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Climate Change and Hunger as the Challenges in the Global Food System

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Abstract

In the last decades, there has been a growing tendency towards international trade and globalisation, particularly leading to a significant increase in flows of agricultural commodities worldwide. From a macroeconomic perspective, the commodity projections are more optimistic than the previous years and the long run tendency shows an increasing demand for feedstock. However, the strong shifts of shocks and fluctuations (in terms of prices and volumes) are a concern to global food security, with the number of hungry people rising to nearly one billion. Agriculture is a main user of natural resources, and it has a strong link with rural societies and the environment. Forecasted impacts from climate change, limited productive endorsements and emerging rivals on crop production, such bio-energy, aggravate the panorama on food scarcity. In this context, it is a great challenge on farming and food systems to reduce global hunger and produce in sustainable ways adequate supplies for food, feed, and non-food uses. The main objective of this work is to question the sustainability of food and agriculture systems. It is particularly interesting to know its role and if it will be able to respond to a growing population with increasing food demand in a world where pressure on land, water and other natural resources are already evident, and, moreover, climate change will also condition and impact the outcome. Furthermore, a deeper focus will be set on developing countries, which are expected to emerge and take a leading role in the international arena. This short paper is structured as follows: Section I, "Introduction", describes the social situation regarding hunger, Section II, "Global Context", attempts to summarise the current scenario in the international trading scheme and present the emerging rivals for primary resources, and in Section III, "Climate Change", presents an overview of possible changes in the sector and future perspectives in the field. Finally, in Section IV, "Conclusion", the main conclusions are presented.

Introduction

The world is faced with a great challenge to feed the entire population despite adverse conditions such as scarce resources and climatological changes. One of the most severe issues is the enormous and rising number of undernourished people, exasperated by the recent price spikes and the global economic recession. The Organisation for Economic Cooperation and Development and The Food and Agriculture Organisation of the United Nations [OECD – FAO] (2010) reports it will affect nearly one billion persons in 2010 (p. 44). In addition, the OECD-FAO (2010) points out that a growing world population[1],which is estimated to reach 9 billion people by 2050, is mainly coming from developing countries (p. 44). To counteract the stresses on food security, agricultural production will need to double by 2050. (The Organisation for Economic Cooperation and Develop-

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ment [OECD], 2010; OECD-FAO, 2010). Furthermore, there will be changing needs from developing countries which includes dietary patterns and requirements that will increase the demand on animal protein (OECD, 2010; OECD-FAO, 2010). Agriculture and the global food system play an important role, especially in eradicating hunger and responding to growing food demands by delivering safe and high quality food at fair prices.

Food accessibility rather than global food availability seems to be a greater quest as argued on OECD-FAO (2010). The world now produces enough to feed all the population, however in spite of that hundreds of millions of people still remain food insecure (OECD-FAO, 2010; Heinemann, 2009). A comprehensive approach to food security requires more than just alleviating hunger as the major problem is poverty; in fact, the OECD-FAO (2010) reported that a vast majority of the world's food insecure people are farmers (p. 43-44). Moreover, as much as one-third of food is estimated as waste and this occurs at the farm level, in the storage and distribution system, in food service, and at home (OECD-FAO, 2010, p. 46). Furthermore, the OECD-FAO (2010) acknowledges that a better use of what is produced can be achieved by improved technical performance, provided sufficient investment and sustainable resource management, in addition to efficiency gains being obtained by reducing production losses (e.g. disease, pests, storage) and food waste (p. 44). All of this indicates that there will be considerable additional agricultural products and it will be available to meet food and feed purposes demands over the coming decade (OECD-FAO, 2010: 25) but the enigma remains, will it be able to reach all the population.

Global Context

Agriculture and trade policies have a paramount role in agricultural commodities and food products prices. OECD-FAO (2010) claims that the degree to which domestic markets are integrated within the world market will determine the extent on the price transmission, in addition to the magnitude of the fluctuations being passed through (p. 26-27). Furthermore, term-of-trade effects on higher food commodity prices, as well as border measures, domestic price supports and infrastructure weaknesses have huge implications for resource-poor countries (p. 26-27) Hence, a well-functioning rules-based multilateral trading system is crucial to ensure food access and distribution, moving from where it can be abundantly produced to where it cannot (p. 43).

