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Introduction

The SUFISA project – Sustainable Finance for Sustainable Agriculture and Fisheries – aims to identify practices and policies that support the sustainability of primary producers in a context marked by two main features. The first one is the multi-dimensional sustainability crisis that is currently hitting most farmers and fishermen, and more generally agricultural and fisheries sectors across Europe — though some exceptions do exist. This crisis is multi-facetted and relates to economic, social and environmental aspects. One can cite, among other things, a high pressure exerted on prices by downstream actors, an incapacity of paying off debts, a decrease in incomes, a high exposure to price volatility with little resilience, but also, from a more environmental point of view, a decrease in the biodiversity of the European countryside, water pollution, nitrogen leakages, growing difficulties in renewing the fishery resource, etc. Producers' sustainability is threatened and may even have worsened over the last couple of years, calling for renewed strategies and solutions to address the issue. The second important feature of today's agricultural and fisheries sectors is the complex and changing environment in which it is embedded: policy requirements are constantly evolving and are more and more subtle, agricultural markets and markets in fishery and aquaculture products are increasingly volatile, and environmental changes cannot be ignored anymore.

The whole project is based on a conceptual framework that links the *conditions* affecting producers' decision-making processes, with the *strategies* they develop in response to it, and with their sustainability *performances*. This conceptual framework has been used to look at 22 case studies in contrasted settings all over Europe. This work has notably exposed the wide diversity of the strategies that producers have developed beyond the conventional concentration-specialisation-intensification pathway, as a way to cope with various conditions. It has also set the scene for a more systematic exploration of the kind of solutions – the term encompasses here both public policies and collective strategies – that could be developed to address some of the most stringent sustainability issues faced by primary producers and which they cannot fix at the production unit level.

This report draws on the theoretical framework mentioned above and on preliminary results gathered in the 22 case studies to explore how European producers' sustainability could be enhanced by 2030. It develops four food system narratives to test the relevance and the potential impacts on producers' sustainability of a number of policy options and collective strategies in a variety of configurations. Its aim is threefold:

- First, the report explores how the business environment of primary producers could evolve by 2030 and reflects on the sustainability challenges this environment would pose, taking into account drivers such as the organisation of food chains, European diets, trade policies, the technology and innovation system, and the level of demand on international agricultural markets. Four contrasted "food system narratives" are explored and their consequences for the sustainability of primary producers are examined;
- The report then identifies different solutions (i.e. institutional arrangements combining policy instruments and collective strategies, see section 1.1.1) which could be implemented to cope with these changes in producers' conditions. It proposes a preliminary and qualitative assessment of how each of them could be adopted and implemented, with which impact on the sustainability of producers across Europe under each narrative. More specifically, this part aims to

discuss the "domain of validity" of different solutions commonly discussed for the agricultural and fisheries sectors (e.g. risk management instruments, vertical coordination through inter-branch organisation, increased market power for producers through producer organisations, etc.), and the kind of sustainability transition they can contribute to in different contexts;

- In so doing, the report intends to contribute to the structuration of the public and policy debate about agricultural and fisheries policies / policy reforms in Europe, most notably by shedding light on the variety of issues at stake and by showing their relative importance under different configurations. This last aspect will however not be fully discussed in this document, but only touched upon in the conclusion section.

The report is divided into five main parts. The first part lays down the methodological and theoretical foundations of this work. It is followed in the second part by a retrospective analysis of primary producers' strategies in Europe over the last 60 years, along with the identification of the main drivers of evolution. The third part then builds on this analysis to develop four food system narratives, in which European primary producers could be embedded by 2030. Part four then examines the consequences each narrative could have on the business environment of producers, identifies the associated sustainability issues and the types of solution which could address these environments, arriving at the development of full scenarios. Finally, the fifth part draws on a comparative analysis of the four scenarios to discuss the "domain of validity" and the potential impact of seven main solutions on the sustainability of producers in each case.

1 Theoretical and methodological framework: building scenarios and identifying solutions to increase primary producers' sustainability

The main objective of this research is to identify solutions to increase the sustainability of primary producers in Europe by 2030 through a scenario exercise. In this chapter, we start by defining what we call a "solution" in this context, before presenting the methodology used to develop scenarios.

1.1 Identifying solutions to increase primary producers' sustainability in Europe

1.1.1 What are solutions?

The SUFISA conceptual framework proposes to consider the level of sustainability of primary producers as the result of the strategic choices they make, which themselves result from the broader conditions (economic, environmental, technological, market…) in which they are embedded (Grando *et al.*, 2016). This approach is summarized in Figure 1 (see onder).

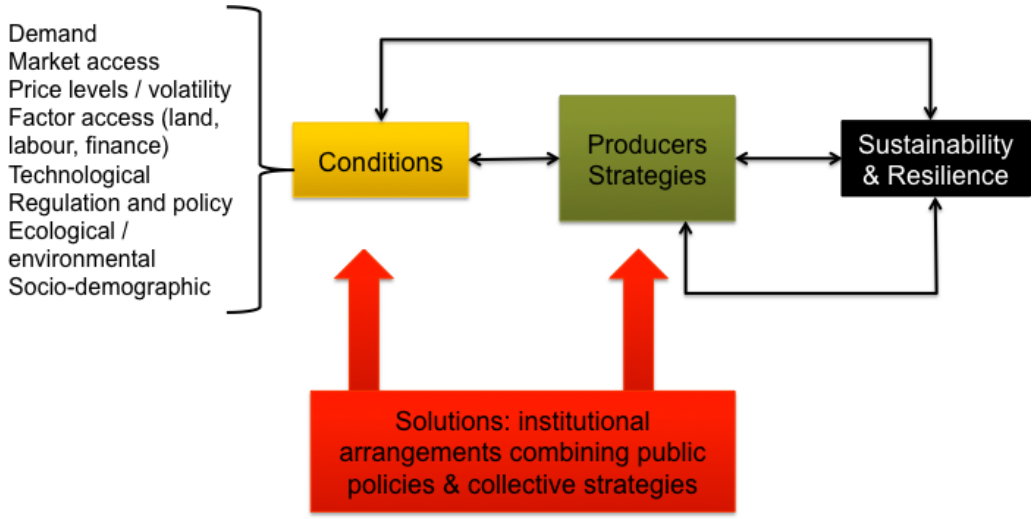


Figure 1: The SUFISA conceptual framework. Source: authors, based on (Bonjean & Mathijs, 2016 ; Grando *et al.*, 2016)

Within such a framework, a preliminary definition of "solutions" include all the interventions that help primary producers to better cope with, take advantage of, or alter, a given set of conditions – most notably through the development of new / renewed strategies – in order to increase their sustainability & resilience. Solutions can take different forms – such as public policies or collective strategies, both vertical and horizontal – but often combine a mix of them under the form of various institutional arrangements (Bonjean & Mathijs, 2016). Many of such "solutions" have long been debated, discussed, and even tested in various settings (e.g. payment for ecosystem services, insurance schemes, contractualization between actors along food chains, territorialisation of food systems…). They are put forth by some stakeholders while being rejected by others. And above all, each solution actually reflects a certain vision of what is at stake when talking about sustainability, and what are the most prominent obstacles to tackle to achieve it. What is meant by sustainable agriculture and fisheries indeed varies amongst stakeholder, despite the many efforts made to define common sustainability indicators / matrix. In short, solutions are hybrid institutional arrangements aiming at improving producers' sustainability, which rely on a particular vision of what is meant by "sustainability" and whose implementation structure specific relationships between food system's actors.

A wide range of such solutions will be examined through the scenario building exercise, to contribute to ongoing – and often heated – debates on their respective merits. This will include, for example, insurance schemes and risk management tools; horizontal and vertical coordination mechanisms; payment for ecosystem services or environmental measures; land access regulations; financial instruments, etc. For each "solution" identified as relevant in the scenario building exercise, we will explore (i) how they frame the problem of producer's sustainability – that is, in our framework, which conditions are considered the most problematic in producers' business environment; (ii) what they propose to tackle it and how – that is, their "theory of change" (see for a good presentation of theory based approach to public policies Weiss, 1997); (iii) what is their status at the moment in Europe (only at the discussion stage, already tested in some settings, ready for a wide dissemination), and (iv) who are their key proponents / opponents, and under which

circumstances could they be adopted and implemented more widely in the scenario under scrutiny.

One of the key questions we will try to answer throughout this report is: which kind of sustainability transition could each of those solutions contribute to? More specifically, we will use a sustainable transition management studies framework to reflect on this (e.g.Barbier & Elzen, 2012 ; van Mierlo *et al.*, 2017).

Before the methodology we relied on to develop scenarios, let us turn to three important prerequisites. We first need to better characterize what we call "a producer"; then specify the types of conditions we will take into account in our exercise and how we envisage their evolutions by 2030. Finally, we will make explicit the normative framework used to define the "sustainability" of primary producers.

1.1.2 What are producers? A micro-economic approach

First of all, we must specify that the terms "primary producers" or "producers" encompass farmers, aquaculture producers and fishermen throughout this report. For the sake of simplicity, we will use the term "farm" in this report to refer to the economic unit managed by a producer, either a farmer, an aquaculture producer or a fisherman.

As stipulated in the above, SUFISA relies on a producer-centred approach. One objective of the project is, in particular, to better understand producers' decision-making processes – *i.e.* how producers design and implement strategies – in order to identify ways to change these towards increased sustainability. However, these decision-making processes are likely to be very different depending on the type of producers we are looking at. While the vast majority of farms in Europe can still be considered as family farms[1] – *i.e.* farms (i) predominantly relying on family labour, (ii) in which part of the productive capital is considered as family patrimony, and (iii) where decision-making processes combine economic and domestic rationales (see Bosc *et al.*, 2015, p. 45) – new forms of farms have progressively emerged in all countries based on a variety of financing mechanisms. They range from purely financial logics, in which the farm is fully or partly owned by private or institutional investors and operated by managers, to ethical investments in which what shareholders look for is the quality of the project and its level of sustainability (for a typology of these new investment models in France, see Nguyen *et al.*, 2017). Needless to say that decision making processes slightly differ in each case, and are not affected in the same way by changing conditions.

What is thus needed is a broad definition of producers in order to encompass all kinds of situations. Going back to the basics, we propose here to adopt a micro-economic perspective to consider a producer as an economic agent producing raw material – food, fibre, fuel – and in some cases transforming it, from three main production factors: land (or marine areas for fishermen), labour and capital.

Such an approach, firstly, recognizes the huge diversity of producers' situations across Europe, as farms' endowments in land, labour and capital are highly heterogeneous within and between countries and sectors. On the other hand, as stated above, relationships between the ownership of production factors and farm functioning have gradually evolved over the last 10 years (see Swinnen & Knops, 2013 ; Cochet, 2017 ; Purseigle *et al.*, 2017). These trends are likely to bring

[1] This aspect does not correspond to the case of fishing, mainly conducted in the context of an entrepreneurial model which is not based on family work.

about major changes in the coming years and must be seriously acknowledged when looking at the sustainability of primary producers more than 10 years down the line.

A last point needs to be mentioned here: the changing features and boundaries of primary producers, especially in terms of whether they hold production factors (or, conversely, whom these production factors belong to), can be considered as the result of strategic choices made by producers to adapt to an evolving business environment. Let us briefly recall here the broad typology of producers' strategies retained in the SUFISA conceptual framework, which will be used throughout this report. Based on a literature review, five strategy clusters have been proposed, that read as follows:

- *Agro-industrial competitiveness*: These strategies mainly aim to increase farms' (or vessels in the case of fisheries) competitiveness on the global agro-food markets. They do so by enlarging the business size in order to achieve a critical mass of budget and market shares and to profit from economies of scale.
- *Rural development:* This second cluster of strategies encompasses a wide array of strategies centred around the re-grounding of farming into their territories and the re-valorisation of small scale and proximity. They range from the re-discovery of abandoned varieties to the adoption of environmentally-friendly production methods, and extend their scope to cover a range of multifunctional activities and services that farms can provide to consumers and society as a whole.
- *Blurring farm borders:* These strategies represent different ways to blur farm borders in order to achieve a range of objectives. They include, *inter alia*, partnerships and cooperation to create economies of scope, or spaces where quality products can be differentiated and protected by price-based market competition, as in the case of clubs, or externalisations and agricultural contracting to improve efficiency through specialisation and cost optimisation.
- *Risk management*: The strategies to cope with production, business, productive, and ecological risks are mainly based on contracts and legal arrangements through which risks can be shared among partners, or partially or completely shifted to others.
- *Coping with farming decline*: A final set of strategies describes all those situations in which a farm "merely" copes with the decline of its activity, finding ways in which the household can survive, or even improve its livelihood standards. This can happen with or without a central role being played by the farm business.[2]

The three first strategy clusters refer mostly to the agricultural or fishing model prioritized by the producer and are not easily combined – opting for one or the other has also often quite direct consequences on the farm's structure, considered here from the perspective of production factors. However, they can each be combined with the fourth cluster of strategies. The fifth one works more in isolation from the others. From a more theoretical point of view, and as we shall see below, the deployment of a strategy, or of a mix of strategies, often gives rise to or stabilises into institutional arrangements.

The underlying assumption of the SUFISA project is that producers engage in one or more strategies on the basis of their subjective appreciations of their conditions. Let us now turn to a more precise description of the latter.

[2] A sixth cluster has also been proposed that encompasses more collective-based strategies aiming at changing the political context. This cluster in not included here, as it clearly falls into what is considered as collective strategies / solutions.

1.1.3 Conditions at farm gate and their drivers: linking the micro, meso and macro levels

Factors affecting producers' decision-making processes are numerous. They can be either internal or external conditions. Internal conditions reflect the individual characteristics of the farm and of the farmer. They encompass human, social, and psychological factors among others, as well as farmers' preferences, motivation, experience, traditions, etc. External conditions are imposed onto producers who can, to a certain extent, be considered as "conditions-takers". Eight such external conditions have been identified through a literature review, which read as follows:

i. *Demand:* local demand, consumers' knowledge and information, consumers' level of income, consumers' willingness to pay, distance to consumers

ii. *Market access:* distance to market, signalling, visibility, proximity, exports, imports, competitiveness, tariffs, boycott, number of similar producers (differentiation), etc.

iii. *Price:* level, volatility, predictability, far-sightedness, etc.

iv. *Ecological/environmental:* stress and constrain, access, permits, regeneration, etc.

v. *Finance:* level of debt, access to capital, liquidity constraints, equity, etc.

vi. *Regulation & policy:* legislation, rules, subsidies, quality of institutions, proximity, administrative issues, domestic institutions, supra-national instances, political stability, quality and access to infrastructure, etc.

vii. *Socio-demography:* population of farmers and fishermen, networks, organisation, trust within the sector, informal relationships at the sector level, etc.

viii. *Technological:* new technology, education, training, human resources, evolution of practices, etc.

The boundaries and the headings of these categories could, of course, easily be challenged. More important is the fact that these conditions are the ones perceived by producers "at the farm gate" but that they themselves depend on broader trends. Changes in the conditions at the farm gate are thus very often – if not always – the result of changes / evolutions in the organisation of the food system(s) in which the farm is embedded. Hence, there is a need to consider producers in the wider perspective of European food systems' transformations, in order to fully understand (i) how their conditions are likely to evolve and (ii) which kind of solutions could enhance producers' sustainability.

In the rest of this document, we rely on a literature review describing how past evolutions of European food systems have impacted producers' strategies (see section 2). This has led us to consider six main building blocks to apprehend European food systems and their dynamics – the evolution of which, to a large extent, determine the evolution of the eight above-mentioned "conditions" at the farm gate and, in turn, producers' strategies, while conditioning the kind of solutions that can be adopted / implemented. Those six building blocks are the following:

— Trade policies between Europe and the rest of the world;

— The level of global demand for agricultural commodities / agrifood products, which determines / influences world market prices;

— Agricultural, fisheries and environmental policies pertaining to the agricultural and fisheries sectors;

— The evolution of European diets;

— The structure and organisation of food chains; and

— The evolution of technologies (digital revolution, machinery, biotechnology, etc.).

Figure 2 onder summarizes the approach adopted.

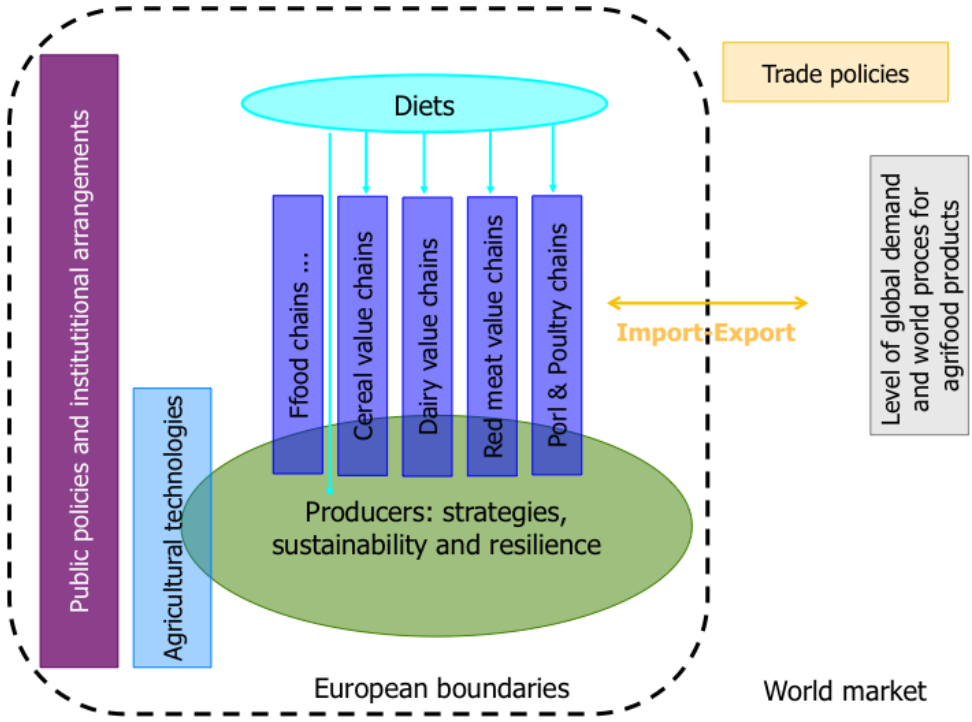


Figure 2: Main building blocks of European food systems (Source: authors)

1.1.4 Enhancing producers' sustainability: a normative framework based on the SDGs to think about sustainability

Identifying "solutions" to enhance producers' sustainability supposes having a clear, explicit definition of what is meant by "sustainable". In the SUFISA project, the sustainability concept appears twice (*sustainable* finance for *sustainable* agriculture and fisheries). It refers to the idea that farms' financial conditions, economic profitability, business stability and economic and financial resilience are key factors of the broader sustainability of agriculture and fisheries. To operationalize this approach, and in line with the recent communication of the European Commission on the future of food and farming in the EU (EC, 2017, p. 8), we developed a normative framework based on the Sustainable Development Goals framework (hereafter referred to as the SDGs). The SDGs indeed provide an integrated understanding of sustainability, integrating social targets like health and reduced inequalities, environmental targets on, for example, halting the loss of biodiversity and ecosystems, as well as economic targets like decent work and resilient businesses. They set 17 ambitious goals and 169 targets to be achieved by 2030. These targets do not, however, all apply to agriculture. We selected 47 of them on the basis of their relevance for the sector. Some targets were re-phrased to be adapted to the agricultural sector, as their initial framing was nation-wide rather than sector-based. An example is the target 1.2: "By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions". Whereas the SDGs give no mandate to support all farmers, they give the mandate to address the poverty of farmers, as well as poverty created by unsustainable farming.

