Sustainability in Global Food System and the Pursuit of Human Life on Earth

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Abstract

The global food system represents the set of the most important activities aimed at both the continuation of human life on Earth and the safeguard of natural resources. There is no doubt, in fact, that human beings cannot live without food and, at the same time, for their food supply they are dependent on global food system.
In addition, agricultural activities involve 37% of all the emerged land and they require the use of natural resources (soil, water) and living organisms (cultivated plants and raised animals) to be done.
It follows that, for the sustainability, no human activity is more relevant than those aimed at food production.
At present, all the agro-industrial activities covered by the food global system, are experiencing serious efficiency problems, which effects are evident in environmental, social and economic criticalities, whose costs tend to be higher than the total value of the production. The future of mankind appears to be more and more tied not so much to a further increase in the agricultural productivity, but rather to the possibility to redirect the agro-industrial activities towards a more efficient behaviour able to achieve the best possible compromise between the different human needs and the necessity to preserve natural resources useful for their development.
The purpose of this paper is to analyse if the current productive systems are able to achieve their economic objective while taking into account the human needs and the characteristics of the nature, that is if their development can be achieved through a cost benefit ratio acceptable as regards the objective of sustainability. To do this, a comparative analysis of studies about the sustainability of global food system was conducted. The analysis highlighted the unsustainability of the current global food system and the need to re-orientate in a more efficient way agro-industrial business so that the top quality of product and process sustainability and efficiency can be ensured. This study might serve as a starting point for further research on the subject.

Keywords

Global Food System; Sustainability; Food Security; Agriculture.

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Introduction

For years, sustainability has been the main reference for carrying out of every human activity. That said, you should not underestimate that, for the purpose of human existence, agriculture, including all activities aimed at ensuring food supply is the most relevant activity to boost sustainability

In fact, every human activity can continue to be practice, to evolve and to differ only if humanity will continue to exist. For existing, all human beings ought to be able to take food; without any exceptions. Regardless any differentiating features, all human beings have in common the need to eat. This means that every day, even if we don't think so or we don't realize, we need of agriculture. Beyond the above considerations, there are a lot of aspects which highlights the absolute importance of agriculture for sustainability. First of all, agriculture is the most widely practiced human activity on Earth. Farming activities occupy 37% of emerged lands (FAO, 2021); no other business can compare unto it in this respect. In addition, there are no other business that use natural resources and living organisms in order to get their products and that, to be carried out, need to artificialize nature. It follows that, as it happens for the humankind, also for most of natural resources and living organisms the relationship with agriculture is obliged every day.

Since the beginnings, the human beings through their activity interact with the environment: natural resources, animals, plants, their fellows and the same results of these interactions. People have always been the author of a continuous process of transformation which is continuing to going on through following settling in addition to the previous. This compounding process that has been -and that still is -the basis of social and economic development of all human communities creates a permanent unbalanced situation, with unclear effects on sustainability.

In this framework, it is necessary to develop the awareness that the continuous impact linked to the increasingly diverse sequence of human activities must be consistently aligned with the research of balance each time representing the best possible compromise between the needs of men and the necessity to maintain resources in order to meet those needs. While this consideration may be addressed to all activities, this is particularly true for agricultural activities. There is, in fact, no doubt that agriculture is no more sustainable when it is not able to balance the economic goals, the needs of men and the characteristics of nature. When that happens, the resulting costs are passed on all mankind and nature.

For these reasons, it is of fundamental importance to try to figure out if the current productive systems are able to realize the mentioned compromise, namely if they result in a cost-benefit ratio considered acceptable for the purpose of sustainability. This paper aims to deal with this issue.

First of all, the issue of the sustainability of agri-food system is analysed through a literary review in order to highlight the main economic, social and environmental criticalities.

Secondly, the critical points, identified during the literary review have been discussed taking into consideration the three pillars of sustainability (environment, ethic and economy). Then, the authors have chosen to use two different estimates: World Bank (WB, 2019) and Food and Land Use Coalition (FOLU, 2019) in order to highlight the cost-benefit ratio. Finally, some conclusions have been drawn.

1. Review of the scientific literature

The issue of sustainability of agricultural and food production systems is very difficult to deal with, as many economic, social and environmental variables are, at the same time, a driver and an outcome of the agri-food system, given that they affect it but they also receive strong impacts from it (Fanzo, et al., 2021).

Also for these reasons, lately, the issue of the sustainability of agro-industrial system has been the theme of several studies aimed at investigating both specific aspects and their overall impact.

According to the findings of current studies, it seems now clear that the global food system should be considered the main responsible of the most important environmental and socio-economic issues that, at present, riddle our world (Rockström, et al., 2020).