High volatility and fluctuations of international commodity prices and agricultural products, in comparison to industrial goods and manufactures, are frequently observed as stated in the OECD-FAO (2010) report. High food prices clearly place a burden for consumers, particularly on poor net food importers who typically spend a large share of their income on less processed foods that make up for a major part of their diets, and have no saving possibility (OECD-FAO, 2010: 40). More concerns on food security arise as strategies to avoid large variations in food costs, such as diversification of diets, are difficult to achieve (OECD-FAO, 2010; Vermeulen et al., 2010). Hence, the OECD-FAO (2010) explains that often consumption is reduced or less money is available for non-food items, such as basic needs: housing, transportation, health and educational services (p. 40). In addition, the impact of price surges and shocks on domestic economies have significant implications in terms of resource allocation and revenues; the OECD-FAO (2010) has argued that in developing countries with a less diversified production base and a high reliance on international trading of agriculture commodities, small shifts in prices can induce to considerable disequilibria on their trade balance (p. 59-60). In fact, disparities among countries tend to increase with price volatility, producers in developed countries often have access to various support schemes and credit markets, while producers of commodities in developing countries, whom tend to lack of assets and adequate insurance coverage, may face larger income fluctuations (OECD-FAO, 2010: 49). Furthermore, high volatility and unexpected strong changes in prices levels impose great costs throughout the food chain due to higher uncertainty which hinders investments and sectoral development (OECD-FAO, 2010: 49).

The OECD (2010) emphasised an important aspect regarding agriculture which is the prevalence of the risks that could simultaneously affect several farmers or productive areas (p. 13). For farmers risk management is traditionally part of its business strategy since production faces many uncertainties, such as weather-related hazards that threaten returns, or even the viability of farms (OECD, 2010: 13). Managing these risks typically includes production diversification, irrigation, futures markets, insurance and contracts, as well as diversified sources of income by off-farm activities, environmental and recreational services and assets (OECD, 2010: 13). However, the application and viability of the instruments depends largely on the market structure, production side and local conditions.

Another important feature in global food chains is that the food industry has become more globalised, vertically integrated and more concentrated (OECD-FAO, 2010: 46). On one side, this has provided a response to a wide range of changing consumer preferences at relatively affordable prices, and on the other side, there are

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raising concerns regarding the growing market power and the correct distribution of profits along the food chain (OECD-FAO, 2010: 46). At the same time, there is an increasing tendency through stringent food quality and food safety standards which are often viewed as a response to consumer claims; yet this generally implies higher compliance costs which are hard for farmers in developing countries to meet as reported by the OECD-FAO (2010).

Developing countries are expected to be the driving force behind the expected growth in agricultural production, consumption and trade (OECD-FAO, 2010: 3). The population and income dynamics in developing and emerging economies will represent the major market growth for virtually all commodities and continue to increasing demand for food over the next and coming decades as stated by the OECD- FAO (2010). The OECD (2010) and the OECD-FAO (2010)[2] reported that the developed countries' agriculture will continue to supply a large share of world food and feed supplies but with lower growth prospects, higher costs and more constrained resources in contrast to the new players, this suggests that the contribution to global food balances will decline but will increase towards the higher value-added food. However, the OECD-FAO (2010) projections for the Least Developed Countries imply higher reliance on international markets, as well as a growing exposure to commodity prices shifts and fluctuations prone to import bills (p. 3). Furthermore, the OECD-FAO (2010) explained that the sectoral growth will be led mainly by Latin American and Eastern Europe, and to a minor extent by Asia; and as to international trade growth, a particularly dynamic and higher share of developing countries, mainly in Asia and Latin America, will expand South-South and North-South trade (p.11-12).

