IDDRI

ISSUE BRIEF

N°10/18 SEPTEMBER 2018

An agro-ecological Europe: a desirable, credible option to address food and environmental challenges

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Social expectations regarding healthy diets, the protection of natural resources and biodiversity are becoming increasingly apparent at the European level. Effectively managing these expectations implies generalising an agro-ecological model, in other words one that uses no pesticides and maximises ecological processes. In Europe, this kind of agriculture is less productive on average, and is therefore considered incompatible with tackling other crucial challenges: producing enough for Europe and the world while developing bioeconomy sectors to combat climate change.

The TYFA project (Ten Years for Agroecology in Europe) addresses this apparent dilemma by examining how much feed/food/fuel and material the agricultural sector could and should produce to tackle, with equal priority, challenges associated with climate change, health, the protection of biodiversity and natural resources, and the provision of a sustainable and healthy diet to Europeans—without affecting global food security. Top scientific experts helped to build a quantitative model simulating the agricultural functioning of the European food system in order to examine the current situation and to develop an agro-ecological scenario for Europe in 2050. This is the first component of a foresight exercise that will successively deal with the socio-economic challenges and the policy levers for an agro-ecological transition.

KEY MESSAGES:

- Current diets, which are too rich and unbalanced (three times the recommended amount of sugar, double the recommended amount of protein, not enough fruit, vegetables or fibre):
  - contribute to the increase in many conditions (obesity, diabetes, cardiovascular diseases);
  - lead Europe to depend on the rest of the world for food, through its imports of 40 million tonnes of plant proteins, which represent 20 % of its utilised agricultural land and far exceed the level of its exports.
- The TYFA scenario is based on abandoning pesticides and synthetic fertilisers, redeploying natural grasslands and extending agro-ecological infrastructures (hedges, trees, ponds and stony habitats), and the generalisation of healthy diets (fewer animal products, more fruit and vegetables).
- Despite a decline in production of 35% compared to 2010, this scenario:
  - meets food requirements for Europeans, while maintaining export capacity for cereals, dairy products and wine;
  - results in a 45% reduction in agricultural GHG emissions compared to 2010;
  - helps to restore biodiversity and to protect natural resources.
- The extensification of livestock grazing plays a key role in this scenario. It enables the maintenance and redeployment of natural grasslands, maximising the production of spontaneous legumes and therefore soil fertility management, and contributes to the restoration of biodiversity, climate mitigation and high-quality animal production.

This work has received financial support from the Charles Léopold Mayer pour le Progrès de l'Homme Foundation and the French government in the framework of the programme "Investissements d'avenir", managed by ANR (French national agency for research) under the reference ANR-10-LABX-01.

This document has also greatly benefited fom the critical inputs of a scientific board: Marc P. Benoît (INRA, COMETE), Marc Benoît (INRA, ASTER), Tamara Ben Ari (INRA, UMR Agronomie), Gilles Billen (CNRS, UMR METIS), Laurence Guichard (INRA, UMR Agronomie), Philippe Lescoat (AgroParisTech), Marc Moraine (INRA, UMR Innovations), Natacha Sautereau (ITAB), Olivier Thérond (INRA, UMR LAE).

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SciencesPo

THE CURRENT EUROPEAN FOOD SYSTEM IS NOT SUSTAINABLE

The European food system is often perceived as being highly productive. To its credit, we can consider the volumes produced, the structure of an agri-food industry capable of not only feeding more than 500 million Europeans, but also of contributing positively to the balance of trade, providing 4.2 million jobs in Europe. In addition, for the last 20 years, the efficiency of European agriculture has been improving in terms of greenhouse gases (-20% since 1990), due in particular to the concentration of livestock farming and to higher nitrogen use efficiency.

However, for several decades, these successes have produced more and more serious social and environmental impacts. In terms of health, diet-related diseases are growing at an alarming rate (diabetes, obesity, cardiovascular disease). Although we produce a lot in Europe, we also eat too much and our diets are unbalanced in relation to the nutritional recommendations of the European Food Safety Authority (EFSA) and the World Health Organization (WHO).[1] This is particularly true for animal products (+60% animal proteins in relation to recommendations), which are themselves fed by a growing share of the crop production available in Europe—58% and 67% of, respectively, available cereals and oilseed/protein crops are used to feed livestock—the majority of the later being mostly imported from Latin America in the form of soybean meal.