All targets from this list were then gathered into twelve "objective categories", which together reflect how the global intent behind Agenda 2030[3] could be applied to the agricultural and fisheries sectors in a comprehensive manner. The categories can be clustered in three main "boxes" that read as follows:

- Box 1 comprises all objectives that directly relate to the level of socio-economic sustainability at the farm level: (1) producers' income, (2) decent working conditions, (3) farms' resilience to social, economic and environmental shocks, and (4) entrepreneurship capacities;
- Box 2 encompasses environmental aspects that are essential to agricultural production (natural capital) and also reflect the services that agriculture is supposed to provide, as part of its multi-performance (preservation of natural resources, landscape conservation, etc.), both at the farm and the landscape level: (5) land, (6) water, (7) climate, (8) biodiversity and (9) ecosystems, are the categories that relate to the preservation of natural resources;
- Box 3 finally refers to societal aspects beyond farm gate: (10) food security, (11) nutritional issues and healthy diets, and (12) contribution of the agrifood sector to the economy (jobs, contribution to GDP and economic growth).

While this last box could be seen as going well beyond the scope of the SUFISA project, which focuses on primary producers' sustainability, we argue here that increasing producers' "sustainability" while negatively impacting upon these aspects is not, all in all, sustainable.

The following part will depict the methodological approach developed to build scenarios and assess the relevance and potential impact of identified solutions.

1.2 Building scenarios

The main scenario building tools currently used to reflect on the impact and relevance of policy options, especially in the agricultural and fisheries sectors, are economic models. In the EU, economic models are often used in the policy process to carry out impact assessments (IAs), which have been made mandatory since 2003[4]. Since such an IA is currently being carried out as part of the CAP post-2020 reform process, the added value of such an approach would have been limited here. Hence, we decided to rely on a more qualitative approach to complement econometric approaches mostly used in IAs. Our aim has been to develop exploratory scenarios of how European food systems could evolve by 2030, to analyse (i) their possible consequences on producers' conditions, and (ii) the associated needs for public policies or collective strategies to maintain / enhance their sustainability. In such a perspective, scenarios are considered as *stories* that help to explore what, how and why things could happen in a certain way, in order to discuss about their possible consequences (Schwartz, 1998 [1991]).

The key starting point of the approach developed here is the idea that by 2030, European societies will experience changes that will not be directly linked to agricultural policies or producers' strate-

[3] Agenda 2030, adopted at the United Nations Sustainable Development Summit on September 25th, 2015, establishes the 17 SDGs and corresponding targets.

[4] From 2003 to 2014, 24 IAs have been carried out in the policy area "Agricultural and rural development". See for a recent review (Reidsma *et al.*, 2018).

gies. Yet, these changes will in turn affect the organisation of food systems and hence producers' conditions. Thinking about solutions in such a perspective thus implied developing scenarios following three main steps:

1. A first step was to develop "food system narratives". Such narratives intend to reflect how societal changes could affect the organisation of European food systems in different and contrasted ways, quite independently from agricultural and fisheries policies and producers' strategies. Four such narratives have been developed using a methodology presented in more details in section 3.
2. The second step was to analyse the possible consequences of each narrative for producers. We discuss three main aspects: (i) the consequences of each narrative on producers' conditions (based on the categories presented in paragraph 1.1.3); (ii) the type of producers' strategies that each narrative would be likely to favour the most; (iii) the main resulting sustainability issues in each narrative;
3. A third and final step was to reflect on the relevance and potential impacts on producers' sustainability of a wide range of "solutions" – in the sense described above. Each food system narrative was combined with a set of practical solutions to develop full scenarios, and the kind of sustainability transition which could unfold was qualitatively assessed in each case (see below).

It could be noted here that the role of our four "food system narratives" in the scenario development process is somewhat similar to the one played by Shared Socio-economic Pathways (SSP) in the climate change community, (O'Neill *et al.*, 2014 ; Van Vuuren *et al.*, 2014), although their time span is much shorter and their focus quite narrower:[5] They are to allow us to think critically about how different societal changes could challenge or favour sustainability transition for primary producers and, more broadly, for the entire agri-food sector.

Let us now describe in more detail the methodology and the data used to develop these scenarios. This will be followed by a brief presentation of how we intend to use these scenarios in policy debates, and of how they are going to be refined through a participatory process in the course of the year 2018.

1.2.1 Some methodological considerations: building scenarios and assessing their impact on sustainability transitions.

As stated above, a scenario is a combination of (i) a food system narrative and (ii) a set of potential solutions to address key (potential) sustainability issues implied by each narrative. The scenario building process followed a classical approach in forward thinking known as "morphological analysis", developed and presented by authors such as Michel Godet or Hugues de Jouvenel (see De Jouvenel, 2000 ; Godet & Roubelat, 2000). Five main steps are involved in such a perspective:

(i) Definition of the issue and setting of the time horizon: we are seeking solutions (i.e. public policies and / or collective strategies) to enhance European producers' sustainability by 2030;

[5] We will come back on the parallels between the climate change scenario research framework and the framework developed here in the last section of this report.

(ii) Definition of the system and identification of its key variables: the SUFISA conceptual framework as well as the literature review done for this scenario exercise led us to consider a system made up of five main components (see sections 1.1.3 and 3.1 for a full description), of which two were considered as main "driving forces" (trade policies and global demand) and three as descriptive components of the system (food chain organization, diets, technologies available in agriculture and fisheries);

(iii) Retrospective analysis and development of hypotheses for the possible future evolution of each component: the retrospective analysis is presented in section 2 below; we combined it with a careful review of recent scenarios about European agriculture and fisheries (McIntyre *et al.*, 2009a ; Freibauer *et al.*, 2011 ; Mathijs *et al.*, 2015 ; Mylona *et al.*, 2016) to develop hypotheses regarding the future of each component by 2030 (these hypotheses are presented in sections 3.1.2 and 3.1.3);

(iv) Development of the possible futures in two steps: we first built "food systems narratives" by combining the selected hypotheses for each component in a coherent manner; and then identified a set of solutions to apply to each narrative;

(v) This finally allowed us to develop a reflection on the relevance and potential impacts of a range of solutions and to determine their "domain of validity", *i.e.* in which kind of context could this or that solution lead to this or that kind of sustainability transition?

Some precisions are needed at this point regarding what we call "sustainability transition". The concept derives from a large body of work usually grouped under the heading of sociotechnical transition studies, or "multi-level perspective" (Geels, 2005 ; Geels & Schot, 2007). In this perspective, the emergence and adoption of innovations at a broad / systemic scale is considered the result of the interplay between three "levels": the macro-level sociotechnical landscape; the mesolevel regime and the microlevel niche. On the basis of numerous empirical studies analysed through this analytical lens, several "transition pathways" have been described that combine changes in the macro, meso and micro levels differently. The most common transition pathway discussed is one in which a shift in the dominant sociotechnical regime comes from the combination of two dynamics: a growing pressure from the landscape on the regime, coming, for example, from changes in norms or societal expectations; and the emergence and consolidation of some innovations at the niche level which are able to break through in the dominant regime taking advantage of its destabilization by pressures from the landscape.

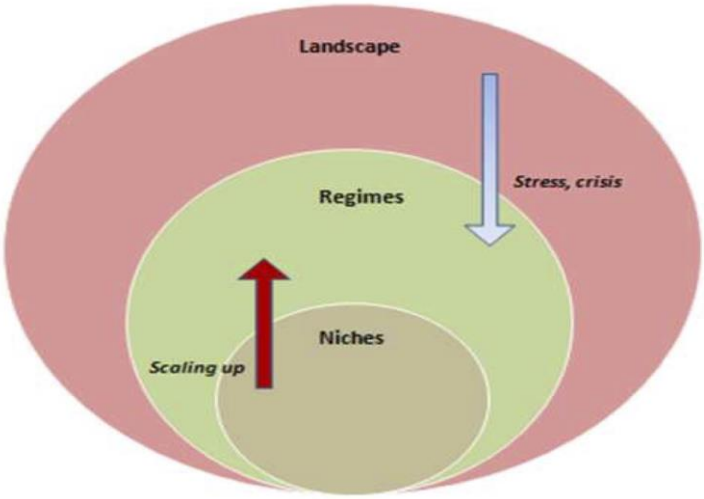


Figure 3: Transition processes in a multi-level perspective. Source: adapted from (Geels & Schot, 2007)

The idea of sustainability transition builds on this body of work and refers more specifically to those types of transitions which, in given sectors – in our case, the agricultural and fisheries sectors – could improve its overall level of sustainability. In our work, we refer to Barbier and Elzen (2012) to consider two main pathways of sustainability transition in the agricultural sector, namely:

— system optimisation, which happens when pressures from the landscape to better take into account a specific issue / stake are first met with resistance, but gradually lead to incremental changes through innovation activities;

— system redesign, which happens when pressures from the landscape are coupled with innovation work at the niche level.

In between, several transition pathways exist involving what can be called "partial system redesign" (see Figure 4). Using this framework, we will aim at assessing the kind of sustainability transition in which each scenario is the most likely to result.

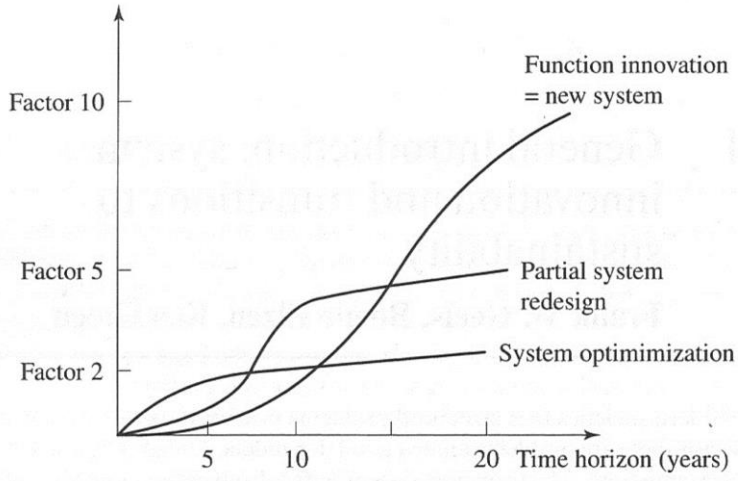


Figure 4: Types of sustainability transitions. The y-axis refers to the improvement in the level of sustainability. Source: Barbier (2012, p. 15)

1.2.2 Some strategic considerations: why develop scenarios, and what for?

In our view, and following Treyer's proposal (2009), a foresight study can be considered as a strategic intervention in a future-oriented debate. As such, it is a way to change the conditions under which this debate takes place, which could be done in (at least) two ways. A first one is by introducing stakes / issues that were previously either not considered at all, or misrepresented in the debates. A second one is by improving the accessibility of the discussion for new stakeholders.

In our case, the debate related to the future of European agriculture and fisheries, and more particularly the future of primary producers, is already well organized. It is structured around qualitative exercises, such as those performed by the Standing Committee on Agricultural Research (SCAR); and (perhaps more importantly) by econometric modelling carried out upon the request of the European Commission to *ex-ante* assess the relevance and the impact of different policy tools before their implementation. In this context, the scenario exercise proposed here has three main merits. First, it explicitly focuses on the *sustainability* of primary producers themselves and uses a comprehensive approach to assess sustainability based on the SDG framework, in the wake of the recent communication of the European Commission on the next CAP reform (EC, 2017). This differentiates our approach from that of most SCAR reports, which reason at the sector level rather than the producer level; and from that of most econometric approaches, in the sense that it considers sustainability in a wide and strong sense.

Second, as it is based on an exploration of contrasted "food systems' narratives" that could occur between now and 2030, this research allows for thinking critically about the relevance and the domain of validity of a broad range of solutions whose impact is often debated *ceteris paribus*, while the context in which they could be implemented is certainly different from the context that prevails at the moment when they are discussed.

Third, the initial set of scenarios presented in this report will be discussed in participative workshops throughout the year 2018 in a variety of settings and at various levels, ranging from regional / territorial workshops to Brussels-based workshops and through member state-level workshops. Not only will this *modus operandi* allow us to progressively refine these scenarios by adding complexity and integrating regional heterogeneity; it will also allow us to open the discussion to a broad variety of stakeholders that are most often excluded from the process.

2 Uncovering the drivers of producers' main strategic choices over 50 years: a retrospective analysis of European food systems

2.1 Main trends in the evolution of production systems across Europe

2.1.1 Industrial competitiveness strategies have shaped the evolution of primary producers

European farming systems have undergone profound structural changes since the Second World War, which accelerated notably since the 1970s. These changes have been inscribed in a larger global narrative of economic development in which agricultural modernization is considered a pillar of societal progress, but were also due to conditions particular to Europe and its socioeconomic and geopolitical considerations in the second half of the twentieth century. Efforts to significantly boost productivity were a central part of Europe's post-war recovery, which included increased focus on achieving food self-sufficiency. As this objective was reached and then greatly

surpassed at the European level (with an emphasis on a few key agricultural products), Europe concretized up to now its position as a major player on the world agricultural market and markets in fishery and aquaculture products. Before turning to the various drivers of change (including the CAP and the CFP as well as national policies) that have shaped European agriculture and fisheries during this period, this section focuses on the overarching strategies at farm level which have shaped the evolution of farming systems.

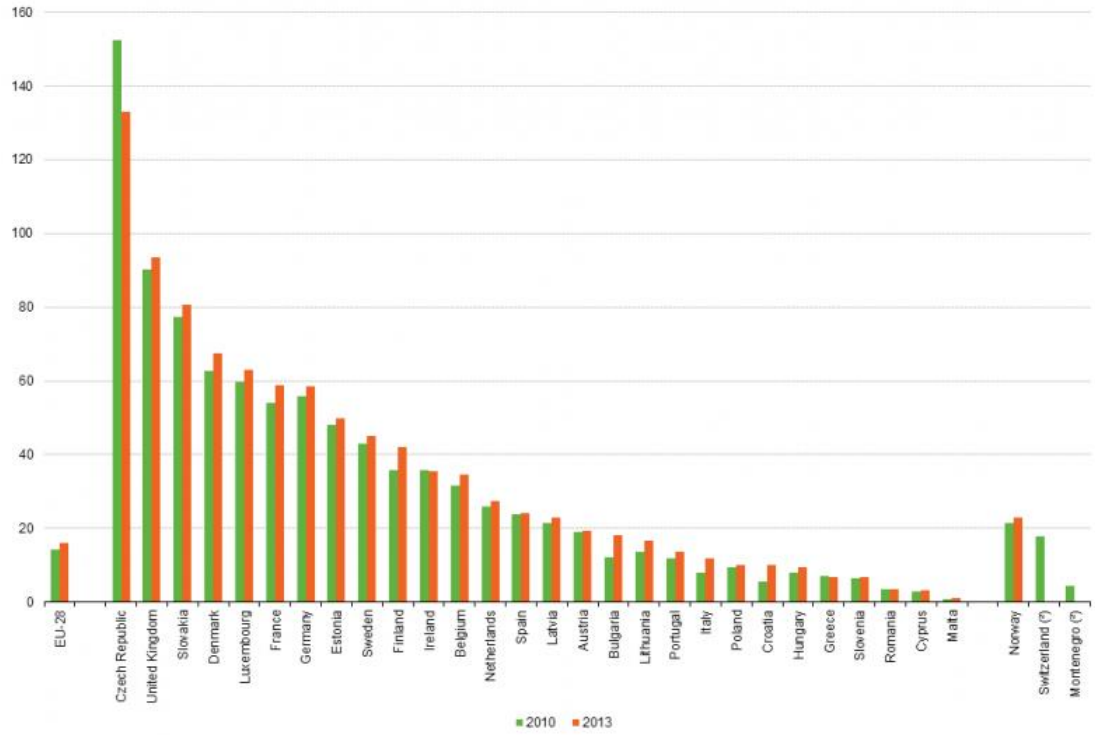
While a wide variety of highly heterogeneous strategies have developed across countries, the strategies pursued to achieve modernization primarily fall within a productivist ideology, which can be considered as "a commitment to an intensive, industrially driven and expansionist agriculture with state support based primarily on output and increased productivity. The concern [of productivism] was for 'modernization' of the 'national farm', as seen through the lens of increased production" (Lowe *et al.*, 1993). This agricultural modernization of the national farm has relied heavily on mechanization, genetic improvements, and the use of chemical inputs, which have all contributed to increasing productivity (Bosc & Bélières, 2015).

The dominant, and relatively hegemonic, character of this group of productivist strategies has first and foremost been expressed through three observable overarching trends: i) enlargement, ii) intensification, and iii) specialization. Each of these trends will be addressed in turn, while recognizing that the three are intrinsically linked.

Enlargement

The first major observable trend in the evolution of farming systems since 1960 has been the trend towards an increasing scale of operations resulting in fewer, larger farms. Enlargement and the resulting economies of size/scale enable cost reductions, helping farmers remain competitive (Dannenberg and Kuemmerle, 2010). Fishing vessels have followed the same path. Evidence for diseconomies of scale have been considered to be "weak or non-existent" (McIntyre *et al.*, 2009a). This strategy is intrinsically linked with the modernization of agriculture through technological change, which favors a highly capital- and input-intensive model requiring high investments in machinery and chemical inputs. Such investments are only considered to be worthwhile for many farmers if farm output is high, lowering costs per unit of production (ibid). Average unit costs have been found to have an L-shape as a result of economies of scale, decreasing sharply at first and then reaching a plateau, after which other factors tend to play a larger role in shaping the costs and structure of farms (Hallam, 1991). Conversely, mechanization has been a primary mechanism that has allowed for larger average farm sizes, since it severely reduces the labor inputs required per unit of land.

Figure 5 highlights the considerable heterogeneity in farm size and scale across the EU-28 presently, while also showing that the enlargement trend has continued in recent years. Between 2010 and 2013, the average utilized area increased in almost all member states, from 14.4 to 16.1 hectares on average. The notable exception is the Czech Republic, which has the highest average size per agricultural holding (133 hectares in 2013), far above the next highest average of 94 hectares for the United Kingdom; small reductions in size also occurred in Ireland and Greece. Overall, the smallest average sizes are primarily found in Eastern and Southern Europe, notably Romania, Cyprus, and Malta. The same trend was apparent in previous farm structure surveys (2003, 2005, and 2007), with the number of holdings decreasing in all but five EU countries (Eurostat, 2010). In Romania, Bulgaria, and Portugal, the number of farms decreased by over 25 % between 2003 and 2007 (ibid).



(1) Iceland not shown for reasons of scale: 2010 value was 616 hectares.
(*) 2013: not available.
Source: Eurostat (online data code: ef_kvaareg)

Figure 5: Average utilized agricultural area per holding, 2010 and 2013 (hectares). Source: European Commission, 2015.

The enlargement of farms goes hand in hand with a decrease in the total number of farms, with smaller farms in particular disappearing across Europe. Due to the high capital investments associated with farm enlargement, smaller farms are increasingly unable to compete with large ones. In addition to economic factors, CAP subsidies are still considered to privilege large holdings despite reforms based on payments per hectare, making large holdings more competitive as a result of subsidy capture even if they are not necessarily more efficient in terms of farming (van der Ploeg *et al.*, 2015). The same phenomenon can be observed with the enlargement of fishing vessels and the CFP subsidies privileging large vessels and important fleets. In the EU12, the number of farms decreased from about 9 million to 6.5 million from 1983 to 2001, and the number of vessels in the EU12 fishing fleet decreased from about 105 000 to 70 000 from 1992 to 2011. This trend has occurred both in crop and livestock production. These parallel trends of enlargement and reduction of small farms have been much less pronounced than in other regions of the world – average farm size in Western Europe remains only one tenth that of the U.S., for example, and the total number of farms is much higher, but the two have followed similar trends due to similar processes of modernization.