With regard to environmental criticalities, we refer, in particular, to: the greenhouse gas emissions (Crippa, Solazzo and Guizzardi, 2021); the loss of biodiversity (Sukhdev, May and Müller, 2016); the destruction of eco-systems (Bongaarts, 2019); the land use change (Vieri, 2012; Ramankutty, et al., 2018) and the soil degradation (Shukla, et al., 2019); the depletion of commercial fish stocks (Troell, et al., 2014; Loring, 2021); the consumption of water (Islam, et al., 2021); the different forms of environmental pollution (FAO, 2017; Chaudhary, Gustafson and Mathys, 2018) and the related effect on human and animal health ranging from the nitrogen leaching (Lassaletta, et al., 2016), the presence of chemical residues in soil (FAO-UNEP, 2021) and food (FAO, 2021a) up to the contamination of animal products due to the phenomena of antimicrobial resistance (Naghavi, 2022; EMA, 2020).

As regards social and economic aspects, the most relevant critical issues are malnutrition, in its three burden: denutrition, overweight and obesity; and micronutrient deficiencies.

It is important to note that issues affecting malnutrition are the most critical risk factor for human life, so much so that it was estimated that, only in 2017, 11 million people died prematurely and about 255 million years of life have been lost for these reasons (Afshin, et al., 2019).

We must also consider that, in addition to the above-mentioned costs in terms of human life, also direct costs (health expenditures) and indirect costs (loss of income and working capacity), both considered effects of malnutrition, should be added: (Freijer, et al., 2013; Webb, et al., 2021).

According to FAO (FAO, 2021b), 2,37 billion of people, in the world, are in condition of food insecurity, 928 million of which live in conditions of severely food insecurity.

These issues are expected to worsen as a result of both pandemic covid-19 (FAO, 2021a; Manning, 2021) and the war in Ukraine. According to World Health Organization (WHO, 2022) there are about 1,9 billion of overweight people, one third of whom are obese; the number of people suffering from micronutrient deficiencies is estimated to be about two billion.

The existence of relationship between malnutrition and sustainability of agro-food systems, in the last years, has been the focus of growing attention and it has been highlighted both in general (Lindgren, et al., 2018; Steiner, et al., 2019; Willet, et al., 2019), and with reference to the single burden (Ul-Allah, 2018; FAO, 2021b; Fanzo, et. al., 2022).

Another important issue is the problem of food loss and food waste (FAO, 2011) that, in addition to being a direct expression of the inefficiency of the current production and consumption system (Alexander, et al., 2017), it has also important implications in terms of food security and environmental impacts. Food losses not only involve a reduction in food availability (Santeramo and Lamonaca, 2021), but also a useless waste of natural resources and productive factors, with all that is in terms of environmental impacts on water, soil and emissions (Hodges, Buzby and Bennet, 2011).

It is to be also noted that the above mentioned issues don’t just determine negative impacts on single aspects but, especially in Developing Countries, combine to slow down rural development processes, going to drastically increase rural poverty and inequalities (De Schutter, Jacobs and Clément, 2020) and, more generally, to further compromise the already compromised chances of achievement of the Agenda 2030 Sustainable Development Goals (Herrero, et al., 2021; United Nations, 2021).

By this such complex framework, results some elements of certainty, first of all the knowledge that, in order to overcome the aforementioned issues, a complete rethinking of the current development models is necessary, rather than acting on single variables (Calabrò and Vieri, 2014; Springmann, et al., 2018; Rockström, et al., 2020). For example, it appears evident that, the current results given, it is just not an option to rely only on increasing agricultural productivity in order to ensure food security worldwide (Benton and Bailey, 2019).

Moreover, there are no particular doubts about the fact that the efficiency of agricultural production processes must be increased, by reducing, for example, food losses and wastes (El Bilali, et al., 2019) and improving the level of food consumer education in order to gear their choices towards products with a lower environmental and health impact (Springmann, et al., 2018). In particular, the consumption of products of animal origin (Alsaffar, 2016; Ranganathan, et al., 2016; Clark, et al., 2020) should be reduced in order to relieve ecological footprint of global food system, especially in terms of land use, greenhouse gas emissions and water use.

2. Research Methodology

With the purpose to better highlight the relation between costs and -benefits of the performance of agro-industrial activities, reference has been made to the 2019 estimates of both the World Bank and Food and Land Use Coalition (FOLU), a community of Organizations that supports science-based solutions in delivering on the Sustainable Development Goals of Agenda 2030 and the Paris agreement on climate. In both cases, both costs items of the main environmental, economic, and social issues and the value of production attributable to the global food system have been estimated.

These data have been subdivided by impact categories (environmental, social and economic), in order to better represent the costs arising from the different issues with regards to the three dimensions of sustainability.

3. Results and discussion

By the analysis of considered data, two different non overlapping and non-integrable situations emerge, because the methodology used by the different sources for the calculation do not coincide, as shown by table 1, where the different estimated values per similar items on both cost items and production are reported.