In the meantime, the agri-food sector is strongly influenced by energy, rural development and environmental measures (OECD-FAO, 2010: 16). This is particularly clear when considering the heightened linkages among crop and energy prices; as increased variability in energy markets, specifically on crude oil prices, impact directly on crop prices and trade flows through both demand (reinforce feedstock demand for biofuels) and supply (influencing input: price of fertiliser, pesticides and chemicals, transportation and processing costs) (OECD-FAO, 2010: 26-27). According to the OECD-FAO (2010), the growing biofuels market is becoming a rival to food markets through related land use changes, which raises fears of "food versus fuel" in times of shortages of conventional fuel sources (p. 42-43). In spite of substantial additional land available for agriculture use, bringing further marginal land into production could involve considerable investment and lower yields, while possibly incurring social and environmental costs (OECD, 2010: 28). Furthermore, it is expected that if energy future prices rise further on, the tie with food prices will be even stronger (OECD-FAO, 2010: 54).

Climate change

Agriculture is particularly vulnerable to climate change (Vermeulen et al., 2010: 4). Scientific consensus and projections by 2050 suggest both an increase in global mean temperatures and further weather variability; this will have implications for the type and distribution of agricultural production worldwide (OECD, 2010; OECD-FAO, 2010). The OECD-FAO (2010) argued that less-resilient agricultural production areas will suffer the most, as already dry regions face even drier conditions, especially the semitropical and tropical latitudes (p. 9, 44). Production variability and uncertainty of supplies with climate change may enhance food safety risks which might result from increases in the frequency of extreme events such as droughts and water borne diseases, with temperatures rising and flooding, or even extreme shifts in the production zones (OECD-FAO, 2010: 44). According to the OECD (2010) climate change will also worsen the living conditions for many who are already vulnerable, particularly in developing countries that lack assets and adequate insurance coverage to compensate (p. 9).

As agricultural production increases so will resource constraint, water will particularly become tighter. The OECD (2010) claims that agriculture globally consumes about 70 per cent of the world's freshwater withdrawals (p.10). Climate change is expected to alter the seasonal timing of rainfall and snow pack melt, and result in a higher incidence and severity of floods and droughts (OECD, 2010: 10). Another derived effect is linked to aquaculture, as they interact in several ways. Competition between the fishery and agriculture sectors may arise for water and land, especially for irrigated agriculture, as well as competition between feed for terrestrial animals or farmed fish (OECD-FAO, 2010: 41). Another factor to consider is agriculture support policies which are linked to production. These policies should be carefully evaluated because if wrongly applied they could encourage less efficient use of water, leading to off-farm pollution and exacerbate flooding (OECD, 2010: 6). As the OECD (2010) explains, given the anticipated growth in the demand for food and water, in addition, to the increasing pressures from climate change, rain-fed and irrigated agriculture will need to be managed more sustainably to reduce resulting production risks (p.10).

On the whole, the OECD (2010) states that climate

change effects are expected to be negative for agricultural production, nonetheless some regions may benefit from improved weather conditions (p. 10). Quantifying greenhouse gas [GHG] emissions from agricultural activities is challenging as it is subject to a complex interplay between climate, soil type, slope and production practices (OECD, 2010: 9). Despite scientific uncertainty on valuation methods, increased concentrations of GHG in the atmosphere are already locked-in and by 2004 agriculture, forestry and land use altogether had contributed directly to about a third of GHG emissions (OECD, 2010: 9-10; Vermeulen et al., 2010: 4). Mitigation in agriculture can be achieved through improved cropland and grazing land management (by sequester of carbon and offset emissions from other sources), restoration of degraded lands (improving soil quality), and land use changes (such as agroforestry) (OECD, 2010; Vermeulen et al., 2010). According to the OECD (2010) currently available technologies range from altering farm management practices to the adoption of new varieties, crops, and animal breeds more suitable to future climate conditions (p. 10). Furthermore, emissions can be reduced by improved nutrition and better management of manure from livestock production (OECD, 2010: 10). It is acknowledged that agriculture has the potential to contribute to mitigation and sequestration of carbon, particularly the GHG emission reduction, by adapting to climate change conditions and adopting more efficient and sustainable production methods (OECD, 2010; OECD-FAO, 2010). Worldwide the panorama seems to be quite different, and agriculture will undergo major changes. Setting the ground will require a new approach to combat world hunger and adverse conditions, while improving productivity and production in a sustainable way. According to the OECD-FAO (2010) progress will depend on the application of available technologies and to a great extent on innovation and technology in the field (p. 46).