The combination of a decreasing number of farms combined with increasing total output has led to the concentration of production. Although small farms have persisted, they contribute to a very small proportion of overall production. In 2010, 80 % of farms in the EU-28 were less than 10 hectares each, cultivating a total of only 12 % of the total area. On the other hand, large farms (of 50 hectares or more) comprised 6 % of all farms but cultivate two-thirds of total utilized agricultural

area (Eurostat, 2014). In 2012, farms with an area of over 1 000 hectares represented only 0.6 % of the total number of farms, but cover a fifth of the total UAA in Europe, equivalent to roughly the size of Germany (van der Ploeg *et al.*, 2015). The evolution of concentration and its variation across selected countries is shown in Table 1. Since 1990, all eight countries saw a significant decline in land used for farms of less than 2 hectares, while land use for farms bigger than 50 hectares increased for all countries aside from Italy and Romania. In general, the EU has seen a reduction in total agricultural land and accompanying land abandonment, a trend that is less pronounced in Central and Eastern European countries.

Table 1: Utilized agricultural area (UAA) by size of holding, 1990, 2003, and 2007, selected countries in today's EU. Source: van der Ploeg *et al* (2015).

	Total UAA			Holding size < 2 ha			Holding size > 50 ha		
Country	1990	2003	2007	1990	2003	2007	1990	2003	2007
Bulgaria		2,904,480	3,050,740		312,790	191,100		2,278,900	2,497,710
Germany	17,048,110	16,981,750	16,931,900	123,670	24,770	20,110	9,228,820	12,046,610	12,594,570
Spain	24,531,060	25,175,260	24,892,520	555,600	369,710	311,960	14,836,700	17,406,120	17,481,430
France		27,795,240	27,476,930		82,610	62,180		22,022,030	22,745,390
Italy	14,946,720	13,115,810	12,744,200	1,246,160	901,620	773,120	5,072,440	5,099,300	5,015,850
Hungary		4,352,370	4,228,580		210,920	145,410		2,961,900	3,159,770
Austria		3,257,220	3,189,110		23,280	22,330		1,262,440	1,298,220
Romania		13,930,710	13,753,050		2,031,430	1,807,510		6,798,110	5,500,620

The tendency towards farm enlargement is generally associated with various changes in farming practices.

Intensification

Higher productivity resulting from the intensification of agriculture and fisheries has relied on two primary mechanisms: an increase in value added per worker and an increase in physical productivity (i.e., improved yields for crops and livestock products), both of which rely on the heavy use of different inputs to production. Productivity of labor has primarily increased through the substitution of labor by capital. During the second half of the 20th century, increased mechanization was achieved as a result of the introduction of the diesel engine, compact combine harvesters and various types of hydraulic and transmission equipment, which have reduced the need for manual labor at all stages of production: weeding, harvesting, and threshing (McIntyre *et al.*, 2009a). Concerning fisheries, artisanal fishing has been largely supplanted by industrial fishing in Europe and the fishing depth has steadily increased.

Throughout this retrospective section, we consider five countries as an illustrative of evolutions across the EU: France and Germany as representative of Western European (and both present as the two leading agricultural producers, with relatively divergent agri-food models), Denmark as representative of Northern Europe, Poland as representative of Eastern Europe, and Italy as representative of Southern Europe. Figure 6 onder shows the evolution of value added per worker for these five countries, showing the fluctuating but persistent upward trend. Poland is the clear outlier in the sample, with a comparatively steady value added per worker. Similar trends are apparent for other Eastern European countries due to the highly divergent models of production developed in the wake of collectivized agriculture under socialism; this regional contrast will be discussed at the end of this section.

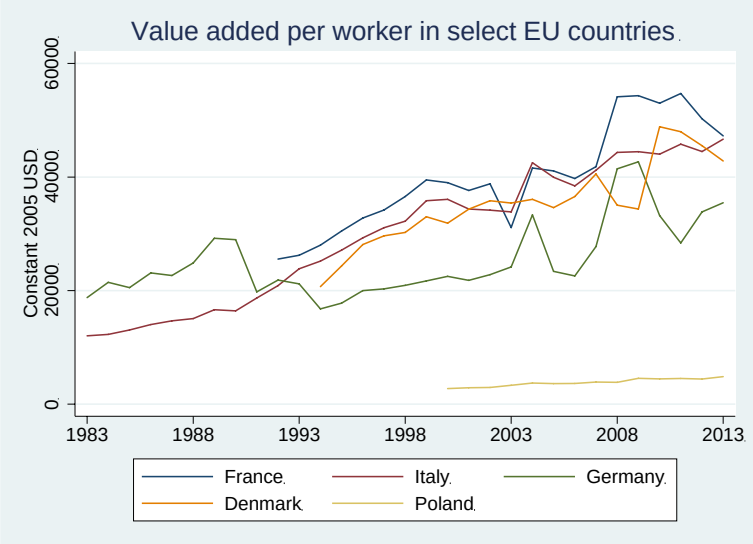


Figure 6: Value added per worker in select EU countries, 1983 to 2013. Source: authors, based on FAOSTAT (2017).

The increase in labor productivity has generally led to a parallel trend of decline in farm labor as a result of the use of machinery (Figure 7).

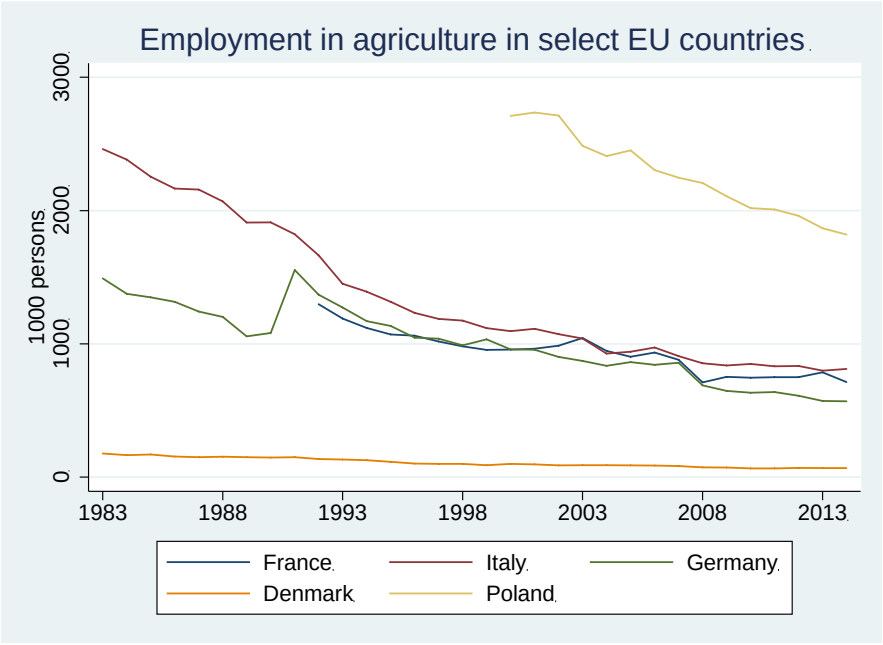


Figure 7: Employment in agriculture in select EU countries, 1983 to 2013. Source: authors, based on FAOSTAT (2017).

In countries in which mechanization has largely already taken place, such as Denmark, additional value added per worker is created through the second means of intensification: increasing physical productivity. The production of almost all crops has increased substantially since the 1960s as a result of yield increases. These increases are attributed to several factors, notably: the breeding of higher yielding varieties and breeds, the increased availability and use of synthetic fertilizers and pesticides, better understanding of yield-constraining factors and the optimization of agronomic

practices, increased use of irrigation, improved machinery, enhanced technology transfer (such as through the development of national agricultural advisory systems), and the delivery of information by the private sector (McIntyre *et al.*, 2009a).

Yields of intensive agriculture tend to be limited by access to essential nutrients, notably nitrogen and phosphate. Although the Haber-Bosch process for synthesizing fertilizers was first developed in the early 20th century, their widespread application and use only began to increase dramatically after the end of World War II, as a result of the breeding of new varieties that were able to respond to increased fertilizer levels (IAASTD, 2009) in the 1950s and to accelerate dramatically in the 1960s (Figure 7). As the detrimental impacts of excess nitrogen use became apparent at the end of the 1980s and farmers began to apply more precise techniques, the use of fertilizers in Europe began to decline. The gradual drop in the price of crops has also increased economic pressure for improving application rates. In France, for example, between 1986 and 1994, the use of nitrogen fell by 10 percent, that of phosphates by 20 percent, and that of potassium by 13 percent (Stoate *et al.*, 2001).

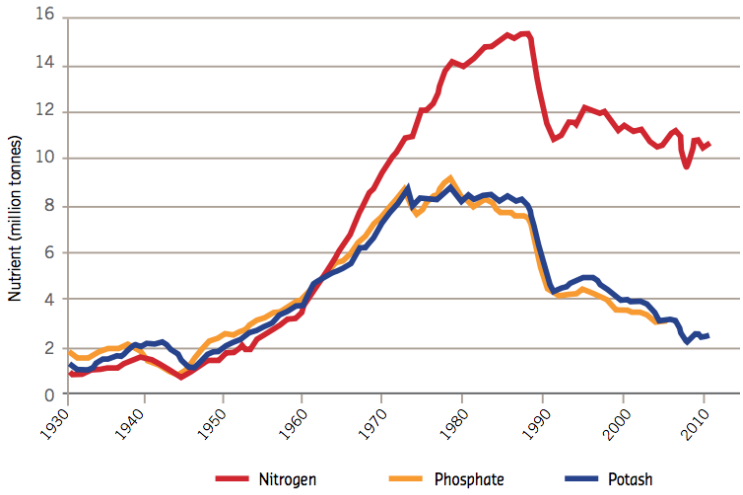


Figure 8: Fertilizer nutrient consumption in the EU-27. Source: Fertilizers Europe, 2012.

Synthetic chemical pesticides (including herbicides, insecticides, and fungicides) also began to be used widely after 1945 as the main form of pest management, following a similar trend to that observed for synthetic fertilizers. However, the volume of pesticides is a limited indicator of the evolution of its use due to the difficulties of amalgamating data on pesticides of different chemical origins and concentrations; currently, over 1000 chemicals are marketed worldwide under tens of thousands of formulations and methods of monitoring pesticide use differs between countries (IAASTD, 2009). However, country-level data is indicative of general trends. For example, the UK national pesticide survey indicate a large increase in land area treated with pesticides between 1974 and 2002, as well as an increase in treatments applied per hectare, from two to nine per year (ibid). As a result of the detrimental impacts of pesticides (to be discussed in section 2.2), many EU countries have adopted legislation to reduce pesticide use. Finland and the Netherlands, for example, saw a 46 and 43 % decrease in use, respectively, between 1991 and 1996 following the adoption of specific policies to reduce pesticides (Stoate *et al.*, 2001). In addition to lower applica-

tion, the harmful effects of pesticides have also been reduced due to the use of newer products with a lower environmental footprint.

Intensification has also occurred in the livestock sector, with an increasing number of livestock raised in housed systems requiring large volumes of grain, oilseeds, and protein crops for feed use, as well as antibiotics to promote growth and control disease (Knickel, 1990 ; McIntyre *et al.*, 2009a). Similarly to crop production, livestock rearing benefitted from developments in genetics, management systems, and restructurations throughout different supply chains. All of these developments have increased crop yields and livestock output substantially over the course of past 60 years. It is important to note, however, that though increasing crop yields has been the main goal in the productivist agricultural model, recent evidence suggests that there has been little progress in this respect since 2000 (e.g. for wheat Brisson *et al.*, 2010).

Specialization

Intensification and enlargement of farms have gone hand in hand with specialization, which has also played a key role in increasing productivity and has been a major pillar of agricultural and fisheries policies. Prior to 1945, most farm households were small and diversified in terms of activities, focusing on self-sufficiency to produce for household consumption needs. Mixed crop-livestock systems were still common in 1950, which is considered the turning point for the evolution of production into systems largely specialized by crop or livestock type. Between 1975 and 1995, the number of mixed crop-livestock farms decreased 70 % (Ryschawy *et al.*, 2013). However, specialization has not been limited to farms themselves, but rather has occurred at multiple levels, enabled by the growth of agricultural markets.

At the farm level, specialization has primarily increased efficiency and production control by allowing producers to refine and focus their skills on a few specific activities. Specialization has taken the form of both a shift away from mixed-crop livestock systems, and one away from crop diversity, with farmers increasingly practicing mono-cropping. Mono-cropping allows farmers to fully take advantage of the technical advancements and agro-technical expertise developed for a given crop, favored as a result of policy designed for that end, with agricultural training, education, and advisory services encouraging this shift as opposed to a lack of economic advantages for joint production (Knickel, 1990).

The degree of specialization across the EU is highlighted by statistical categorization of farms by activity; farms are classified as specialized if the total production from a given activity exceeds two thirds of total production, measured both through total area and total income for different activities (Eurostat, 2016). Between 2005 and 2013, while the total number of farms in the EU decreased by almost 4 million to about 11 million, the share of holdings specialized in crops increased by 6 % while the share of mixed farms decreased by 7 % (ibid). Overall, about three quarters of farms were specialized in 2013, with 49 % of holdings specialized in cropping, 27 % specialized in livestock, 23 % mixed-farming, and 1 % unclassifiable (ibid).

At the regional level, specialization has allowed different regions to exploit their agro-climatic advantages for specific types of production and has also enabled downstream firms to become better organized spatially, with downstream (including processing) industries located close to production, reducing transport costs (Chavas, 2001). In France, for example, cereal cultivation dominates the Paris Basin and the Alsace and Aquitaine regions, while western parts of the country (the regions of Bretagne, Normandy, and Pays de Loire) are devoted to corn silage and grasslands to pro-

vide inputs for the proximate intensive livestock industries (Meynard *et al.*, 2013a ; Meynard *et al.*, 2013b).

At the national and global levels, specialization is the basis for political negotiations over gains from trade; different countries now yield significant geopolitical advantages from their dominance in production of specific crops, most notably Brazil for its development of soybeans and contribution to what has been referred to as a grain-livestock-fuel complex (Oliveira, 2016).

Central and Eastern Europe

While the productivist strategies described above have been pursued across the EU, Central and Eastern European countries (CEECs) have followed distinctive paths of agricultural development relative to Western European countries as a result of collectivized agriculture under socialist regimes. During this period, farms in CEE followed a distinctly dualistic path, with two principal types of farm structures: small, self-subsistence plots on one hand, and large-scale collectivized state farms producing the majority of output on the other, which followed the same logic of economies of scale as in Western Europe (Lerman *et al.*, 2004). Agriculture was an integral part of the centrally planned economy, and CEE countries were major suppliers of agricultural products to the Soviet Union, with collectivized farms linked to centralized input-supply and product-processing facilities (IAASTD, 2009). Large farms underwent rapid industrialization from the 1970-1990s, during which time CEE agriculture was considered as intensive as its Western European counterpart in terms of inputs such as fertilizers (Figure 9). Meanwhile, small farms developed and were authorized by Soviet authorities in response to food shortages, but their development was not supported financially by the government as to avoid tendencies towards private ownership (ibid). Socialized agriculture was focused on quantity rather than quality, and is largely regarded as having suffered from inefficiency as a result of its insulation from market signals (Lerman *et al.*, 2004).

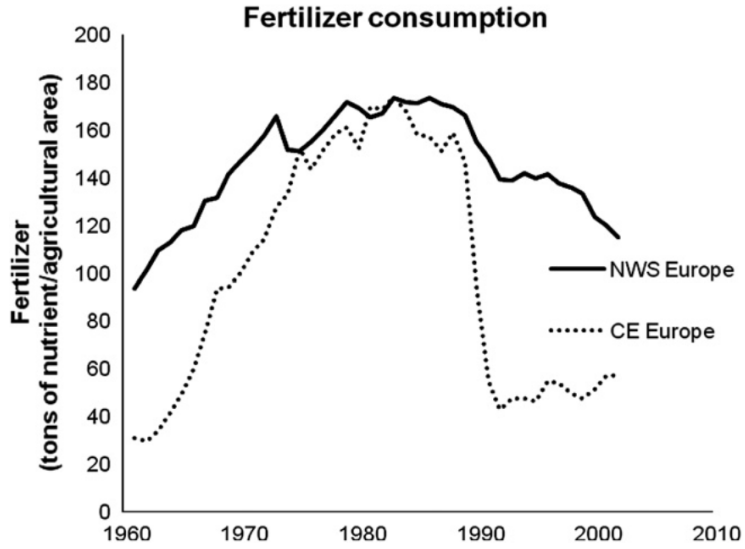


Figure 9: Fertilizer consumption in 13 North-, West- and South-European (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, The Netherlands, Portugal, Spain, Sweden, United Kingdom), and in four CEECs (Bulgaria, Hungary, Poland, Romania) between 1961 and 2002. Source: Stoate et al. (2009).

The transition to democracy and market economies beginning in the early nineties was marked by a high decrease in overall output as a result of market restructuring, a decrease in consumption, and difficulties with market access (Macours & Swinnen, 1999 ; OECD, 2001). De-collectivization took two central forms: state farms were either downsized or dismantled to create family farms, or were taken over privately by corporations without significant downsizing. Within the second restructuring, some farms underwent a "token restructuring", in which privatization did not significantly change production, whereas others underwent "genuine restructuring", consisting of a radical change in attitudes towards profit-driven operation (Lerman *et al.*, 2004). Domestic policy reforms occurred in multiple stages: during the first half of the nineties, reforms consisted of privatization, demonopolization upstream and downstream of production, and liberalization of prices and trade. In the second half of the decade, deeper restructuring took place, focusing on productivity improvements and integrating agriculture into rural development (OECD, 2001). Access to credit and high interest rates were considered as key limitations to the development of agriculture in the nineties, with Poland as the notable exception with a functioning mortgage credit scheme (ibid). Privatization was largely completed by 2001, but resulting farm structures differed considerably across CEECs as a result of different policies for land property rights, degrees of control of land rental and sale markets, and procedures for restructuring state farms (Lerman *et al.*, 2004). For example, privatization in the Czech Republic and Hungary resulted in limited ownership fragmentation but produced pronounced fragmentation in Bulgaria, Lithuania, and Romania. A study of the post-socialist transition in Poland, which only had 18 % state-managed farms, shows profound restructuring and similar trends of enlargement and intensification as in Western Europe: increased field sizes and a polarization of farm sizes, with a disappearance of medium-sized farms (Dannenberg & Kuemmerle, 2010). Policies across CEE have generally promoted the consolidation of farms, contributing to concentration of ownership across the region.

Overall, while CEECs followed divergent paths throughout this period, their restructuring since the transition period is marked by similar strategies as those adopted earlier in Western Europe. Poland, Romania, and Bulgaria remain exceptions to the general trajectory that has occurred in other CEECs since the nineties, in which agriculture has decreased as a share of GDP as a result of significant growth in other sectors (OECD, 2011). Similarly, the share of employment in agriculture decreased in all countries aside from Bulgaria and Romania during and after the transition. Since CEECs' accession to the EU (10 countries in 2004 and 2007 and Croatia in 2013), trends in agriculture have converged with those of Western Europe due both to the opening of markets and associated increases in profitability for large farms, as well as to subsidies, which facilitate specialization and intensification (Stoate *et al.*, 2009). Currently, CEECs still have a significantly higher share of mixed crop-livestock than Western Europe, but have seen rapid decreases in recent years (McIntyre *et al.*, 2009a). These trends highlight that farming systems in CEECs are following a delayed, but similar trajectory to those in Western Europe, with potentially detrimental and far-reaching sustainability impacts if these trends continue.