The high productivity of land in Europe is also the result of the widespread use of chemical inputs – pesticides and synthetic fertilisers. The former are responsible for an increase in the prevalence of numerous diseases among farmers,[2] and there are strong concerns about their impact on our food, including drinking water. European agriculture is also threatening biodiversity, the loss of which is causing alarm. In the space of one generation, 20% of common birds have disappeared,[3] and some regions are lamenting the loss of three quarters of all flying insects.[4] This picture should also include the destruction of tropical forests, which we indirectly "import" through the soybean produced in South America. Natural resources are unquestionably changing.

These dynamics are the result of specialisation, concentration and intensification processes in farms. Farmers are engaged in competition to expand and to over-equip their farms, in an approach in which every agricultural advance consumes more and more energy and imported nutrients, and in a continuous race between pesticides and pests. Maintaining agricultural potential has a high financial and environmental cost and, more worryingly, seems to have no end.

Faced with these challenges, the dominant response is sustainable intensification, which seeks to "do more with less", by using inputs and resources more efficiently. However, it is based on partial technical solutions, meaning that farm expansion, concentration and specialisation dynamics continue, and are a major cause of biodiversity loss and agricultural landscape degradation. This response also leaves other questions unanswered: will "using fewer" inputs be enough for biodiversity and natural resources? And for the quality of our food?

AN AMBITIOUS AND SYSTEMIC APPROACH TO AN AGRO-ECOLOGICAL AGRICULTURE

In TYFA, agroecology is approached as an innovation pathway in agricultural systems aimed at maximising the use of ecological processes in the functioning of agro-ecosystems, with a view to achieving sustainable food. On this basis, we propose hypotheses concerning every dimension of the agricultural and food system: fertility management, plant production, land use, animal production, non-food uses, and European diets. These hypotheses must be understood in the light of the balance sought when addressing issues relating to health, food security, the protection of natural resources and biodiversity, and climate mitigation.

In agricultural terms, these hypotheses translate into the need to promote optimum use of local resources—leading to a detailed management of nutrient flows at the territorial level—and a precautionary principle to stop the use of pesticides. The goal is to return to agro-ecosystems that make maximum use of soil life and legume symbiotic nitrogen fixation capacities (which are inhibited by mineral nitrogen fertiliser inputs). Fertility transfers between areas that provides nitrogen through leguminous crops, and areas that exports it (non-legume crops) occur through livestock manure. Unfertilised natural grasslands and the animals that enhance them play a key role in this nitrogen supply. Finally, agroecology as envisaged in TYFA is based on the significant development of agro-ecological infrastructures —hedges, trees, ponds, stony habitats favourable to insects—, to cover 10% of cultivated land, in addition to the extensive grasslands that are the main component of these infrastructures.

The shift to low-input agriculture with a high proportion of permanent extensive grasslands and other agro-ecological infrastructures thus makes it possible to directly address the restoration of biodiversity, the quality of natural resources and a reduction in greenhouse gas emissions.

However, this multifunctional ecological performance of agroecology is only possible because it is accompanied by a decline in production relative to the current situation. Indeed, the yield assumptions used in TYFA (based on organic agriculture references for

1. EFSA (2017b). EFSA Comprehensive European Food Consumption Database. European Food Safety Authority – https://www.efsa.europa.eu/en/food-consumption/comprehensive-database.
2. Inserm (2013). *Pesticides – Effets sur la santé – Synthèse et recommandations*. Paris, Expertise collective, 146 p.
3. Inger, R. *et al.* (2015). Common European birds are declining rapidly while less abundant species' numbers are rising. *Ecology letters*, 18 (1), 28-36.
4. Hallmann, C.A. *et al.* (2017). More than 75 percent decline over 27 years in total flying insect biomass in protected areas. *PLOS ONE*, 12 (10).

Europe[5]) are 10 to 50% lower than current average yields depending on the crops, although future innovations should be considered in this field, which would help to adapt to the impacts of climate change, for example.

