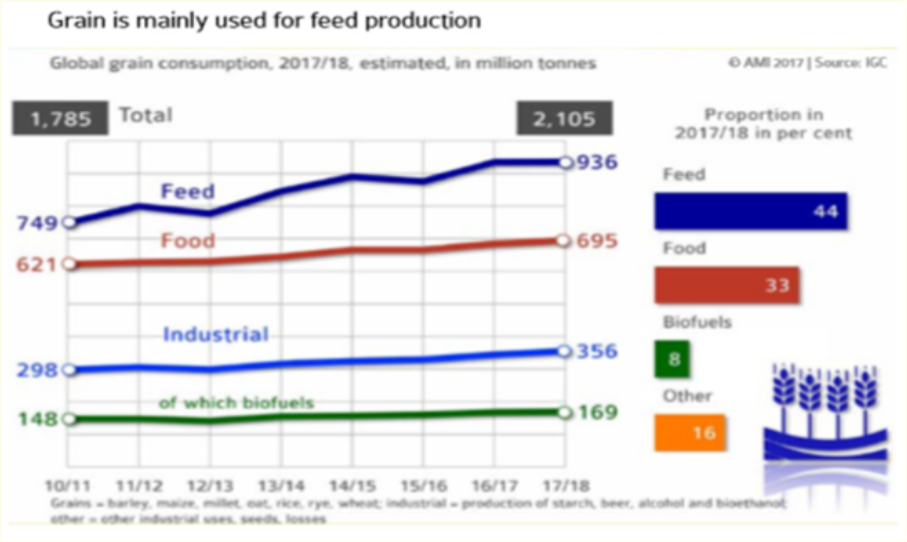


***Figure 2:*** *Worldwide consumption of grains and major uses, 2010/11 through 2017/18 havest. Source: UFOP Supply Report, 2018 [5].*

## Food prices and waste

The ralationship between biofuels and food prices has been another battleground. The answer to this question is more complicated that it appears. Many studies have been carried out to prove or disprove such impacts [7,8].

Most feedstocks used for biofuels do not come from stable food stocks. The largest market for maize and wheat used for biofuel production is from animal feed. Sugarcane, the major source of ethanol fuel in Brazil, also provides many other benefits (e.g. heat and power, animal feed, yeasts, etc.) and has been at the same time the main channel for modernising agriculture and increasing food production around sugarcane growing areas.

It would be unrealistic, however, to say that biofuels do not cause any impact on food prices; unquestionably some impacts are inevitable as happens with any other commodities.

Food waste is a serious problem, particularly in the most developed countries where the price of food is relatively cheap, and this has a considerable impact on food prices in general and for this reason is receiving increasing attention. In many parts of the world as much 70% of the harvest is wasted, particularly vegetables. For example, in the USA about 40% of the food is discarded annually [9]. A reduction in food waste would also ensure considerable $CO_2$ emission reduction and land use savings (www.euroactiv.com/section/circular-economy/). This kind of food waste is scandalous.

This loss and waste occur throughout the supply chain, from farm to fork. Beyond food, it represents a waste of labour, water, energy, land and other inputs. By reducing loss and waste along the food value chain, healthy food systems can contribute to promoting climate adaptation and mitigation, preserving natural resources, and reinforcing rural livelihoods.

FAO has developed tools and methodologies for identifying losses, their causes and potential solutions along the entire food value chain, from production, storage and processing to distribution and consumption. In 2013, FAO launched a global initiative on food loss and waste called “save food” (www.fao.org/save-food). However, there is some resistance in some industrial sectors because restrictions

to food waste add extra cost to producers.

### Are we demanding too much from agriculture beyond food?

The demand for agricultural products is enormous and increasing. It is not only food and fuel but many other natural products. Such demand cannot be met with the present stage of agricultural development in most countries. In the poorest countries, agriculture is still largely undeveloped, undercapitalised, use traditional methods, dominated by small traditional landholdings with very low productivity, land ownership problems and so forth. Agriculture needs to be transformed, modernised, mechanised, and populated with a skilled young labour force if it is to meet such growing demand.

The question is, can the agricultural sector raise to this challenge? Such transformation requires a huge investment in land, people, infrastructure, etc. and a major political commitment. This will be a huge challenge particularly in the poorer countries. Is this a realistic outcome? Perhaps not. And this does not consider the potential huge impacts posed by climate change.

Biofuels' greater criticism have been fear of direct competition with food production, often misplaced. But there is no question that the future will be strictly linked with non-food crops and agro-forestry residues, where there is a huge potential. Technological advances will eventually make this alternative a reality.

Biofuels, however, are not the solution to energy in transportation. With increasing demand for food, feed and many other demands on agriculture, biofuels need to be "complementary" to food production, by using feedstocks which do not compete with food crops and utilizing large amounts of agro-forestry residues, currently largely wasted. This is a real potential waiting to be exploited.

The rapid transformation of the energy sector in which oil and coal are no longer kings, presents biofuels with great challenges and opportunities, particularly in the transportation sector, in the drive to cut down emissions; biofuels are an important component of this energy transition. This rapidly changing energy sector goes far beyond, however. It is also a major social, economic and technological transformation. For the first time in human history, the world is confronting a range of potential alternatives (e.g. fossil fuels, biofuels, solar, wind, hydrogen), a very mixed energy scenario, though it remains unclear which alternative(s) will prevail [10-12].

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**Volume 5 Issue 10 October 2019**