Future food availability is not only an agricultural topic, but also a society issue

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This special issue of the revue *Food Economy* was born thanks to the 24th conference of the ISDRS (the International Sustainable Development Research Society) entitled "Action for a sustainable world: from theory to practice", hold in Messina (Italy) in June 2018. Among the topics dealt with by the conference, was the theme "Food security and agriculture". From the Food Agriculture Organization (FAO), definition of "food security" means that sufficient food is available, people have access to it, food is well utilized, and this situation is stable over time. As the theme focus on agriculture also, the special issue will deal mainly with the availability dimension of food, despite there is much to be said about the other dimensions too. In our opinion, the theme "Food security and agriculture" deserves a specific interest. Indeed, when human beings are starving, there is no room for any activity, not to say for life itself. Food security is intertwined in a paradox. For about 50 years only, most of people have enough to eat daily (such as the fact to be under-nourished seems abnormal and entails accounting), whereas dearth and famines were common places during the former centuries[1]. Despite the deep predicament humankind is facing, issues about food security are in general treated like sectoral limited problems, and not like systemic issues involving everyone. Moreover, the future of agriculture and food security likely depends on political actions taken in other sectors, for instance through the Global Warming (GW) issue! Here are the reasons why this special issue intends to contribute two both objectives: i) displaying the present state and likely future state about food availability and its causes; ii) suggesting practical solutions to enhance food availability in the future.

Food insecurity and agriculture now

Food insecurity is a present issue. In 2016, the number of under-nourished people in the world was on the rise, as it has been since 2014 (FAO-a, 2017). At local level, (*Paganini et al., this issue*) note how the food crisis of 2008 has put the food issue on the agenda again, bringing to the fore "urban agriculture" in certain South Africa and Mozambique' cities.

The agricultural productivity (yields got per hectare) is globally declining. After 50 years of outputs continuous growth (Terrones Gavira & Burny, 2012), the yields per hectare of field crops are declining (since 1990 in France, according to Agreste, 2008) in all the European countries with high productivity[2] (Belgium, Germany, United Kingdom, from Agreste, 2008), but also in the World (FAO, 2000). Most of the field crops (soft wheat, maize, durum wheat, barley, triticale, rapeseed, sunflower) are concerned in Europe (Agreste, 2008). It is the same for cereals at World scale. The World crops yields have raised fast (2.1% per year) between 1961 and 1999. Thanks to the "Green revolution", they raised faster (2.5% per year !) in developing countries. Wheat, rice and maize crops experienced the highest growth rates. Indeed, as they are the most exported basic commodities, they have been the focus of the most important international efforts for cultivated plants improvement. The yields of millet, sorghum, and legume have raised more smoothly (FAO, 2000). As noted by FAO in 2017 « Although agricultural investments and technological innovations are boosting productivity, growth of yields has slowed to rates that are too low for comfort » (FAO-b, 2017: 5). If considering the on-course rise in the World population, here is a very problem of future food insecurity, which demonstrates the need to appraise different solutions.

[1] In average, demographic and agricultural situations entailed one famine year each 10.

[2] The yield stagnation is not effective in Italy yet, whose soils never performed over 55 quintals per hectare in national average (Agreste Primeur, 2008). This suggests that the phenomenon is caused by soil depletion, because soils are exhausted by too high yields.

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The usual method for economical assessment accounts for the human work and the built capital (financial, industrial…) but systematically forgets the natural flows and stocks. The "life cycle thinking" (LCA) tries to fill in the gap (which is dire on the finite planet) by assessing any change in terms of impacts caused to the natural milieu. Even if already 18 categories of impacts are routinized, the LCA method is still incomplete to assess certain very important impacts, such as the ones affecting biodiversity. It is the message by (*Arzoumanidis et al., this issue*) when they suggest assessing the pollination service rendered by honey bees. Moreover, producing sufficient quantity of feed is not enough, because food processing conditions must remain (or become) decent, especially to avoid the people working in the agricultural sector to be the less well-nourished! Thus, current certifications of agricultural products and food do not warrant the improvement of the more fragile actors, as testified by the opinion paper by (*Loeillet, this issue*) about the example of the dessert banana for export.