2.1.2 The rise of "alternative" strategies does not reverse structural evolutions

Although these three principal agro-industrial strategies remain a structuring aspect of the European agricultural landscape, particularly in response to demands for competitiveness partially imposed by increasing exposure to international competition, it is evident that alternative strategies have also emerged in parallel over the past 30 years. Due to a wide range of detrimental so-

cial and environmental effects as well as a growing perception of agriculture as force driving the destruction of rural landscapes, the productivist regime began to be challenged in the late 1980s. The incorporation of a wider variety of actors in the policy-making process (including environmental NGOs) has also facilitated the introduction of environmental considerations into policy (see 2.3.3).

While the alternative farming models that were developed as a consequence have been characterized by some as "post-productivist", Wilson (2001) highlights that different aspects of this characterization are stressed by different actors, with some focusing on re-regionalization and "vente directe" (direct sales from producers to consumers) and others stressing vertically disaggregated processes based on non-standardized demand for high-quality goods and services. Many strategies include a diversification of activities and a farm model based on multifunctionality in order to diminish the role of farming income, including activities such as agritourism and outdoor leisure activities. In the UK, more than 50 % of households have income from non-farm activities (Defra, 2007, as cited in IAASTD, 2009). For 43 % of these households, non-farm income comprises more than half of total income. However, despite the emergence of these alternative strategies, the restructuring of the European farm sector has been dominated by the agri-competitiveness trends that have been ongoing since the 1960s, with a wide range of impacts for quality of life and farm business models, the management of environmental resources, and for society at large.

Different alternative approaches have emerged in the fisheries sector as well, often focusing on artisanal fisheries and resource control: groups of farmers, shellfish farmers and fishermen gathering to develop actions to regain water quality ; organisation of female lobsters tagging ; development of alternative energy to reduce fuel consumption (reintroduction of sail boats) or organisation of direct links between producers and consumers of seafood (community-supported fishery or CSF).

2.2 Sustainability impacts of producers' strategies and food systems evolutions

Following the assessment framework presented in section 1.1.4, we examined the impacts of the evolution of farming systems regarding three main aspects:

1. On the socio-economy of farms
2. On the environment / natural capital (both at the farm level and at the landscape level or in marine areas)
3. On broader societal aspects.

At this stage, we mainly focused on the impacts of dominant strategies pertaining to agro-industrial competitiveness and left aside the impacts of alternative strategies, as they are much less widespread. All in all, we show that the sustainability impacts of these strategies is mixed, with important trade-offs between socio-economic impacts on farms, environmental impacts, and broader societal impacts. We also decided to give more prominence to the analysis of environmental impacts as they are mostly negative and need to be described in details.

2.2.1 Impacts on the socio-economy of farms

Farmers' income[6]

On average, the evolution of farming systems as depicted in section 2.1 has gone hand with hand with an increase in farmers' income, although this increase has neither been linear, nor homogeneous among sectors and regions. An interesting feature of the stated evolutions is the strong positive correlation that exists between the size of farms and the average level of income, which tends to show that the impact of enlargement / concentration strategies on farms' income has been positive. However, this trend has not reversed a situation marked by a sharp difference between the agricultural income and the average wages and salaries in the EU. As of today, the average agricultural income is still 60 % below the average wages and salaries (Figure 10), and the situation has even worsen over the last decade (EC, 2011). However, this does not mean that farmers all have low incomes, given the fact that almost a third of them have other income sources.

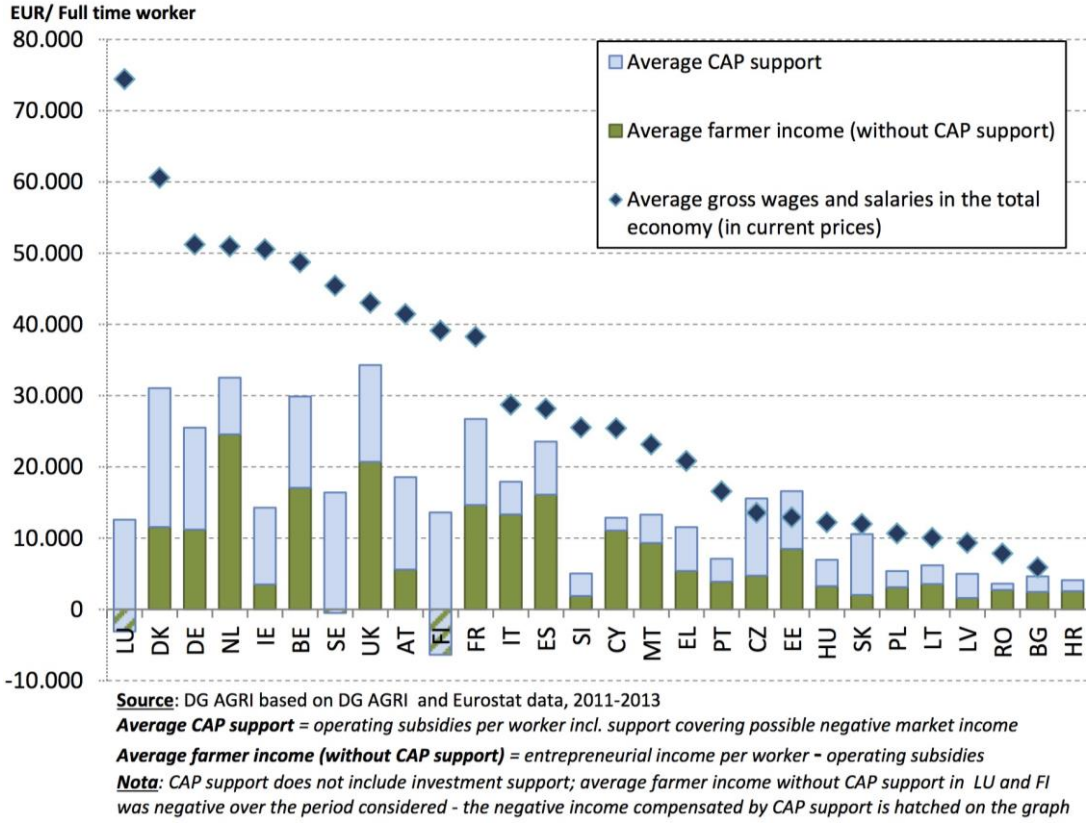
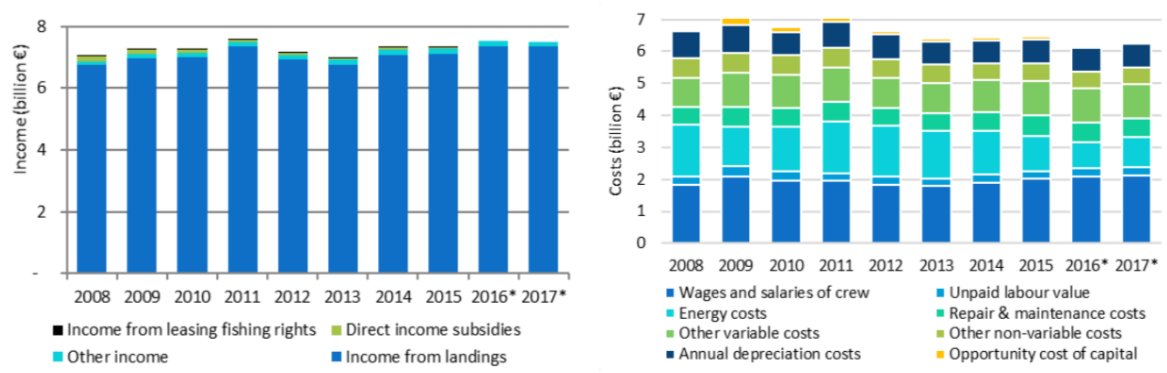


Figure 10: farmers income lagging behind salaries in the whole economy (source EC, 2017, p. 14)

Concerning fisheries, revenue (income form fishing and other income) has not varied significatively over the period 2008 – 2015 (see figure below).

[6] This paragraph relies mostly on (Hill & Bradley, 2015) unless otherwise stated.



Data source: MS data submissions under the DCF 2017 Fleet Economic (MARE/A3/AC(2017)); *projections

Figure 11: Trends on income (left) and costs (right) generated by the EU fleet (source Dentes De Carvalho Gaspar *et al.*, 2017)

Quality / decency of work

Agricultural intensification has had several direct impacts on farms, principally driven by mechanization and changes in labor dynamics. The increased use of machinery and the resulting increases in productivity and efficiency have made farm work less laborious and enabled a better work environment and less repetitive, dangerous, and disliked tasks (IAASTD, 2009). This also resulted in more time for other work and activities for farmers.

On the other hand, mechanization has been a major driver of the decrease in farm labor across Europe and of rural employment losses (Figure 12).

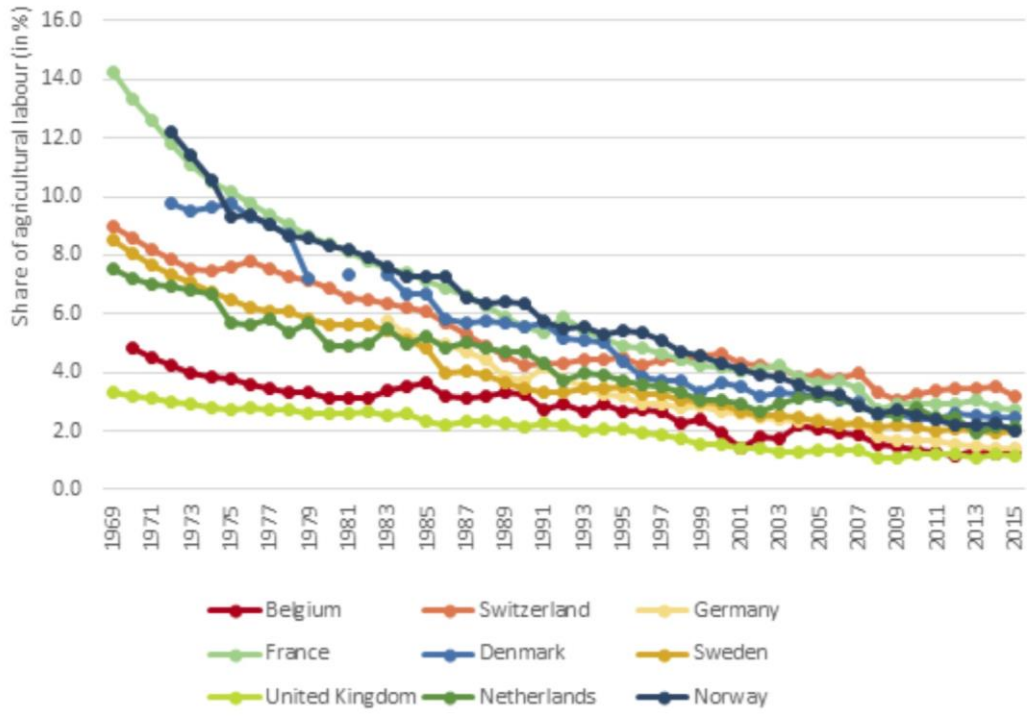


Figure 12: Employment in agriculture since 1968 in Western Europe as a share of total employment. Source: (Pe'er *et al.*, 2017, p. 89)

On top of that, farmworkers often face bad working conditions, and agriculture is among the sectors which often rely on undeclared and illegal labor, particularly for seasonal activities (FRA, 2013). For example, in 2005, over 320,000 foreign nationals were employed in Germany for seasonal work, mostly coming from CEECs (Parliamentary Assembly, 2006). Farm wageworkers often have incomes below the minimum wage, and undocumented workers (often migrants) face additional vulnerability and precarious livelihoods.

Farms' resilience

The generalization of agro-industrial competitiveness strategies in Europe has gone hand in hand with a shift towards a market-based agricultural system (see section 2.3 on drivers of change). This has resulted in producers more and more dependent on commodity prices and, as such, more and more exposed to price volatility.

On the other hand, specialization patterns and the sharp decrease in the diversity of products at the farm level have made producers much more vulnerable to extreme events, be they climatic or economic (Meynard *et al.*, 2013a). While agriculture is by its very nature a risky sector, the capacity of producers to cope with risks and uncertainties has tended to decline over time. As a result, increasing resilience through the development of a wide range of risk-management tools at the farm level is a core concern of many stakeholders and policy makers (e.g. Buckwell *et al.*, 2017 ; EC, 2017).

2.2.2 Environmental impacts

At the farm level

The immediate environmental impacts of intensive farming have been well known and documented since the 1970s, but their longer-term effects have accelerated and become increasingly evident in recent years. Several key changes in farming practices that have accompanied the trends of enlargement, intensification, and specialization include: an increase in mechanization and farm size; a simplification of crop rotations; a loss of non-crop features in the landscape (such as hedges and ditches); an abandonment of fallows; a widespread adoption of irrigation practices; an increased use of inputs (fertilizers and pesticides for crops; animal feed and antibiotics for livestock); a tendency towards mono-cropping and a selection of a restricted number of crops; and a separation of mixed farming into independent crop- and livestock-specialized farms, leading to various disruptions of interactions between the two systems. This intensification of production in some regions as well as the concurrent abandonment of agricultural land in others have had varied and interactive direct effects on local soil, water, air, and biodiversity. All of these impacts have been extensively documented in the literature; this section does not aim to give a complete account of these impacts but instead to give a brief overview of the main implications of dominant changes in farming practices both for crops and livestock systems as a basis for the impacts discussed in our narratives.

Soil

Soil degradation has been a major concern as a result of the intensification of agriculture, which has led to changes in soil structure, nutrients, and carbon content, as well as contamination by pesticides and heavy metals. The use of heavy machinery and frequent passes with cultivating

equipment contributes to soil compaction and erosion, which is further enhanced by increases in field size (Stoate *et al.*, 2001 ; Stoate *et al.*, 2009). Erosion is considered the most serious issue affecting soils and a major problem across Europe. Continuous cropping, a lack of crop rotations, and mono-cropping without the use of soil-conserving cover crops all intensify erosion, and the low infiltration rates of compacted soil increase soil runoff. A variety of intensification practices, including heavy tillage, irrigation, and inappropriate application of fertilizers and lime, also severely affect soil fertility through the loss of nutrients and organic matter and through soil acidification. Ultimately, although shallow, nutrient-depleted soils are associated with lower productivity in the long run, changes in soil may not severely impact productivity during a farmer's life or during the planned period of exploitation of a piece of land, rendering incentives for reduction of these impacts relatively low, but contributing to increased use of fertilizers and pesticides as natural soil productivity and natural defences against pests and diseases decrease.

Water

Agricultural intensification has had direct impacts on water use and pollution through three primary means: field drainage, irrigation, and chemical runoff. To allow for the conversion of wetlands to agricultural land, vast areas of land in Western Europe have been artificially drained, affecting the hydrology and the biodiversity of watersheds.

Meanwhile, the large-scale increase in irrigation across Europe has primarily led to an increase in water withdrawals for agricultural use, facilitating access to water at all periods of the year, including dry seasons (typically summer).[7] Irrigation is particularly concentrated along the Mediterranean, where agriculture comprises more than 80 percent of total water freshwater use in some countries (European Environment Agency, 2016). Moreover, poorly managed irrigation has caused salinization as a result of insufficient drainage, which affects over 1 million hectares in the EU, mainly in Mediterranean countries, where irrigation is also a cause of desertification (IAASTD, 2009). The use of pesticides and fertilizers contaminates surface and groundwater sources, with largely externalized effects on rivers and coastal waters through eutrophication and changes in aquatic populations.

Climate

Both crop and livestock production practices directly contribute to local gaseous emissions in a significant manner, as well as sometimes creating local chemical pollution or odor problems. Arable farming primarily generates nitrous oxide and carbon dioxide emissions, while digestive fermentation from ruminant livestock is a major and dominant agricultural contributor to methane emissions. Because not all of the nitrogen that is applied to fields (notably as fertilizer) is used, nitrogen is released to the atmosphere through denitrification, which is influenced by the amount of fertilizers used, crop type, and soil moisture (Stoate et al., 2001). At the same time, there has been an increasing interest in the possibility of using agricultural management as a means of increasing carbon sequestration. In 2014, total greenhouse gas emissions from the agricultural sector were 434 million tonnes of CO_2 equivalent (Eurostat, 2017).

[7] The volumes of water used for irrigation are difficult to estimate, however, and little data exists covering extensive periods of time aggregated across large areas. This is partially due to unrecorded water abstractions and national differences in reporting and accounting (European Environment Agency, 2016). As a result, modelling approaches are often used to estimate total irrigation requirements and scarcity risks, but may underestimate the multitude of environmental risks that water shortages (paired with pollution) pose, as well as the far-reaching impacts of withdrawals on other sectors and areas.

Biodiversity

Several aspects of intensified farming have also had a wide range of effects on local biodiversity. In addition to its impacts to soil microfauna discussed above, agriculture has been identified as a main cause of habitat and species loss more generally and a driver of the simplification of landscapes, at the local and regional levels (Knickel, 1990). This has primarily been the result of: farm enlargement and the removal of hedges to facilitate machinery access; a simplification of cropping systems and reduction of crop diversity; a loss of mixed crop-livestock systems; heavy application of pesticides and fertilizers; the replacement of hay crops by silage (which is harvested earlier), impacting grassland habitats; and land abandonment, notably in Eastern and Southern Europe (Stoate *et al.*, 2001 ; Pe'er *et al.*, 2014 ; Pe'er *et al.*, 2017).

The reduction in species diversity has a direct influence on agricultural productivity: due to the disappearance of natural pest management species, farmers use more pesticides, encouraging a positive feedback loop of biodiversity reduction.

Oceans

Concerning fish resources in the ocean and seas surrounding Europe: both sizes of fish and the capacity of fish resource to regenerate has decreased. Knowing that the most consumed fish from aquaculture are carnivorous fish (25% of the aquaculture production in EU) such as salmon, aquaculture also has a strong impact on marine resources as one kilo of farmed fish is requiring three to four kilos of fish (mostly from sea fishing) turned into flour to feed it.

Impacts at the landscape level and beyond

Besides its impact at the farm level, the generalization of agro-industrial-like strategies has had broader – and perhaps more important – impacts at the landscape level. Those impacts derive from three changes brought about by this generalisation, which can read as follows: a regional specialisation, a "cerealisation" of livestock, and a growing protein deficit (which in itself can not be explained only by farmers' strategies as it has other determinants, see below paragraph 2.3.1 on trade policies). Let us briefly explain how these changes happened to explain their environmental impacts at the landscape level and beyond.

Regional and cereal specialization

The enlargement, intensification, and specialization of farms and farming practices has led to tremendous disparities in production by regions across Europe and a great dependence on various inputs, both of which have had a wide variety of impacts beyond the farm on European landscapes and land use. Agriculture is the main type of land use in the EU, accounting for almost half of the total EU-27 land area.

It is instructive to examine the transformations of European agri-food systems and their impacts on land use through the evolution of production, areas, and yields of various major crops as well as the production and concentration of livestock. The productivist strategies discussed in section 2.1.1 have led European agriculture to where it is today: highly productive, highly specialized in cereals, highly protein deficient, and witnessing a decrease in permanent meadows and pastures. These structural evolutions have persistent implications for sustainable transformations in the future.