Table no. 1. Hidden costs of global food system 8 (billion US$)

		World Bank (2019)	FOLU (2019)
A	**Costs for health care (social dimension)**	**4,050**	**6,600**
a.1	Denutrition	2,430	1,800
a.2	Overwieght and obesity	1,620	2,700
a.3	Pollution and antimicrobial resistances	not estimated	2,100
B	**Environmental costs (environmental dimension)**	**470**	**3,200**
b.1	Soil degradation due to poor agricultural practices	200	not estimate
b.2	Greenhouse gas emissions	270	1,500
b.3	Natural capital loss	not estimated	1,700
C	**Economic costs (economic dimension)**	**1,510**	**2,100**
c.1	Financial losses for land use and land chance	330	Not estimate
c.2	Economic losses from food insecurity	110	not estimate
c.3	Food loss and waste	1,070	1,300
c.4	Costs for rural welfare	not estimated	800
D	**Full costing estimates (A+B+C)**	**6,030**	**11,900**
E	**Market value of agro-industrial production**	**8,000**	**10,000**
F	**Total budget (E-F)**	**1,970**	**-1,900**

Source: our processing of World Bank (2019) e FOLU (2019) data.

In this regard, for example, it is considered that the value of the losses and wastes is estimated to be 1,070 billion dollars by the World Bank and to 1,300 billion dollars by the FOLU and the production value is estimated to be respectively 8,000 and 10,000 billion dollars.

This does not mean that the comparative analysis of the two studies brings out elements which allow important indication to be drawn regarding the current level of sustainability of global food system.

First of all, the substantial difference that seems to be between the cost-benefit balances resulting by the two studies (in positive of about 2,000 billion dollars for World Bank, in negative of 1,900 billion dollars for FOLU) is, actually, less marked than may seem.

A large part of the difference through the two balances (3,900 billion dollars) is, in fact, attributable to the following values: pollution and antimicrobial resistances costs (2,100 billion dollars) and natural capital loss (1,700 billion dollars) estimated by FOLU but not considered by World Bank; the different value of estimates of the greenhouse gases emission costs (1,500 billion dollars FOLU, 270 World Bank).

If we consider that, the description of the calculation methodology in the World Bank study expressly states that the costs are underestimated, because pollution and antimicrobial resistances costs could not be calculated but the global food system is, however, considered primarily responsible of greenhouse gas emissions, there are reasons to believe that the two studies have reached results much closer than it may seem from the observation of values attributable to single items.

Another important consideration is that according to both studies the most critical issue refers to malnutrition as major cost item and, therefore, the impact of this issue over mankind which, as should recalled, for about 40% (more than three billion people) is affected by this problem.

This is an extremely important aspect that, more than any other, denotes the level of unsustainability of the current global food system, as it highlights the failure respect to what should be its most important aim: ensuring food security to all the world population.

Similar considerations can be referred to the environmental issues that are the expression of the substantial inability of the current agri-food systems to operate efficiently to ensure the right compromise between economic needs and the necessity for natural resources conservation.

In recent decades, we had been able to benefit from an unprecedented availability of food and this is strongly reflected in the world population that from 1950 to today increased from 2,5 billion people to 7,8 billion people.

However, it cannot be ignored that this result has been achieved through an unprecedent exploitation of resources. It is legit to have doubt that the opulence of the last decades can constitute the condition for future growing difficulties. Indeed, there are worrying signs in this respect; first among all, the unbalanced cost-benefit ratio that, as mentioned, characterizes the present global food system.

With regards to the above, it is clear that the above-mentioned issues, are mainly due to efficiency problems closely related to the current structure of the agro-industrial sectors. We are referring, in particular, to the fact that, in these sectors, the different upstream and downstream segments are dominated by players operating under an oligopoly. This is particularly marked in the production factors sector , especially in the field in which operates the three so-called multinational biotech, that control almost the entire of the seed and pesticide market in the world. These firms, more than others, have the power to guide and affect the activities of the whole system (Pavitt, 2001), given the close link between agri-food production and seed (Deconinck, 2019).

It is clear that in a system like the one just described, where production is guided by three multinational that control the market of the main production factor (seed) and where the other main sectors (raw material, distribution and trade) are conducted by just a handful of firms, only inefficient behaviours can occur. These behaviours are also caused by the lack of competition due to the presence of entities operating in oligopoly.

Given that such a structure would lead effectively to distortion, it is inevitable that, inefficiencies will come out from this, as well as costs that will pass on the most vulnerable member of society.

This mechanism is one of the plagues affecting humanity and, for what concerns agro-industrial systems, takes the place of costs which we have already said.

Conclusions

Given the importance for the continuation of human life and the relationship with natural resources and living organisms, the global food system has to work in a sustainable manner.

The unsustainability of this system so important for the existence of humankind happens when it is not possible to realize the right compromise among the economic objectives, human needs and characteristics of nature. And when this happens, mankind and nature pay the consequences for the imbalance of the system.

That is what is happening in global food system where costs attributable to the main critical issues of the system- such as malnutrition, food loss and waste, greenhouse gas emissions and its economic, environmental and social consequences- exceeded the production value.

The cause of such issues lies mainly in the structure of the current agro-industrial productive systems, that being controlled by few firms operating under oligopoly, in itself distorting competition, tends to generate inefficiencies whose costs are inevitably relieved on the most vulnerable member of the society. The possibility that, in the future, the global food system will continue to ensure food supply to humanity is not therefore linked to increase agricultural productivity but is tied rather to the ability to re-orientate in a more efficient way agro-industrial business in order to create the best possible compromise between the different human needs and the necessity to preserve natural resources without which it will no longer be possible to carry out development.

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