AN AGRO-ECOLOGICAL EUROPE CAN MEET BALANCED FOOD REQUIREMENTS FOR 530 MILLION EUROPEANS BY 2050

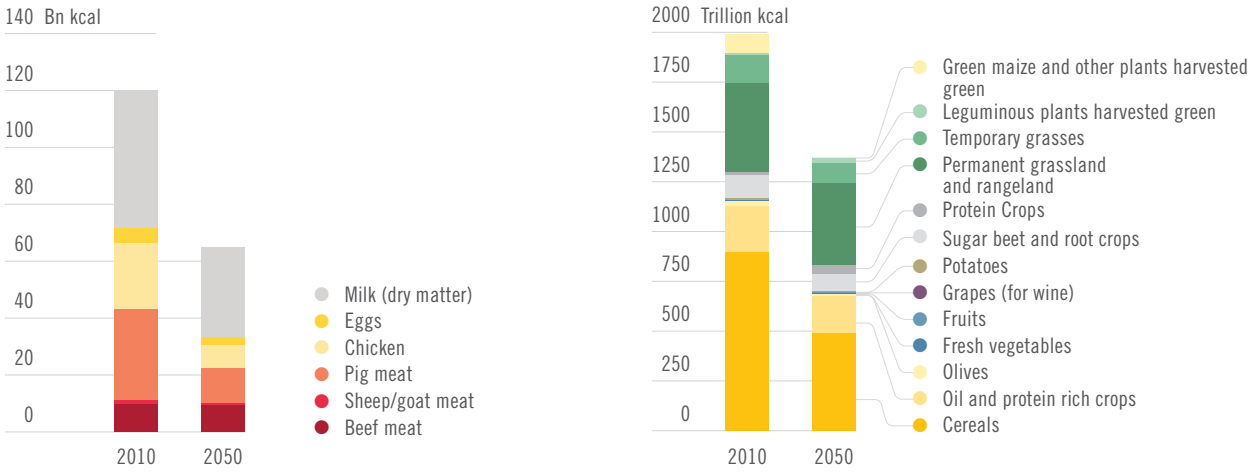
Can we therefore envisage the decline in production that would result from the generalisation of yields observed today in organic farming and still meet the needs of a population expected to reach almost 530 million people by 2050?

The answer is yes, and this is one of the key findings of the modelling and quantification process undertaken in TYFA. Based on a healthy diet, according to current nutritional recommendations (EFSA, WHO and PNNS), while retaining important cultural attributes such as the consumption of animal products and wine, the decline in production modelled in the scenario (-30% for plant products and -40% for animal products) is sufficient to feed Europeans, even when a high proportion of land is given over to agro-ecological infrastructures that do not directly produce, but contribute to the proper functioning of agro-ecosystems.

In particular, this diet contains fewer animal products (but those consumed are of better quality) and less sugar; on the other hand, it is higher in fibre and contains more—seasonal—fruit and vegetables. Overall, it is more nutritionally balanced and has absolute environmental quality if we consider the replacement of pesticides by beneficial organisms. It unquestionably marks a shift away from what we eat today, but this transformation is not necessarily on a vastly different scale from the changes occurring in this field between the post-war period and today.

5. Ponisio, L.C. *et al.* (2015). Diversification practices reduce organic to conventional yield gap. *Proc. R. Soc. B*, 282 (1799).

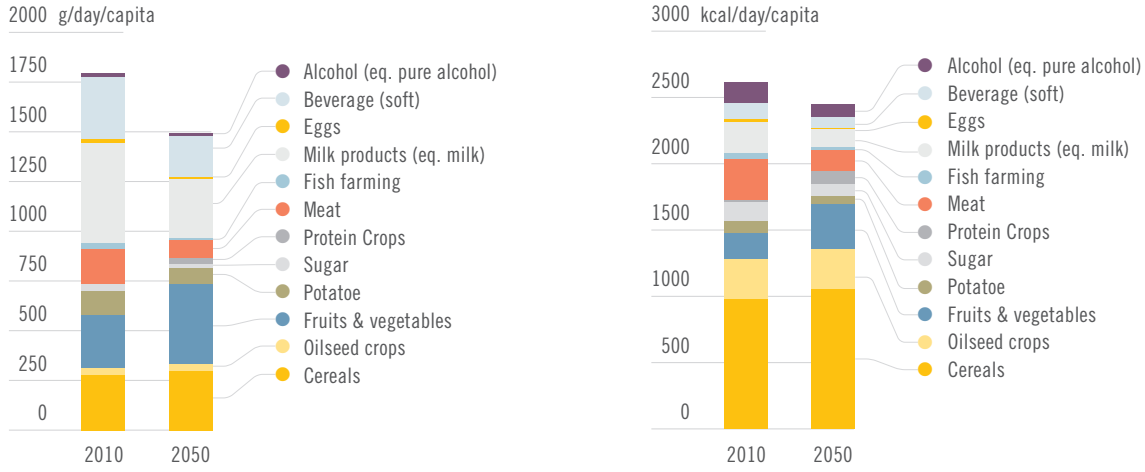
Figure 1. Evolution of the European agricultural production under the TYFA scenario (in kcal)



Source : authors.