Higher output has largely been the result of increases in yields rather than an increase in total cultivated area (Table 2). Cereals have long comprised Europe's main agricultural products, cover-

ing a vastly larger area than all other crops combined. As a result of a variety of agricultural policies and the development of specialized technical expertise, average cereal yields have substantially increased, with a few countries showing advances far above the European average, notably France, Germany, Belgium, the Netherlands, and Denmark (Table 2). This has led to a decrease in the total area cultivated, from 64.5 million hectares in 1964 to 58.2 million in 2014, while production has increased from 146 million tonnes to 334 million tonnes over the same period.

Table 2: Area of major crops in today's EU28 countries (1000 hectares). Source: authors, based on FAOSTAT (2017).

	1964	1974	1984	1994	2004	2014
Cereals	64 507	63 062	62 346	60 773	61 616	58 207
Oilseeds	3 406	4 681	8 846	13 044	13 934	16 781
Fruits & Vegetables	6 068	5 253	5 060	5 877	5 498	4 815
Root crops	10 358	8 973	8 064	6 896	4 765	3 355
Grapes	6 107	5 426	4 885	4 158	3 838	3 181
Pulses	5 701	3 289	2 639	2 265	2 019	1 584
Industrial crops	1 367	1 030	983	869	844	572
Total	97 513	91 714	92 823	93 882	92 515	88 495

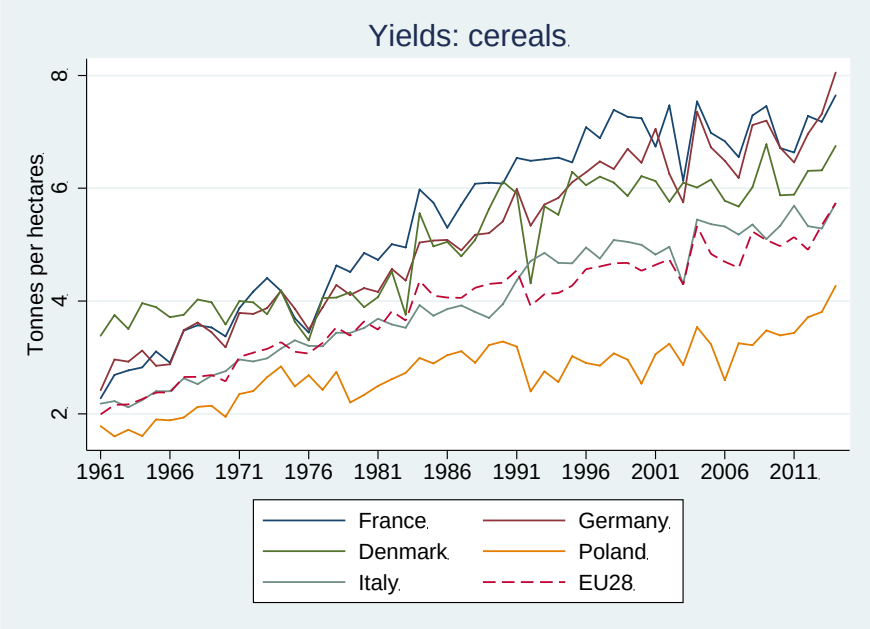


Figure 13: Average cereal yields for the EU-28 and 5 selected countries. Source: authors, based on FAOSTAT (2017).

Oilseeds are the only crop for which cultivated area has increased since the 1960s, notably beginning in the late 1970s and accelerating since 2009 as a result of the Renewable Energy Directive and the use of rapeseed for biofuels. In contrast, the area devoted to all other crop categories has declined, notably that for pulses by almost three-quarters and that for root crops by two-thirds.

Cereals have not been the only crops to benefit from yield improvements, however: as shown by trends in total production, fruit and vegetable production has vastly increased despite declining

land use, and the production of oilcrops has increased far more than proportionally to the its expansion in area (Table 3).

Table 3: Production of major crops in today's EU28 countries (1000 tonnes). Source: Authors' calculations, based on FAOSTAT (2017).

	1964	1974	1984	1994	2004	2014
Cereals	145 866	206 347	271 646	251 626	328 344	333 998
Oilseeds	6 252	10 508	17 897	24 448	37 093	45 115
Fruits & Vegetables	76 501	86 588	101 438	99 429	110 480	106 744
Root crops	221 757	226 805	244 625	209 597	205 424	191 586
Grapes	32 906	36 904	33 979	26 445	30 210	24 400
Pulses	3 144	2 540	3 736	6 616	5 386	3 561
Industrial crops	1 183	986	1 235	1 162	1 235	852
Total	487 609	570 679	674 557	619 323	718 172	706 255

More revelatory, however, is the evolution of the cultivation of pulses and of land use for permanent meadows, which are largely the product of evolutions in meat production, the decoupling of crop-livestock systems, and shifts in animal husbandry systems towards what can be called a form of "cerealisation" of livestock (Poux, 2004).

Cerealisation of livestock & protein deficit

Since the 1960s, the production of animal products has, on an average, kept increasing (Figure 11).[8]

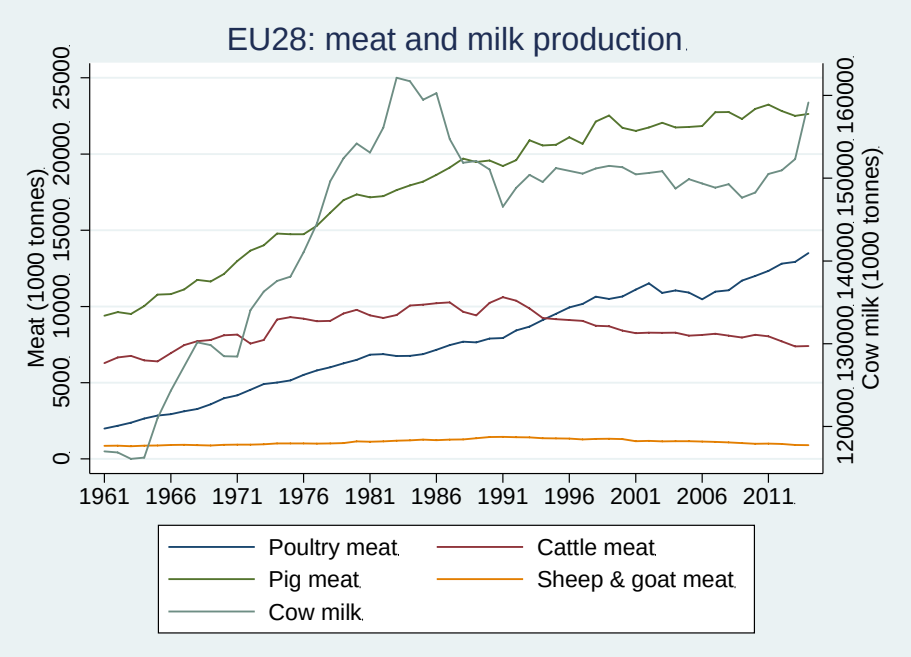


Figure 14: Meat and milk production in today's EU-28 countries. Source: authors, based on FAOSTAT (2017).

[8] Evolution in milk production has been mostly driven by quotas, while beef production has been affected by the BSE epidemic in the mid 1990's paired with health recommendations encouraging less red meat consumption

As farms have become more and more specialized and intensive, farmers have increasingly made use of purchased compound animal feed. While cattle diets still mainly consist of grass and arable forage in most EU countries, their diets (particularly those of dairy cows) include a complement mainly consisting of cereals and protein crops, which increases their weight gain and productivity. In contrast, monogastric animals (poultry and pigs) obtain their energy primarily from cereals, while their protein needs are met with oilcakes (primarily imported soybean). Poultry have higher protein needs than pigs and therefore have a higher average proportion of oilcakes in their diets relative to cereals. Overall, feed for monogastric animals can largely be decoupled from local production whereas for ruminants this is less frequent in Europe given the high proportion of grazing animals. These dietary needs and their diverse formulations across EU countries are shown in Figure 12.

This has had direct repercussions on cereal and protein crop production. The majority of cereal consumed in Europe is for animal feed, and while the use of cereals for human food has only increased very slightly since the 1960s, cereal use for feed has increased by almost 100 million tonnes during that period (Figure 15).

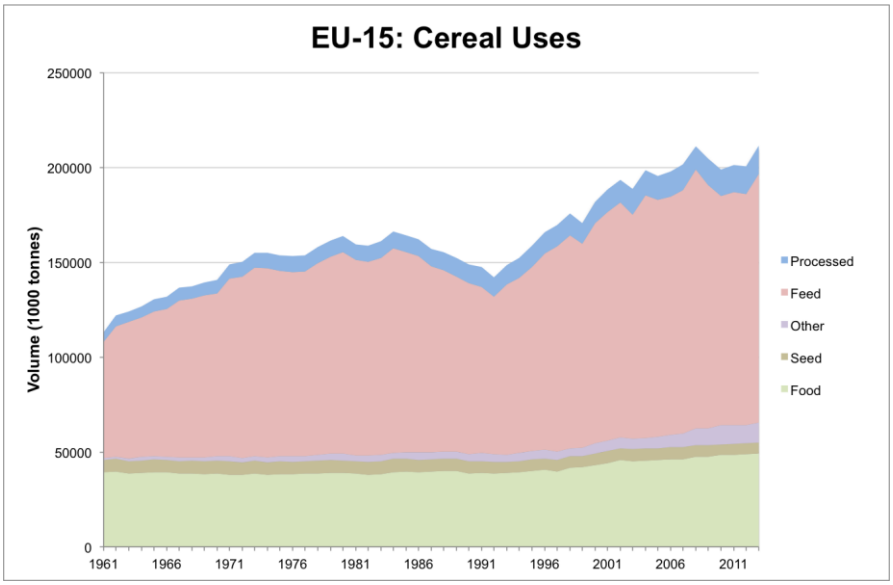


Figure 15: Cereal usage in EU-15 countries. Source: authors, based on FAOSTAT (2017).

The EU's specialization in cereals and its protein crop deficit take root in the 1960s and have persisted for geopolitical reasons via bilateral negotiations with the US (Martin, 2014) (see section 2.3.1). In 1961, protein crops represented almost 5 % of the European arable land and currently only represent 2 %, despite a recent uptick in production (ibid), leading to an average protein deficit, at the European level, of roughly 75 %.

This, in turn, has significant environmental impacts in soybean-producing countries in Latin America. Various studies have shown the linkages between soybean expansion and deforestation in Brazil and Argentina, which has accelerated steadily over the past 40 years (e.g. Grau *et al.*, 2005). Such studies show that certain periods showed greater decoupling of soybean expansion from deforestation as a result of differences in economic incentives for soybean production, technological innovation, government policy on deforestation, as well as important macroeconomic factors

such as currency exchange rates. However, it remains evident that global meat demand and the global economic context for soybean expansion are major drivers of deforestation. Between 2007 and 2008 alone, the soy price boom fuelled an increase in deforestation that led to the clearing of almost 8,000 square kilometers of forest. One analysis predicts that the continuation of current trends would lead to the destruction of 40 percent of Amazonian rainforest by 2050 (Soares-Filho *et al.*, 2006).

The lock-in of cereal specialization has hindered the development of eco-technical expertise in legume cultivation, as public and private research investments have been primarily oriented towards cereals, and, increasingly, oilseeds (Magrini *et al.*, 2016). This is reflected by the trend in pulse yields since the 1960s (Figure 15), which shows both the low average yields relative to cereals (a current EU average of almost three times less per hectare than that of cereals) as well as the large increase in yields which was achieved during the period of policy incentives oriented towards this goal in the late 1970s to early 1990s, particularly in France. Currently, the low price competitiveness of European pulses remains a major hindrance to their development.

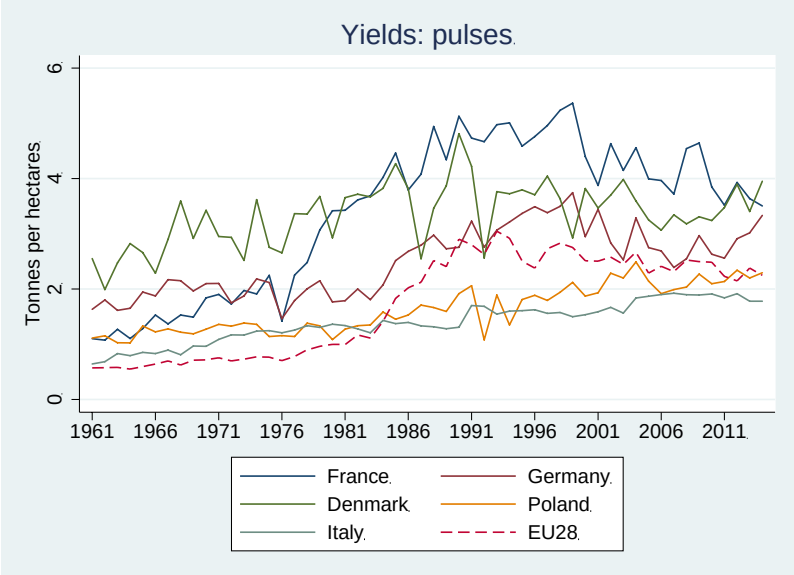


Figure 16: Average pulse yields for today's EU-28 and five selected countries. Source: authors, based on FAOSTAT (2017).

The decrease in permanent pasture across Europe since the 1960s, due in part to shifts in animal diets as well as changes in land use, has also more directly contributed to the protein deficit as grasslands contain a high proportion of legumes (often around 30 %). Across the EU-15, the total area for grasslands has decreased from 65 million to about 52 million hectares since 1961, leading to reductions in biodiversity and disrupting the nitrogen cycle (FAOSTAT, 2017). Forage legumes are often used to replace fertilizers; thus the decrease of permanent pasture contributes to increased use of synthetic fertilizers. Furthermore, the local and regional decoupling of crops and livestock not only decreases possibilities for using manure as fertilizer, but also creates significant manure management problems (Knickel, 1990). In particular, a lack of manure storage facilities on farms with a large number of animals poses an increased risk of nutrient run-off and leaching to ground- and/or surface-waters, as well as the introduction of antibiotics into the environment

(Eurostat, 2013). Manure management and application also directly impact methane and nitrous oxide emissions. It is important to note, however, that animal by-products can cause environmental damage in mixed systems if not managed effectively.

2.2.3 Societal impacts

The evolution of European food systems has had far-reaching societal impacts, notably on food security, nutrition, and the sector's contribution to the economy.

Food security

The great achievement of European agriculture since the 1960s has been a tremendous increase in agricultural output, comprising largely of specialization in a few key items and a decline in the production of others. This has led to a substantial decrease in the real prices of food, reducing food insecurity in Europe and contributing to greater consumer choice. The most fundamental impact of advancements in agriculture since the 1960s has been to increase output so substantially as to far outpace demand, providing an abundant quantity of food, reducing prices, and thereby driving profound societal transformations. The drastic increases in productivity achieved as a result of the practices described above allowed Europe to escape the food insecurity it faced after World War II and to provide people with more wealth (as a result of lower expenditure on food) and choice. One of the main effects of overproductivity has been a fall in commodity prices globally (illustrated by Figure 17), which has helped enable access to relatively cheap food for a majority of Europeans.

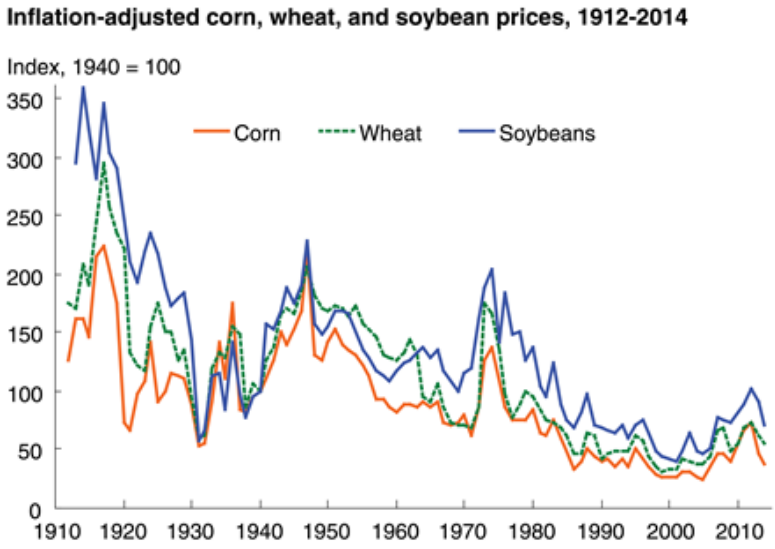


Figure 17: Commodity prices in the long run. Source: USDA, 2016.[9]

Nutrition

These food system transformations have had a two-stage impact on nutrition in Europe. First, increases in production have had a positive impact by increasing overall calorie availability and diversifying food choices. These positive impacts of adequate access to food have therefore enabled

[9] https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=76964

people to live active, productive, and healthy lives. At the other extreme of this nutritional spectrum, Europe has more recently witnessed the emergence of a negative health burden from dietary issues due to a diverse range of non-communicable diseases, notably obesity. It is important to note, however, that important disparities in access and nutrition persist to this day, with about 3 million people in Eastern Europe (inside and outside of the EU) still undernourished (IAASTD, 2009). On the other hand, food-related health challenges as a result of overconsumption or poor nutrition, such as obesity, heart disease, and diabetes, have proliferated at a very rapid pace in recent years. This is not only a European challenge but a global phenomenon due to what is described as the nutrition transition (Kearney, 2010). Discrepancies exist among European countries, with obesity rates currently lowest in France, Italy, and some Scandinavian countries, and highest in Central and Eastern Europe. These differences have been attributed to context variables including the availability of fats, the availability of fruits and vegetables, urbanization, transport infrastructure and cost of food, as well as policies (Rabin *et al.*, 2007). Estimates of the total burden of ill health in the EU have found diet-related diseases to be responsible for 10 percent of the disease burden, accounting for a greater share than tobacco smoking (IAASTD, 2009). This has a significant impact on state budgets: it has been estimated that the EU currently spends approximately €700 billion on non-communicable diseases (Seychell, n.d.).[10]

Economic gains

As one of the biggest agricultural producers and the largest agricultural trader in the world, the EU has benefitted from substantial economic gains from the advancements of its agricultural sector. The agri-food industry is the EU's biggest manufacturing sector in terms of jobs and value added and a significant asset in trade with non-EU countries.[11] The industry also contributes to the EU's trade surplus: food and drink exports have doubled in the past 10 years, reaching over €90 billion. In France, the EU country with the second largest agri-food sector after Germany, the agri-food industry is the biggest sector in the economy, representing €170 billion and directly employing about 440,000 people in 2015.[12]

On the other hand, the uneven development that the European agriculture has experienced has left aside numerous territories / landscapes. As agricultural production was one of the main activity in such areas, and as it has gradually disappeared for not being enough competitive, the vitality of the countryside has slowly but surely decreased (Rivera *et al.*, 2017). The different political measures taken to reverse these trends, most notably through the setting up of the CAP pillar II, were unable to do so.

Taking into consideration this analysis of the most striking past evolutions of agricultural production systems in Europe and of their impacts on the sustainability of the food system, we selected six main drivers of change that will likely continue to influence the evolution of the system in the future. The following part summarizes the past trends which affected these drivers.

[10] Seychell, Martin. "European Commission: Your gateway to trustworthy information on public health." *Towards better prevention and management of chronic diseases*. European Commission, n.d. Web.