Biotechnology in agriculture has been a controversial subject. Among consumer groups and the public at large, genetically modified [GM] crops are considered to be an inferior product in quality compared to those produced in a traditional method (Sobolevsky et al., 2005; Disdier et al., 2010) and there are growing concerns on its impact on human health and the environment (Heinemann, 2009: 39). However, the OECD-FAO (2010) reveals that nowadays there is a considerable use and dependence on technology and innovation in global food and agriculture systems (p. 46). Disdier et al. (2010) show that GM technology is applied in a wide range of crops and countries; by the year 2008 the main adopters of GM technology were (cultivated land in million hectares [MH]): United States (62,5 MH), Argentina (21MH) and Brazil (15,75MH), followed to a lesser extent Canada (7,625MH), India (7,625MH), China (3,75MH), Paraguay (2,75MH) and other 18 countries (less than 2 MH). Furthermore, the OECD-FAO (2010) claims that Asian countries are expected to adopt and engage in the commercial production of GM crops by 2015, and that product differentiation, segregation and labelling, will acquire increased prominence in the commercialisation of GM and non-GM crops (p. 29). Sobolevsky et al. (2005) argues that this should take place throughout the entire production chain, marketing, processing, and distribution chain of the food system. For this reason, many countries have already started to implement mandatory labelling regulations or even switching towards a GM free zone (Disdier et al., 2010). According to the OECD-FAO (2010) the development and approval of GM crops is still unsettled in the international arena and it is already generating trade diversions among countries and regions (p. 46). Particularly developing countries are struggling between a trade–off on the expected production and agronomic benefits of producing GM crops, and the potential loss in terms of access to rich markets (Vigani et al., 2009)

Conclusion

Agriculture and food systems will be challenged by several factors but in particular by the increasing demand of food availability and accessibility to feed the world (with those suffering from hunger now estimated at one billion). Furthermore, climate change and the growing concerns over the competition for natural resources with the development of various innovative bio energies suggest that major impacts on the future of agriculture production and the sustainability of the sector and environment. The development of emerging economies with their dietary food habit changes are set to increase pressures on commodities, especially on coarse grains, vegetable oils, meats and feedstock. Clearly in order to fulfil agricultural and food demand around the globe, improvementregarding distribution and efficiency is required, by way of increases in yields and reductions of crop losses.

A holistic approach seems to be the one that will contribute to viability of rural areas, progress of agriculture and environmental harmony. On an environmental level, climate change presents great challenges as well as beneficial opportunities to adapt towards a more sustainable approach that reduces GHG emissions, increases carbon sequestration, and mitigates the impacts of climate change. Moreover, countries should invest more on research and development (e.g. crop varieties and breeds which are better adapted to adverse conditions) as well as consider risk management instruments (crop and dis-

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aster insurance) and agricultural policies more in line with a market-based approach (e.g. incentives for more efficient use of water and land). In addition, a healthy and diversified local economy that provides off-farm work opportunities and services is core to the survival, stability and welfare of a rural development. All in all, an integrated approach, which takes into account domestic production, international trade, stocks and safety nets for the poor, is essential to provide a solution to global food insecurity and hunger in the longer term.

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Conflict of Interests

The author hereby declares that there is no conflict of interests.

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1. According to OECD-FAO (2010) "World population growth is expected to average 1.1% per annum to 2019, compared with 1.2% in the previous decade. Only slow population growth of 0.4% per annum is expected in the OECD area. Higher growth is expected in the developing countries, with the population of Arica as a whole growing at over 2% per annum. Continuing urbanisation trends and rising per capita incomes, emerging large middle classes and underlying population demographics collectively reinforce higher food demand in these countries " (p. 16).

2. As OECD-FAO (2010) explains"…OECD countries will continue to dominate exports in 2019 (shares in brakes) of wheat (52%), coarse grains (59%), pig meat (80%), butter (80%), cheese (63%), whole milk powder (66%) and skim milk powder (74%). Developing countries will hold dominate shares in 2019 for: rice (88% share), oilseed (56%), protein meals (80%), vegetable oils