Food insecurity and agriculture in the Future

Food insecurity is likely to worsen in the coming decades, especially in developing countries, where productivity may be reduced three times faster than in developed countries by 2050 (IPCC, 2007; Calzadilla et al., 2013). More generally, most scientists think that global food security is threatened by certain ongoing or future changes, as highlighted by the review by (*Macombe-a, this issue*). Be that as it may, the issue of food insecurity is reality, because the pace of the exploitation of planet's resources does not allow for self-renewability. At local level, food security is a future issue for all urban areas, in developing as well as in developed countries, as highlighted by the future of Melbourne (*Candy et al., this issue*). Again, about food insecurity in the future, are noticeable the outputs of the World3 model crafted by a handful of researchers from the MIT (Massachussets Institute of technology) in the 60'. World3 depicts the World population evolution according to different drivers, including available food per capita. Testing diverse scenarios, the conclusions are consigned in the famous « Limits to Growth » by Meadows et al. (1972). In 2012, Graham Turner checked how World3's scenarios would account for the 40 years spent since its creation. The idea is that if such a scenario was confirmed, it is likely that the future calculated by this scenario would come true also. Such a scenario exists, it is the "business-as-usual" one (without any practical action), the one we currently follow (Turner, 2014). This scenario envisions a stagnation of the food production per capita during 15 years, then a rapid decline around 2025, followed by the collapse of the World population.

However, solutions are available to enhance food security, either in a sectoral approach or in a systemic approach (accounting for relationships between sectors) as well.

Agricultural solutions for food security

Urban agriculture is part of the solution, as discussed by *(Paganini et al., this issue)* for African case studies. Regarding changes in the agricultural sector alone, Le Mouël & Forslund (2017) performed a meta-analysis gathering 25 models (from 278 documents) focused on food availability and land-use in 2050. They conclude that it will be possible to feed the World population over 2050 by « *reducing calorie availability per capita and per day, by eating less and/or reducing retail and household waste [-]. But most frequently, the most emphasised response is to reduce the share of animal products and in particular the share of meat in diets*" (Le Mouël & Forslund, 2017:556). Other works prescribe to shift agricultural practices, in order to maintain yields despite GW and shortages. Indeed, future agriculture will have to perform better while to go without the agro-industrial inputs that supported its development for 50 years. Long term experiments in organic agriculture in Africa (*Auerbach-a, this issue*) are demonstrative of practicability and soundness. Moreover,

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Auerbach reminds us that similar results have been reached in Switzerland, United Kingdom and United States. In the same vein, the review by (Norris & Congreves, 2018) about intensive vegetable cropping systems under organic or conservative management, demonstrates that soil fertility can be restored. It is then suggested that securing food availability likely involves a combination of several different farming systems linked with compatible distribution systems (*Macombe-b, this issue*) for each one to balance the weaknesses of others.

Systemic solutions for food security

Policy-makers should and can efficiently support organic agriculture, as demonstrated by (*Auerbach-b, this issue*) by comparison of South African, Danish, Swiss, and U.S cases. Halting GW is mandatory to improve food security. In France for instance, the think-tank « Shift Project » recommends i) to halve losses and food waste; ii) to strongly reorient cattle rearing towards high-quality labelled products (that will decrease the livestock and increase prices paid to farmer per unit) ; iii) to lower the quantities of products derived from animals[3] in diets. Devoting the lands to direct feeding of people would face the increasing needs from importing countries, like the ones on the South side of the Mediterranean Sea (Le Mouël et al., 2017). The international project Drawdown also aims to halting GW. Among the recommended measures, food and agriculture stand for key drivers. By order of efficiency, they are ranked 3rd (reducing food waste), 4th (shifting to a plant-rich diet), 9th (developing silvo-pasture for cattle), 11st (expending regenerative agriculture for degraded lands), 14th (conversion from annuals to perennial staples) and 16th (developing conservation agriculture). The already quoted World3 model (Meadows et al., 1972) suggests solutions alike. To avoid collapse, World3 claims for the combination of several actions together, like : stabilizing the population (the birth rate equal the death rate) and the industrial capital (the investment rate equal the depreciation rate), reducing the resource consumption per unit of industrial capital, shifting the economic preferences of societies towards health and education instead of material goods, reducing pollution generated by industry and agriculture, diverting capital towards food production for everyone, making soil enrichment and conservation a priority (e.g. composting urban organic wastes), and increasing average life time of industrial capital (better design, repair, less discard) (see Meadows et al., 1972: 162-164).

The message of this special issue is that we are aware of solutions, and we know that they work! At agricultural sector level and at systemic level as well, we know the virtuous pathways. At agricultural sector level, proofs from organic agriculture, urban and *peri*-urban agriculture and other forms of respectful agriculture let us know that we are heading in the good direction. But the future food availability depends only partially on the agriculture itself. Converting to organic and conservative agriculture, getting perennial plants in farming systems, restoring degraded lands is mandatory, but will not be enough. To halt biodiversity loss and GW, to cope with growing scarcity of resources, the main part of the solution lies in each of us to reorient towards a more frugal way of consuming.

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[3] European cattle consume the crops from about 2/3 of the arable lands in Europe (Westhoek et al., 2011).

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