[11] https://ec.europa.eu/growth/sectors/food_en

[12] https://www.ania.net/economie-export/conf-eco-2016

2.3 Key drivers of change and state of play in the European agrifood and fisheries sector

Section 2.1 showed that the strategies of producers had followed two trends: the prominent, almost hegemonic one, has been towards a specialization, a concentration and an intensification of production, mainly aimed at increasing agro-industrial competitiveness. In parallel, alternative strategies at the farm level have emerged, along with the structuration of what has been called "alternative food networks" – a term that refers to "networks of producers, consumers, and other actors that embody alternatives to the more standardised industrial mode of food supply" (Renting *et al.*, 2003, p. 394). While some have argued that such alternative networks were materializing a shift from a productivist to a "post-productivist" paradigm in the agrifood sector, their importance and their impact today is still quite limited (eip-agri, 2015)[13]. Rather than a "paradigm shift", what has occurred over the last decades is a progressive "*dualization*" of agricultural practices and landscapes, both from a social and from a territorial perspective, between standardized / specialized production processes responding to economic standards of competitiveness on the one hand; and localized / specialized production processes trying to trade on the basis of environmental, social or nutritional qualities, on the other. However, the two types of practices / systems do not only "co-exist": they relate to one another in a competitive manner for access to land, to subsidies and to other production factors (Sonnino & Marsden, 2006).[14]

The aim of this section is thus twofold: to shed light on the main drivers lying behind the generalization of specialization-concentration-intensification strategies on the one hand; and to depict the emergence of alternative strategies and their limited capacity – at least so far – to reverse structural trends. Six drivers will be discussed in more details: trade policies, global demand, agricultural and environmental policies, diets, food chain organisation and the agricultural technology and knowledge system. In this section, we primarily aim at identifying the links between a driver and the above-stated evolutions. Of course, the depicted changes being highly systemic, drivers relate to each-others in many ways and do not have an influence in isolation from other processes. We nevertheless see a value in presenting them individually, trying to shed light on two main aspects: what are the mechanisms through which they influence producers' strategies?[15] How did they evolve over time? This will allow us in subsequent sections to (i) identify possible evolutions by 2030 to build food system narratives (section 3) and (ii) make hypotheses on how these food system narratives are likely to impact producers' strategies (section 4).

2.3.1 Trade policies

Over the last decades, trade policies greatly affected producers' strategies in two main ways.

A first one is indirect, through the effect they had on agricultural policies. For instance, the MacSharry reform in 1992 was a clear consequence of ongoing trade negotiations under the Uruguay Round. At the beginning of the 21st century, the Agenda 2000 and the Mid Term Reform of 2004, with the introduction of the second pillar to foster "multifunctional agriculture", resulted from an anticipation of the European Commission of what could come out of the Doha negotiation round (Fouilleux, 2004). The protein deficit of Europe is also a consequence of early trade negotiations

[13] For example, direct sales between farmers and consumers represent only 2 % of the fresh food market, and on average, only about 15 % of EU farms sell more than half of their production directly to consumers (Augère-Granier, 2016).

[14] These trends are currently much more visible in Western European countries than in Central / Eastern ones. In the next steps of this work, more attention will be given to the differences that actually exist between regions.

[15] We did not try to distinguish between "direct" and "indirect" drivers (as in McIntyre *et al.*, 2009b) since all the drivers described below have both direct and indirect impacts on producers' strategies.

under the Dillon Round in 1960-61, during which import duties for soy were removed (Martin, 2014). While the 1973 US soybean embargo caused Europe to relaunch incentives to encourage oil and protein crops, the resulting increased in protein crop production was though short-lived (Figure 18). In 1992, the Blair House agreement with the US indeed limited the supported protein crop area to 5.5 million hectares, leading to a sharp decrease in protein crop production.

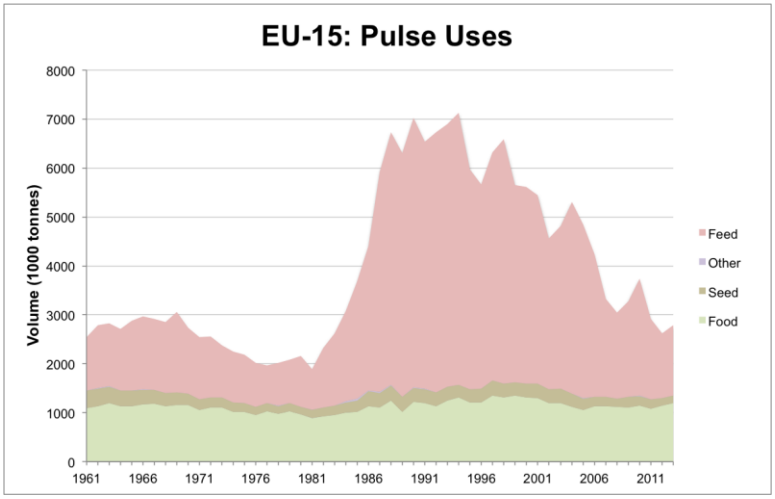


Figure 18: Pulse production and usage in EU-15 countries. Source: Authors' calculations, based on FAOSTAT (2017).

The second way in which trade policies had impacts on producers' strategies is more direct and also more recent. The progressive liberalisation of agricultural trade led European farmers to compete with other farmers on international markets as well as on domestic markets. The direct consequence was the obligation for farmers to produce at world market prices – though direct payment have buffered this effect – in a context where their endowment in production factors could be quite different from the one of their competitors across the globe. This further stimulated a course towards mode competitiveness and its associated strategies: enlargement, intensification, specialization. Other producers reacted quite differently: rather than adapting their production systems to the fiercer competition on global markets, they tried to develop strategies to "escape" it by developing new sales channels or "niches" based on alternative criteria.

2.3.2 Global demand

The level of global demand for agricultural raw commodities (including for feed, food, fibre and fuel uses) directly affects producers' strategies through its effect on world prices. In principle, a higher demand (relative to the supply) leads to higher prices. However, this relationship between global demand and world prices is not that linear, since a large share of the international trade of agricultural commodities is done through financial markets that have proven more and more volatile over the last 15 years due to increased speculation (Clapp & Helleiner, 2012). Over the past decades, the idea that has dominated among agricultural players was that the level of global demand was likely to grow steadily, given the demographic growth and the nutritional transition in

emerging countries[16]. This idea prompted the consolidation of productivist strategies across Europe at an institutional level: producers were encouraged and incentivized to produce more to supply global markets, the plan being for Europe to reinforce its position of a global player on the world market.

As a result, the export market is now a major outlet for the agricultural sector in Europe and an important contributor to GDP of the EU, which resulted in a positive trade balance of more than 18 billion euros in 2016 (+131 billion euros of exports) and in the EU being the top world agricultural exporter since 2013, ahead of the US. Given that the EU market is considered as relatively saturated, the European Commission expects that 90 percent of the additional world demand of agri-food products for the next 10-15 years will be generated outside Europe (Copenhagen Economics, 2016).

To elaborate on what we indicated above on the many links between the different drivers, it should be mentioned here that the way in which the level of global demand affects producers' strategies also depends on trade policies. Over the last decade, the EU has sought to take advantage of the high level of global demand by signing free trade agreements (FTAs), mainly because income and employment in the EU agri-food sector are considered to be dependent on access to export markets. The combination of high global demand with the development of FTAs with numerous countries / regions over the last 15 years has thus further encouraged productivist strategies.

2.3.3 Agriculture, fisheries and environmental policies

Among institutional arrangements, public policies, whether implemented at the regional, national or local level, are important drivers of change to consider when looking at the evolution of production systems and producers' strategies. In this section, we consider two main policies: the agricultural policy, and most notably the CAP; and environmental policies pertaining to the agricultural sector. In the last paragraph, we also briefly present how decision making processes have changed over time and how this can help to explain the stated evolutions.

The CAP

Created in 1962, the CAP is one of the oldest policies of the European Union. The main objectives of this policy, mentioned in the Rome Treaty, are (a) to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production, in particular labour; (b) to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture; (c) to stabilise markets; (d) to assure the availability of supplies; (e) to ensure that supplies reach consumers at reasonable prices. Originally, the main focus of the CAP was therefore linked to agricultural productivity—it was a multifaceted agriculture modernisation project with the objective to raise production, to provide its population with cheap food and to generate regional development. Hence, the CAP favoured from the start productivist and competitiveness strategies.

Environmental aspects of agricultural production and, more generally, the multi-functionality of agriculture, began to emerge in the CAP in the late 1980s. Agri-environment schemes were first

[16] While the global demand has indeed increased for many commodities, it has not been the case for others, with sometimes quite difficult consequences. This is for example the case of the milk market, for which most players expected a growing demand coming from China which eventually did not sustain, with critical consequences on prices.

introduced as an option, before becoming compulsory in 1992 for Member States in the framework of their rural development plans – which became the key implementation framework of rural development policy, officially put in practice as the second pillar of the CAP during the 'Agenda 2000' reform and financed both by the Member States and the European Agricultural Fund for Rural Development (EAFRD). While these schemes remain optional for farmers, they prompted the emergence and development of alternative strategies, or at least strategies that were not fully orientated towards increasing productivity and competitiveness. The integration of environmental concerns and multi-functionality into the CAP went a step further with the creation of the second pillar in 1999, and then with the introduction of new objectives in 2010 which read as follows: f) Viable food production, with a focus on agricultural income, agricultural productivity and price stability; g) Sustainable management of natural resources and climate action, with a focus on greenhouse gas emissions, biodiversity, soil and water; and h) Balanced territorial development, with a focus on rural employment, growth and poverty in rural areas. However, EU expenditures on agri-environment and rural development measures never exceeded 25 % of the total CAP budget, maintaining alternative strategies at the periphery and in marginal areas of the European food system, partly explaining what we stated at the beginning of this section.

The introduction of environmental conditionality in 2003, and then the greening of pillar I in 2013, were supposed to limit the dualization process already engaged, by introducing environmental objectives and constraints in conventional practices. However, this mainly led to minor adjustments in existing producers' strategies, without bringing about radical changes (Hart *et al.*, 2016). In the Transition Management Studies jargon, we would say that the introduction of cross compliance and greening led to some forms of system optimisation, but did not prompt any reflection regarding the re-design of production systems.

The CFP

The Common Fisheries Policy (CFP), setting out the overarching regulatory conditions for all fishers within the EU, was first implemented in 1983 and has subsequently been reformed three times: in 1992, 2002 and 2013. Based on the fact that there had been over-investment in vessels, overfishing and that numbers of fish landed were decreasing, the key measure developed as part of the first CFP reform (1993-2002) was a series of vessel decommissioning schemes. The second reform (2003-2012) focused on regional policies such as recovery and management plans. It was claimed as a radical revision of the previous unsuccessful system (since 1993, several EU fish stocks had reached dangerously low levels), aiming for sustainable development in environmental, economic and social terms. It was characterized by strong centralization to the Fisheries Council, who set the quotas through a multiannual management plan, and to the European Commission (EC) who enforce the CFP regulations, strengthening its powers of monitoring and applying counter-measures against the non-compliant, such as quota cuts (Gray & Hatchard, 2003). Under the 2002 Reform, the way in which Total Allowable Catches (TACs) are discussed, designed and implemented has become a complex process involving the EC, the European Parliament (EP), the Scientific and Technical Committee of Fisheries (STECF), the Regional Advisory Committees (RACs), the ministers of each Member State, and other stakeholders. The volume of catches is determined, as follows: i) the EC makes a proposal for TACs on the basis of the scientific recommendations of the International Council for the Exploration of the Sea (ICES), RACs and the opinions of the STECF; ii) the Council approves it after arduous negotiations (Da Rocha *et al.*, 2012). In order to start planning a new CFP reform, the EC issued "The Green Paper for the Reform of the CAP and the

Lisbon Treaty" in 2009. In this Green Paper the Commission identified five central structural failings of the CFP:

- A deep-rooted problem of fleet overcapacity.
- Insufficient guidance for decisions and implementation.
- A short-term focus on the management of natural resource.
- An insufficient responsibility of the industry.
- A lack in Member States of political will to ensure compliance.

Building on the Green Paper, the Commission issued a reform package in July 2011 that lead to the latest reform of 2013, effective from January 2014. The 2013 Reform includes five main policies: the implementation of discard bans; Maximum Sustainable Yield as a key objective of fisheries management (which is now a key factor when determining the annual TAC); incentives to help develop the regionalisation of fisheries management; an increased emphasis on the social dimension/sustainability of fisheries; and the promotion of Transferable Fisheries Concessions (TFCs) (Le Floc'h *et al.*, 2015, p. 375). In this respect, the intention is to give more responsibility to the fishing industry itself, in the hope that it will prove to be more effective at reducing overcapacity than a top-down regulatory approach. Despite the succession of CFP reforms, some commentators still denounce the lack of consideration of the capacity for the regeneration of fisheries resources and the low protection of sensitive marine areas (breeding areas for certain species for example).

Environmental policies

Similar conclusions can be reached when looking at most EU environmental policies implemented since the 1980s: while their implementation forced producers to adapt their practices and to adjust their strategies, they did not prompt more structural changes in producers' strategies. More particularly, neither did environmental policies fundamentally altered productivist strategies, nor did they frankly contribute to the development of alternative ones – except maybe for the case of the Habitat Directive, which allows farmers to receive subsidies on the basis of the protection of certain species or specific areas. Amongst the most stringent environmental directives – the Birds directive, the Habitats Directive, The Nitrates Directive (1991) and the Water Framework Directive (2000) – the Nitrate and the Water Framework Directives are probably the ones that had the biggest impact, most notably on the pig and the milk sectors. Under these directives, Member States have to evaluate their level of nitrate pollution, to define "Nitrate Vulnerable Zones" and to implement strict measures in these areas. The difficulty of tracing nitrate from its point of origin though complicates the task. Under the Water Framework Directive, Member States must also define water management plans and implement water tariffs intended to encourage users to use less water. The four above-mentioned directives are part of the Statutory Management Requirements (SMRs). Since 2003, failure to meet these requirements may result in a decrease in CAP subsidies for farmers – although the SMRs also apply to farmers not receiving CAP subsidies. In 2009, the new Directive for the sustainable use of pesticides imposes countries to develop national plans to reduce their consumption of pesticides, which had consequences in some countries (e.g. the Plan Ecophyto in France).

Last but not least, the EU energy policy launched in 2009 set a 10 % target for biofuel incorporation at the European level (as part of the Renewable Energy Directive). This measure had a tremendous impact on the increase in rapeseed production (usually in the framework of specialized and intensive farming systems): today, 60 % of total European rapeseed production is used for

energy market, which has also led to an increase in the price of these products (Bureau & Thoyer, 2014).

Public policies evolution and societal demands

Changes in European public policies – both agricultural and environmental ones – are themselves driven by many factors, among which: (a) the demand expressed by a wide range of stakeholders and the power balance that exists between them (civil society organisations, NGOs, interest groups, etc); (b) the institutional settings through which policies are negotiated; and, most notably, (c) the capacity of the different Member States to reach an agreement.

From this perspective, the adoption of measures favouring alternative strategies clearly resulted from the high level of pressure exerted by civil society organisations and NGOs on the Commission and on Member States' negotiators as well as from the progressive opening of the CAP decision making process (Roullaud, 2012). In spite of the important work achieved by these organisations and networks, it is also clear that they did not managed so far to obtain the radical measures they called for.

On an other note, the quasi status quo that characterized the last CAP reform (Swinnen, 2015) and led to an adjustment of existing productivist strategies at the farm level, can also be seen as the result of the combination of two factors: the introduction of the co-decision between the Commission and the Parliament; and the fierce debates that exist among Member States regarding agricultural policies, especially since the enlargement of the EU to Eastern and Central European countries (Figure 18).

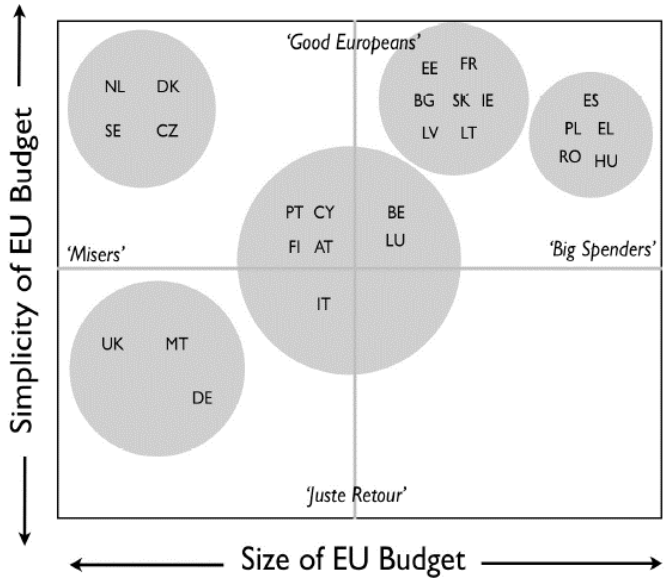


Figure 19: Member States position in the debate of the reform of the CAP. Source: Clasper & Thurston (2010)

– the "Modernisers": Like the Misers (see below), they are economic spendthrifts who want to shrink the CAP, simplify the budget, and support national co-financing. However, they also want to scrap all corrective mechanisms, including the UK's rebate – the Czech Republic, Denmark, the Netherlands, and Sweden (total number of Council votes – 42)

- the "Misers" – Like the Modernisers, they support budget discipline, shrinking the CAP, and introducing national co-financing. Yet they also want compensation for net balance deficits, and support corrective mechanisms such as budget rebates – making them "old school" fans of juste retour – Germany, Malta, and the UK (total number of votes – 61)

- the "Fence Sitters" – These states have a comparatively centrist position. On the one hand, they pay lip service to the idea of reform and budgetary discipline; on the other, they want to maintain CAP spending. Some are open to corrective mechanisms; others support national co-financing – Austria, Belgium, Cyprus, Finland, Italy, Luxembourg, and Portugal (total number of votes – 78)

- the "Big Spenders" – Like the Gold Diggers (see below), these states see a big role for the EU budget and want to maintain current CAP funding. However, they pay lip service to the idea of gradual reform and budget discipline. Some states, such as France, support co-financing as a way of minimising their own future net contribution – Bulgaria, Estonia, France, Ireland, Latvia, Lithuania, and Slovakia (total number of votes – 68)

- the "Gold Diggers" – Like the Big Spenders, these states want to maintain CAP spending levels and oppose cutbacks. But they are happy to reap the benefits and let other states pick up the tab: the Gold Diggers oppose co-financing and don't even pay lip service to budget discipline – Greece, Hungary, Poland, Romania, and Spain (total number of votes – 92).

2.3.4 Diets

The fact that diets and agricultural production systems relate to each other is quite obvious; the very nature of this relationship is, however, difficult to characterize, as it is both non linear and reciprocal. While diets have long been influenced by agricultural production – which is most visible in the existence of regional specific diets, as the Mediterranean one – dietary patterns also strongly affect production through their impact on demand, both in terms of changes in the quantity and quality demanded for various products and in terms of where and in what form these products are consumed. Moreover, dietary patterns are influenced by a wide range of other variables, whose careful consideration is well beyond the scope of this paper: purchasing power of food, food prices, urbanization and lifestyle, the so-called "globalization of taste", awareness raising by government interventions and / or civil society organisations, etc.

Having said that, one can notice that the nutrition transition theory (Popkin, 1993) well accounts for the kind of evolutions of production systems depicted in section 2.1, characterized by both the domination of productivist and agro-industrial strategies, and the emergence of alternative food networks based on quality.