Source : authors.

Figure 2. Changes in diets under the TYFA scenario with respect to 2010 diets



Source : authors for 2050 and EFSA (2017) for 2010.

Non-food uses of biomass are also considerably reduced in TYFA. In this respect, the scenario contrasts with other scenarios that rest on a highly productive bioeconomy to reduce the use of fossil fuel. The production of biofuels and natural gas (by anaerobic digestion) is indeed reduced to zero in 2050 compared to, respectively, 8,7 and 10,7 millions of toe in 2010—which however represents only 2 % of European energy consumption. Despite this, the TYFA scenario has the potential to reduce agricultural greenhouse gas emissions by 36% compared to 2010. This figure increases to 45% if the calculation of 2010 emissions includes those associated with "imported deforestation", which disappear completely in TYFA with the suspension of plant proteins imports.

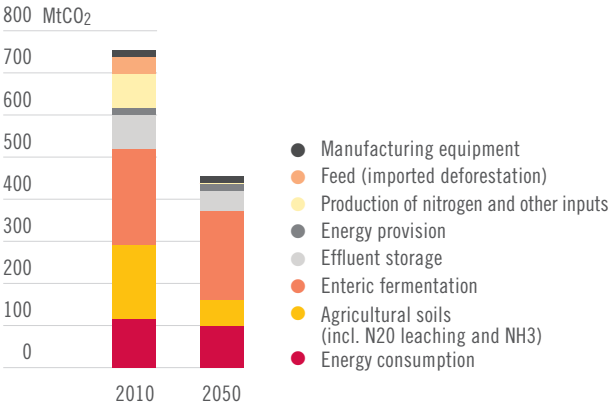
Moreover, the diversification of agricultural products and landscapes is an advantage of this scenario in terms of adaptation to climate change.

AN AGRO-ECOLOGICAL EUROPE THAT CONTRIBUTES TO GLOBAL FOOD SECURITY

Although the benefits of TYFA are centred on Europe —the health of Europeans (especially agricultural producers) and of functional ecosystems and landscapes—global challenges are not sacrificed in the shift to an agro-ecological Europe, which, moreover, will not become self-sustaining in the process. In terms of food security, reducing the consumption and production of animal products, especially granivores, translates into reduced demand for cereals for this sector, freeing up a surplus of cereals comparable, in volume, to the net export-import balance of the last decade (6% of production). This quantity is not expected to "feed the world"—countries must first feed themselves—but at providing a reserve that can be used in case of food crises, especially in the Mediterranean zone. But the main contribution to food security consists in envisaging a more autonomous European agriculture, which stops importing almost 35 million hectares of soybean. For soybean exporting countries, this means lower deforestation pressure.

The agro-ecological Europe described in TYFA also frees up a share of production not directly consumed by Europeans, which can be used for export, in particular because of its quality, for dairy products (20% of production, just under half the 2010 amount) and wine.

Figure 3. Potential of reduction of greenhouse gases in the agricultural sectro under the TYFA scenario



Source : authors.

ENVISAGING A TRANSITION TO AGROECOLOGY

The lessons from the TYFA scenario, summarised above, are based on the construction of a picture of agriculture and food in 2050. In this picture, the agro-ecological "European farm" is productive and very efficient in the use of scarce resources. This picture can be perfected and variations can be considered. Its function is not to impose a diet and an overall structure for agricultural production, but to inform the debate by demonstrating the feasibility and relevance of a different approach to integrate environmental and social challenges into agricultural production. The next stage of the process needs to address other economic and policy issues. The challenge appears in the very title of TYFA: "Ten Years" is the timescale needed not to achieve an entirely agro-ecological Europe by this time, but to launch a movement that makes this a feasible prospect by 2050. The goal of the analysis presented here is to show that this transition is not only desirable, but also credible. A debate and a new strategic area are opening; they will be political.