From the 1960s to the 1990s, Western European dietary patterns have gone through the 3rd and 4th nutritional transition described by Popkin. The 3rd transition is characterized by a decline of famines linked to the industrialisation of agriculture, by low variety diets based on starchy staples, and by the growing importance of animal proteins. The 4th one is described as the shift towards sedentary lifestyles, a high consumption of fat, sugar and animal proteins, and the emergence of non communicable chronic diseases. During these transitions, the demand for food was marked by the search for low prices and high caloric food (Gracia & Albisu, 2001), to which agro-industrial and productivist strategies at the farm level were able to respond. The continuous decrease in the expenditure dedicated to food and non-alcoholic beverages as a share of total household expenditure illustrates this search for low-cost food. In France, for example, 25% of a total household budget was spent on food in 1960. In 2007, this share had shrunk to 15%. Important discrepancies persist between countries, especially between new and old Member States. In 2008, households in the poorest Member States still spent 20 percent of their budget on food and non-alcoholic beverages (EEA, 2012). However, some degree of convergence of food consumption patterns between CEECs and Western Europe has been observed since the beginning of the 2000s (Van der Wilk & Jansen, 2005).

From the 1990s onwards, while past tendencies regarding the increase in total caloric and protein intake continued, new trends started to emerge, which Popkins refers to as the 5th nutritional transition: a decrease in fat and protein consumption, and an increase in the demand in fruits and

vegetables and, most notably, in quality food. This is well illustrated by the evolution of organic product consumption, which doubled over the last decade (Willer & Lernoud, 2016) – though the dynamic of organic food markets significantly varies from one country to another in terms of market shares, growth rates, and concentration. These new dietary patterns contributed to the development and consolidation of so-called "alternative food systems" or short food chains, which we mentioned above (and describe in more details in section 2.3.5 onder). They were themselves promoted / accompanied by the development of a wide range of local / civil society initiatives which tried to redefine the consumer-producer relation and to give a political dimension to an otherwise purely economic act of buying food (Renting *et al.*, 2012).

A last trend whose impact on producers' strategies is quite indirect is the increase in the consumption of both "functional food" / food supplements (Kearney, 2010), and convenient food (Etiévant *et al.*, 2010). The demand for functional food is particularly high in Germany, France, the United Kingdom and the Netherlands and is increasing in Hungary and Poland (Siro *et al.*, 2008). Functional food usually includes fortified food, enriched food, altered food and enhanced commodities. Its consumption is increasing in almost all developed regions of the world, driven by health concerns. Convenient food includes processed food, frozen meals and ready meals – the demand growing faster for highly transformed items. The increase in the demand for both convenient and functional food is associated with changes in lifestyle, as busier lifestyles make it more difficult to meet nutritional requirements using traditional food (Frewer *et al.*, 2003).

How the increase in functional & convenient food consumption has affected demand at farm gate and, in turn, producers' strategies is far from being clear. The organization of food chains linking this kind of food to raw material produced at the farm level farms clearly plays a key role therein. We now turn to an analysis of the way in which food chain organization affect producers' strategies.

2.3.5 Food chain organisation

Food chains affects producers' strategies through the influence their organisation has on both the demand (type and quality of product) and the price paid to producers. While food chain organisation can evolve partly in response to the evolution of consumers' demand (e.g. to provide them with ready meals especially regarding the increased demand for convenient food), a given demand from can be satisfied by several types of food chain, ranging from long food chains with several intermediaries to very short ones.

Since the 1980s, most European (and world) food chains have undergone profound transformations, marked by three major trends. First, food chains have grown in length and complexity, as a result of developments in transformation technologies, stabilization ingredients, and transportation. Reduced transportation costs have allowed for increased international sourcing of primary products, while the development of refrigerated cargos enabled the development of long cold supply chains (such as milk products, frozen foods, and out-of-season produce). The now standard process of deconstructing and reformulating food products in multiple stages has played a key role in product diversification. Product variety is therefore largely disconnected from production itself and raw materials have become largely standardized (see Soler *et al.*, 2011).

Second, the level of concentration along value chains has increased at all levels (inputs to production, production, processing, and delivery to customers) (Humphrey & Memedovic, 2006). At the **retail** level, supermarkets have capitalized on the consumers' willingness for convenience, which favour single shopping trips to one retailer offering a wide variety of items. Although the level of

concentration among retailers varies around the world, the concentration is relatively high across Member States – in 2014, the share of the top 5 retailers exceeded 60 % in 13 Member States. As a result, these retailers exert significant price pressure on their suppliers, particularly those with fresh agricultural products that need to be sold rapidly. Concentration at the **processing stage** in large plants allows for increased efficiency (and therefore reduced costs) as well as the possibility to buy inputs in larger volumes. It also encourages the purchase of inputs from a smaller number of large, potentially proximate suppliers. At the same time, concentration has also occurred at the **input stage**, with a few major agrochemical input and seed companies (such as DuPont, Unilever, and Monsanto) accounting for a majority of sales: in 2002, seven companies accounted for 90 percent of the global sales in the agrochemical sector. The multiple simultaneous trends in concentration have led supply chains to take on an hourglass shape, as highlighted in the figure below.

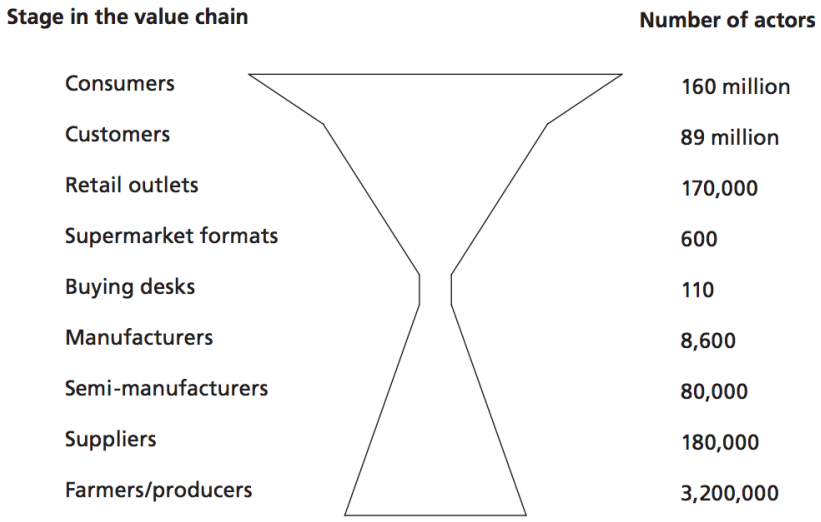


Figure 20: Number of actors at each stage within European agribusiness chains. Source: Grievink, 2002, as shown in Humphrey and Memedovic, 2006.

Third, quality standards have been playing an increasingly important role in the organisation of the whole food chain (Hatanaka *et al.*, 2005). While food standards were initially devised to ensure a certain level of food safety, their role has been broadened in the last two decades and they now serve as key instruments to create market segmentation and add value to products (raw products or transformed ones).

These transformations have led most producers to become interchangeable providers of undifferentiated and highly standardized raw material for a highly complex agro-industrial apparatus (Palpacuer & Tozanli, 2008). As such, they are more than often price takers, due also to their weak bargaining capacities vis-à-vis highly organized and capitalized downstream actors (Agricultural Market Task Force, 2016). All in all, these evolutions have reinforced the views of producers already engaged in a productivist strategy, producing large volumes of undifferentiated products at low prices.

In parallel, short food chains have emerged in the middle of the 1990s as a response to the perceived shortcomings of the conventional agro-industrial system. Different terms are used to desig-

nate such food chains, each of them emphasizing a particular aspect (e.g. alternative food networks, short food chains, local farming / food systems, direct sales). At the heart of the development of such chains is the willingness to re-localize agriculture and to re-connect consumers to producers. They mainly concern fresh products (fruits and vegetables, meat, cheese and dairy products, eggs) and, to a lesser extent, few staple products such as bread. A majority of these schemes implement full or partial organic farming practices. In these different sub-sectors, the development of short food chains has supported producers already engaged in alternative strategies and enabled the installation of new entrants (see for more details Kneafsey *et al.*, 2013 ; eip-agri, 2015). Although short food chains have attracted a lot of attention from the part of different stakeholders (e.g. IPES Food, 2017a) and decision makers (e.g. Augère-Granier, 2016) with respect to the benefits they are supposed to deliver to both producers and consumers, their development has remained quite limited.

The current situation is increasingly blurred, as many actors of "conventional" food chains have developed new supply strategies and new lines of products. More and more retailers, food processors and caterers indeed develop local supply strategies based on quality criterion for many fresh products (as Système U and Carrefour for meat in France, or McDo with wheat and beef…). This tends to encourage the development or, again, the consolidation of existing alternative producers' strategies.

2.3.6 Agricultural technology and knowledge system

Agricultural science & technology (AST) and the associated knowledge and innovation system (AKIS) have played a prominent role in orientating producers towards agro-industrial and competitiveness strategies over the last decades. The modernization of the agricultural sector between the 1950s and the 1970s has relied to a large extent on the dissemination of "technological packages" to producers, including machinery, improved seeds, fertilizers and pesticides. Today, the digitalization of the agriculture is said to offer great promises for lowering its environmental impact, improving working conditions, or increasing the productivity of work. Three main trends in the AKIS can be mentioned to account for the situation depicted in section 2.1, marked by the generalization of agro-industrial strategies and the emergence of alternative ones, two kinds of strategies being in competition for access to production factors.[17]

The first is the continuing focus on productivity (plant productivity, animal productivity, land productivity and productivity of work) that has driven most evolutions in agricultural R&D. Producers are provided with new seeds, new machines, new chemicals, that primarily aim at increasing productivity. In such a perspective, negative externalities (both social and environmental ones) are managed ex-post by successive adjustments, rather than considered ex-ante. Concerning fisheries: technical improvements in the fishing vessels in Europe mainly consisted in increasing their capacity and efficiency of harvesting, storing (cooling and freezing) and on-board processing. This increased efficiency combined with the lack regulation led to a situation where an important part of the fish stocks were overexploited.

A second major trend has been the increasing role taken by private actors – and especially upstream companies – in the overall organisation of the AKIS and all pertaining activities – ranging from fundamental research to extension services. While at the beginning, it was essentially government-driven – both in terms of funding and strategic orientations – private actors came to play

[17] The remainder of this section relies heavily on (McIntyre *et al.*, 2009a ; Dockes *et al.*, 2011), unless otherwise stated.

a major role at the turn of the 1980s, which ultimately leading to a shift towards market-driven rather than public-good driven innovations.
A third trend is the emergence, since the 1990s, of alternative approaches to AKIS based on inter-disciplinary and systems approaches, on the re-introduction of ecological and social sciences into agronomic research, and on the recognition of producers themselves as key actors of innovation. This trend is well illustrated by the launch of the Agricultural European Innovation Partnership or the development of networks of farmers and scientists at the territorial level in many regions. Significant public investments go in that direction, though the dedicated amount of money remains overall well below the one channelled towards more "conventional" research.

What results from these evolutions is a situation in which knowledge and innovation for agriculture are developed along different lines, following different paradigms (e.g. productivist, integrated development paradigm, alternative, eco-friendly, etc.). As rightly mentioned by Dockes and colleagues (2011, p. 5), "each has distinctive ways of defining problems and offers different solutions and are built upon different definitions, meanings and organizational forms which are evolving in response to changing economic, social, political and environmental contexts". They contribute to the development or the consolidation of different producers' strategies and well explain the sort of dualization that characterize the current situation.

3 Four food system narratives to account for possible changes in producers' conditions and strategies

In order to build four food system narratives by 2030, we selected the most important and interesting trends and drivers identified by the retrospective analysis, putting aside the ones linked to farmers' strategy and agricultural policies – which are precisely the kinds of solutions that we would like to test in our four different narratives.
We considered three kinds of components determining the shape of the four narratives:

- Four fixed components: they are the same for all of the four narratives: climate change; level of European integration; cost of energy; demography and human development;
- Two determining variables: the components which we estimated as highly responsible for the shapes of the four different atmospheres: the type of trade policy in place; the global market dynamics;
- Three description components: the aspects of food chains; the characteristics of European diets; the characteristics and availability of research and technology.

3.1 Building blocks of four food systems narratives

3.1.1 Fixed components

Climate change: The horizon of the scenario exercise is 2030. Although the scale of climate change amplitude can considerably vary according to the different IPCC scenarios, placing ourselves at a time horizon of less than 15 years from now decreases the potential scale of variation. Therefore, we decided to adopt IPCC's near term projections (0.2 °C per decade) (IPCC, 2007) for the four narratives.

Level of European integration: Although the European Union is currently facing important risks in terms of the political stability of its institutions and members, especially in the aftermath of the Brexit, we consider it to be unlikely that another EU country will exit the Union before 2030, and consider the hypothesis of a complete political collapse of the European Union also as unlikely. We therefore decided to make the hypothesis that the level of European integration will remain approximately the same as it is today by 2030.

Oil prices: We decided to adopt the IEA's hypothesis of current moderated rising oil prices that will reach a ceiling in the coming years (IEA, 2017), and to apply it to all scenarios.

Demography and human development across Europe: Given the limited time horizon chosen for this exercise, we decided to apply the same demographic trends for all scenarios regarding population growth, migration and the level of human development (moderate but continuous growth of the population, net migration as the main driver of population growth, and steady increase in the level of human development (European Commission, 2015).

3.1.2 The determining variables: trade and global demand for food / fibre / fuel

The type of trade policy in place in the European Union: The retrospective analysis we conducted demonstrated that trade policies in the EU had had tremendous effects on agricultural policies in the past – from the Kennedy Round to the Doha Round and their effect on the decoupling of agricultural subsidies. Although multilateral trade negotiations seem to have become deadlocked in the aftermath of the failure of WTO talks, bilateral agreements have taken up the role of commercial exchange facilitation. In spite of some recent political discourses emphasizing isolationism, the importance of bilateral agreements is expected to further increase in the future (Copenhagen Economics, 2016).

However, a major area of uncertainty is the nature of non-tariff barriers that will accompany the settling of such bilateral trade agreements. Two options were considered for the 2030 time horizon:

- "Full" liberalization, where the decrease or abolition of tariff barriers is not accompanied by rules imposing non-tariff barriers;
- Controlled liberalization, where the decrease of tariff barriers is accompanied by the imposition of non-tariff barriers such as the compliance of imported products to food safety or public health measures, to precautionary principles or to social and environmental production norms.

The global market dynamics: The retrospective analysis showed that the global demand for food, feed and first generation biofuels had increased sharply in the past decade, following: (i) a rise in the demand for food and feed in developing countries, currently undergoing a dietary transition; and (ii) a rise in the demand for first generation biofuels.

The estimates of the global consumption by 2050 vary, from almost a doubling of the needs (e.g. Tilman *et al.*, 2011) to a 60% increase (FAO, 2016). However, these estimates hide important discrepancies between products and geographical areas – for instance, the rise in the demand of

plant-based proteins, milk and meat has been slowing down, even decreasing in developed countries such as European countries.
We make the hypothesis that the global market dynamics by 2030 is likely to have followed one of the two following paths:

- Keep on following increasing past trends (strong demand from developing countries; strong demand for biofuels), resulting in high prices;
- Following the slowing down / decreasing trend of the past few years linked to the evolution of food diets, resulting in lower prices.

Using these two components as horizontal and vertical axes, we established four different general contexts in which developing food system narratives by 2030 by combining the three components presented below (see 3.2.). We do realize that selecting these two components as determining variables bears the risk to give a framework to this exercise that is actually very similar to the way the issue is currently debated (need to feed the world for Europe, even though exports actually represent a small share of agricultural production), thus lowering the chances to move the line of the debate and produce disruptive scenarios. Having this risk in mind, we paid particular attention to the innovative character of the narratives we developed.

3.1.3 Three structuring components and their possible status by 2030

Starting from those four contexts, we then depicted in more detail what the future could look like in each case. To this purpose, we relied on three descriptive components, whose role in the transformation of European food systems until now have been important, as demonstrated in the previous section: the organization of food chains, the characteristics of European food diets, and the technology and innovation system. In the following lines, we present selected hypothesis regarding their possible status by 2030.

Organization of food chains: Recent trends show that food chains have undergone a massive concentration process, from sectors located upstream of the food chain such as the fertilizer industry to sectors located downstream such as food processors and retailers. In addition, contemporary food chains are increasingly complex and globalized – this globalization of the food chains not preventing though the development in parallel of short supply chains. A final noticeable evolution is the important segmentation of the market of final products, with quality-certification booming and increasingly controlled by private stakeholders such as food industries and retailers.

Four possible evolutions of food chains were envisaged for 2030:

- "stationary": the concentration and globalization processes slow down but remain crucial;
- "extreme concentration”: the downstream segments of the food chain are even more concentrated, and increasingly dominant players downstream (such as retailers) massively influence the norms of the whole production system upstream through segmentation;
- commodification and globalization intensified, with an increasingly dominant role played by traders to face logistical constraints;
- relative deconcentration and decrease in power unbalances.

European food diets: Recent trends have shown an increase in the share of animal-based proteins in European food diets, with a decrease in the consumption of red meat and an increase in the consumption of white meat (4th nutritional transition in Popkin's words see Popkin, 1993).
In parallel of these evolutions in the content of their plate, European consumers also increasingly shift their attention towards higher quality, safer and healthier products (5th nutritional transition). They also increasingly focus on practical aspects of food products consumed at home (less time available to cook) and increasingly consume away from home.

We estimate that by 2030, European food diets could follow four different trends:

- a progressive domination of functional food and nutriceuticals, with practical aspects and health as the two main selection criteria;
- an extreme fragmentation of the food market and demand;
- a domination of the demand for cheap food;
- a rapid expansion of the demand for higher quality products (organic / labeled).

Technology: The long term trends have shown that innovation was increasingly focusing on products rather than on systems. In addition, innovation has increasingly been dominated by private stakeholders, who tend to focus on the most profitable innovations, thus limiting the scope of innovation to a small number of "key" agricultural products.
In addition to the evolutions underwent by agricultural machinery and robotics, agricultural innovation has increasingly been focusing on digital technology (Information and Communication Technologies to georeferencing and big data).
In parallel to the rising dominance of private firms on the agricultural innovation system, research and development is sometimes and in some places increasingly undertaken by collective action and farmers at the local level, backed by research institutions (European Innovation Partnership EIP-AGRI, Groupements d'intérêt économique et environnemental in France…), who tend to focus on systems instead of products and tend to attach particular importance to ecological cycles.

Three evolutions in the technology and innovation system are envisaged for 2030:

- continuation of the privatization process, resulting in innovation processes essentially oriented towards key products and high tech;
- rebalancing of public and private research, with the continuous development of systems approach and agroecology;
- strong redeployment of public research with public-private partnerships, both top-down and bottom-up innovations, development of systems approach and agroecology.

3.2 Building narratives

The process to build narratives followed two steps. First, we combined the two determining variables to construct four main contexts. In each of those contexts, we then identified the most relevant hypothesis for each of the three other components we considered (food chain organisation, diets, agricultural technology. This eventually led to four narratives, whose structure is represented in the Figure 21 onder. Each narrative has its own internal logics and focuses on one or two main issues, reflected on its title as much as possible.

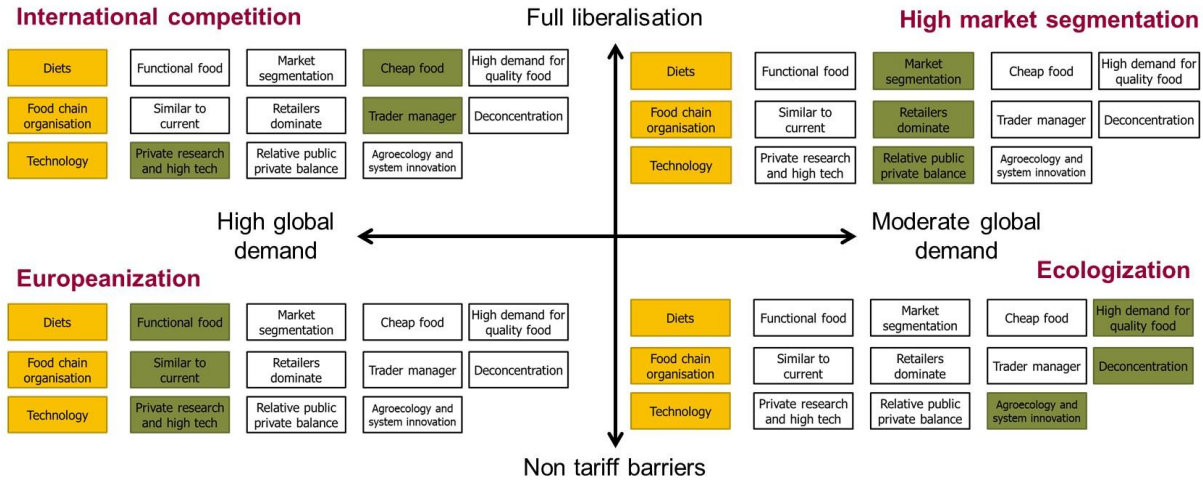


Figure 21: The four narratives in a snapshot (elaboration: authors)

4 From narratives to scenarios

The four narratives we developed served as basis to build full scenarios and explore the relevance and potential impacts of a diversity of solutions to improve the sustainability of European producers. Scenarios were developed following four main steps:

1. For each food system narrative, we first made hypotheses regarding how the specificities of this narrative were likely to affect the main producers' conditions described in section 1.1.3 – putting aside environmental conditions: climate change has indeed been considered identical in each narrative and is by far the main driver of environmental change;
2. We then discussed the kind of producers' strategies that were most likely to be favoured given such evolutions. At this stage, it was not possible to distinguish producers' strategies by sector, by geography or by main farm type – this will be done later in the process through participatory workshops, see section 5.3.
3. The third step aimed at identifying the main sustainability issues associated to these strategies, on the basis of the literature review presented in section 2 (and more specifically section 2.2 on to the analysis of sustainability impacts). For each scenario, we analysed which ones of the 12 objective categories defined in the normative framework (see section 1.1.4) were the most "at threat". We then discussed the kind of solutions[18] that could be implemented to address these issues[19] – reflecting in the meanwhile on the social and political processes through which each identified solution could come into force and be effective. As we shall see below, in some cases, the social configuration implied by a food system narrative proved to be incompatible with the adoption and implementation of one or several proposed solutions;
4. A fourth and last step consisted in a very short ex-ante and qualitative assessment of the impact each scenario would have on the sustainability of producers. To put it another way, we

[18] In the following parts of this report, sentences or paragraphs describing solutions were bolded in order for the reader to identify them easily.

[19] Given that SUFISA focuses on the sustainability of primary producers, we did not, at this stage, reflect extensively and systematically on solutions to address sustainability issues "beyond farm gate", such as nutritional, food security issues or issues pertaining to the vitality of rural areas.

assessed the type of sustainability transition producers would be the most likely to experience in each scenario.

For each scenario, we start with a short presentation of the food system narrative and then describe the four steps presented above.

4.1 Scenario 1: International competition

4.1.1 The narrative

In 2030, under this narrative, global markets are totally liberalized either through bi- or multilateral agreements. Contrary to recommendations made by some experts in the late 2010s (e.g. for the CETA in France Schubert *et al.*, 2017), non-tariff barriers based on sustainability or sanitary criteria have not been set up. As a consequence, European producers, and more generally all European agri-food actors are competing with new global players from emerging countries, often more competitive. Global demand for food is on the rise again and leads to relatively high prices.

Food chains are globalized both for raw commodities as well as for a large number of processed food products and specialty/luxury products. Although an important share of EU agri-food exports still consists in primary agricultural products, the export market is dominated by processed food as a result of the EU's competitive advantage in this sector. The EU is a global export leader of high value added specialty products, notably wine and other alcoholic beverage, as well as cured meat and cheese.

Meanwhile, the majority of consumers in the EU favour convenience and low prices over environmental criteria, with not so much consideration for health and environmental issues. Diets across the EU converge towards calorific processed food and higher meat consumption, with the increase in pork and poultry consumption compensating for the decrease in that of bovine meat. Consumers' demand for healthy, environmentally friendly food exists but fuels what remains a secondary and highly segmented market. In total, the market share of organic products in the EU is about 4% under this narrative. Liberalized global markets offer a great variety of food to consumers, with a heavy emphasis on prepared food (including frozen) as well as a large diversity of fresh fruits and vegetables from faraway locations. The share of the household budget that is spent for food decreases to 10%.

Technology development in the agricultural sector is primarily driven by the private sector and oriented towards productivity gains through yield increases; other criteria (such as resilience to, or mitigation of, the impacts of climate change) remain secondary. Agrochemical and agricultural equipment companies lead and provide the lion share of investments in research and development in the agri-food sector, focusing their efforts on areas where there is the highest potential for short- to medium-term return on investment.

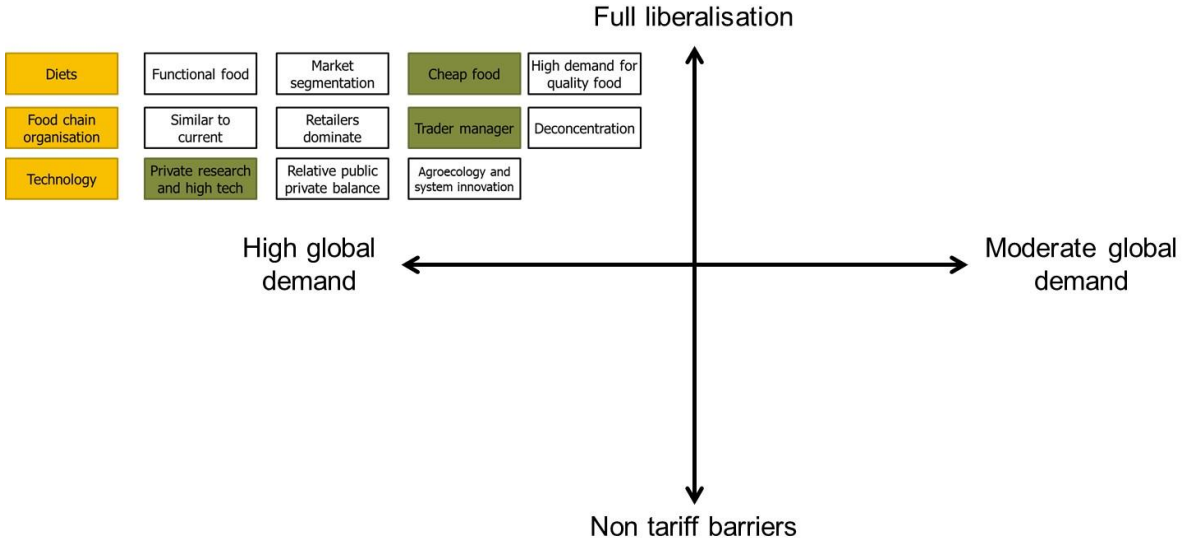


Figure 22: Illustration of the narrative "International competition"

4.1.2 Potential changes in conditions at farm gate

- Demand: due to the evolution in diets, the demand for quality products is weak. Consumers mainly ask for low cost and highly transformed products, meaning that overall, the role of producers in food chains evolve towards the one of raw material providers;
- Market access: given the evolution of food chains and without any other policies implemented, market access is likely to be governed by prices and standards: either producers are able to provide food at price, time and quality demanded by their buyers, or they are just replaced by another producer;
- Price levels / volatility: in this narrative, volatility is likely to be high, as a result of the conjunction of several factors, e.g. the dismantlement of most regulations regarding production levels (e.g. quotas) that followed the signatory of free trade agreements or the limited regulation of financial derivatives on agricultural commodity markets;
- Factor access (land, labour, finance):
    - it could be increasingly hard to find workers in the countryside given the growing urbanisation trends encapsulated in this narrative;
    - land prices are likely to increase due to two inter-related factors: (i) increased demand for land and (ii) weak regulation of the land market, especially in Eastern countries (Swinnen *et al.*, 2013);
    - private finance might be much more available to the agricultural sector than before as the sector industrializes quite quickly and as agriculture becomes a financial asset (Clapp *et al.*, 2017);
- Technological: access to technology is facilitated for producers engaged in the production of main commodities under conventional systems; producers in search of alternative practices do not easily find support;
- Regulation and policy: environmental policies are maintained low as a way to not hamper European competitiveness on the global market;
- Socio-demographic: farmers are increasingly disconnected from end consumers.

4.1.3 Main producers' strategies favoured under this scenario

Under this narrative, producers are incentivized to continue along the same strategic pathway depicted in 2.1.1. (intensification, concentration, specialisation). Alternative strategies pertaining to the rural development or blurring farm boundaries clusters are unlikely to develop and even to maintain, except under very specific circumstances (e.g. in mountainous or "high natural values" areas). On the other hand, strategies linked to the "coping with farm decline" cluster will play a key role in this scenario, as the number of farm holdings will continue to decrease at a rapid pace with an increase in the size of farms and an increased pressure for competitiveness.

4.1.4 Key sustainability issues and associated (potential) solutions

Amongst the 12 key sustainability themes we selected based on the SDG framework (see section 1.1.4), we considered that under this scenario, six of them could be if not at threat, at least seriously questioned. They pertain to all three boxes we identified (socio-economy of the farm, environment, societal aspects) and read as follows:

- Socio-economy of farms: 1) risk of decrease in incomes due to a weakened position in food chains; 2) lack of resilience; 3) barriers to entrepreneurship due to the high investment needs.
- Environment: 4) environmental impacts could be important both at the farm level and beyond.
- Societal aspects: 5) nutritional issues (overweight, obesity and other NCCD) are likely to be important in this scenario as current trends in both diets and food chain organisations continue; 6) risks of decline in rural communities' vitality are also high in many rural areas.

Weakened economic position in food value chains

Under this scenario, downstream actors of the food chain, who can easily find alternative suppliers on international markets, are putting an increased price pressure on European producers. Competition within European farmers and between European and international farmers intensifies, driving down prices – even if the high global demand imposes floor prices for some highly demanded food commodities.

A solution in this context could be to **reinforce both horizontal cooperation through cooperative systems and producers' organisations.** Current discussions at the European level tend to support such orientations (Agricultural Market Task Force, 2016 ; Bodiguel, 2016), as well as the recent agreements reached under the Omnibus regulation. However, the measures currently under discussion would need to be implemented at scale and pace for this to happen, which could not be that easy. **The reinforcement of vertical cooperation along food chains, for example through the development or interbranch organisations (IBO)** (as the study presented here was supposed to pave the way for Bodiguel, 2016), could obviously generate benefits in such a context. However, given the overall evolution of agrifood chains at play in the scenario, which sees a growing concentration at all levels, it might prove difficult to structure such IBOs having around at the same table both multinational food processing companies whose supply strategy is fully globalized, and producers' representatives defending the interest of a given group of producers, whatever the territory represented.

Lack of resilience for farmers facing increased price volatility

In this scenario, producers would need to cope with increasing risks – both market and climatic ones: market, because of the increasing price volatility of global agricultural markets; and climatic,

because the general orientation towards ultra-specialized farms lessens their resilience to climatic or sanitary incidents.

In this respect, the development of public subsidies allowing farmers to contract **insurance schemes** (beyond the agreement reached recently under the Omnibus regulation) covering both turnover and crop yield, and their integration in the first pillar of the CAP, is often advocated as a key solution by experts (e.g. Agricultural Market Task Force, 2016 ; Madre, 2016) and Member States (see for example the French proposal for the CAP post-2020 insisting on having a third pillar dedicated to financing insurances MAAF, 2016).

Given the general atmosphere of this scenario, such a development of insurance scheme could effectively be adopted and come into force by 2030, rather than other types of risk management tools, such as counter-cyclical payment (momagri, 2016) or **the development of public-private income stabilisation funds**. However, this solution would require significant investments from the European Commission, in particular to convince farmer unions – who at the moment are not that enthusiast for such private schemes as less than 300 000 of them have contracted one across Europe (Madre, 2016) – but also to collect the needed data to calibrate insurance models. Whether or not it could have the expected impacts regarding improved resilience is however a matter of important debates, especially given the American experience.

Barriers to entrepreneurship due to high investment needs

Given the increasing size of farms and the progressive substitution of labour by capital, investment needs are likely to increase: following the enlargement trend, farmers will need to buy or rent more land, adapted machinery, etc. While in the past and until recently, most investment needs at producers' level have been covered by bank loans and supported by public policies, either directly through agri-premium on loans, or indirectly through subsidies playing a role of "income insurance", current trends are towards an increased recourse to private investors. Some countries have sought to facilitate the coming of external investors in the agricultural sector, like in Denmark where a law has been passed with the explicit objective of "improving the opportunities for investments in the agricultural industry and thereby enable farmers to attract capital for purchase and further development of farms" (see Hvarregaard Thorsøe & Noe, 2017, p. 45). At the EU level, much effort has been spent recently in the development of **financial instruments with high leverage effects** (Tropea & de Carvalho, 2016). Given the liberalized ambiance of this scenario, such solutions are ultimately most likely to be given much more consideration. However, this is likely to change quite significantly farm governance and thus decision making processes (as reported for France in Nguyen *et al.*, 2017), with perhaps important consequences on the way in which other sustainability issues – such as environmental and social ones – would be considered. **Specific regulations pertaining to investments and "green" finance** would be needed in order to avoid too negative impacts, but their exact contours still need to be defined, as sustainability criteria that frame the use of financial instruments at the moment are very weak.

Weakened environmental sustainability

At the farm / territorial level, the specialisation and continuous intensification of farms will probably lead to the reinforcement of a variety of environmental impacts (N leakages, decrease in biodiversity, etc. (see 2.2)). In this context, two possible solutions – not mutually exclusive – could help cope with worsened environmental impacts: (i) **developing technological innovations and facilitating farmers' access to such innovations through the kind of tools mentioned above**; and (ii)

reinforcing environmental cross compliance and green payment, which is more or less what the recent communication on the CAP of the European Commission pushes for (EC, 2017). While the former solution is likely to be implemented thanks to private R&D orientated and partly funded by public funds, the latter could be highly resisted by farmers' organisations that are well structured and successfully lobby policy makers to avoid any further impact on the competition side, in a context where liberalization increasingly exposes them to international competition. One way to get the approval of farmers' unions would probably be to negotiate a results-based payment on a contractual basis, as for example proposed by Baldock (Buckwell *et al.*, 2017).[20] Concerning fisheries, regulations should be implemented/strengthened to protect fish stocks that could be affected by overexploitation (potentially leading both to fish size decrease or disappearance of fish resource).

At the broader / landscape level, the logic of specialisation entails a growing pressure on global markets, especially for protein based crops cultivated on tropical forest areas. This is likely to increase the amount of "embodied deforestation" imported to the European market (see for an assessment of the current situation Cuypers *et al.*, 2013). Yet, the European Council has precisely announced already back in 2008 that it would take all the necessary measures to halve the deforestation footprint of Europe by 2030. A feasibility study carried out in 2017 on behalf of the Commission in that respect pointed towards the need to decrease the European protein deficit through subsidies (COWI, 2017). However, such measures would necessarily imply some forms of (re)diversification at farm level – in a manner that would need to go well beyond existing greening rules on Pillar 1 – and are therefore unlikely to be adopted under such a scenario given the socio-political context (as mentioned above regarding a possible increase in environmental cross compliance).

Last but not least, maintaining a certain level of subsidies for small scale, multifunctional and / or eco-friendly producers will be essential to maintain agriculture in certain difficult areas, and a certain level of biodiversity in such regions.

Depletion of rural life associated with the strong decrease in farm holdings

The prevalence of competitiveness strategies amongst producers leads to a sharp decrease in the number of farm holdings. The consequences could be some forms of "rural exodus" in a context where cities will not be anymore the labour pool they used to be in the 1970s, when Western European countries experienced such a rural exodus.

4.1.5 Overall impact of the scenario and types of sustainability transitions

At the farm level and from a socio-economic point of view, this scenario can only be sustainable if
(i) insurance schemes and income stabilization tools are designed and implemented effectively,
(ii) producers managed to develop strong producers' organisations.
Small scale farmers will nevertheless face increasing difficulties to remain in the sector as they will not be able to compete with large ones on a market driven by international prices.

[20] Baldock's proposition goes however well beyond the idea of results-based payment. It suggests to get rid of the pillar I / pillar II distinction towards the adoption of a multi-tier system of payments for public goods, proposed in a multi-annual and co-financed way.

From an environmental point of view, the main issues at the farm level could be handled – at least partially – by technological advances and by further developments of the green payment on a result-basis. However, overall environmental issues will probably be important due to the high degree of territorial specialization and dependence over forest risk commodities such as soybean for animal feed.

From a societal perspective, under such a scenario European agricultural production volumes will remain high and food security should not be threatened in any way. However, nutritional issues are likely to remain key societal problems which the depicted evolutions will most probably worsen. From an economic point of view, the trade balance could continue to be positive, but this will be at the expense of the number of jobs in the agricultural sector and the vitality of the countryside, for which no evident solution has been identified.

From a sustainability transition perspective, this scenario will lead the agrifood system to undergo some sort of "system optimisation" as the dominant socio-technical regime will only be altered by some relatively weak pressures from the overall landscape. This will make it difficult to reach a high level of sustainability – even though there will be important trade-offs between socio-economic aspects, environmental ones and broader societal aspects, as mentioned above. Actors involved in niches will not have the possibility to expand their business beyond their current situation and will even have to struggle to maintain it.

4.2 Scenario 2: Europeanization

4.2.1 The narrative

The key entry point to build this narrative is the (very) high levels of food safety demanded by consumers – and, to a lesser extent, environmental sustainability criteria. This has indeed two major consequences. First, the level of stringency of public norms regarding sanitary aspects and some environmental aspects – mostly linked to climate change – is strongly reinforced. This concerns for example the extension of the GMO moratorium to seeds obtained through New Breeding Techniques, the continuous ban of hormones in cattle rearing or the continuous decrease in the limits for pesticides residues.

Second, most of these public norms initially implemented in Europe are introduced as non-tariff barriers in bilateral free trade agreements (FTA) under civil society pressures who eventually managed to get their voice heard (e.g. in the CETA and TIPP case Hübner *et al.*, 2017). This is for example the case for the ban of animal flours in the process of animal feed regarding sanitary aspects. The so-called "forest-risk commodities" (e.g. soybean or palm oil) – whose production is responsible for tropical deforestation – could also be particularly targeted by trade restrictions under different FTAs in the wake of recent discussions at the EU and MS levels. All in all, high public norms in Europe and the proliferation of non-tariff rules set the tone for domestic production and trade dynamics under this scenario, with a series of consequences at all levels.

Given the uneven regulatory constraints that characterize the agricultural world market (high in Europe, medium to low in other major agricultural countries), a key assumption under this scenario is that production costs will become much higher in Europe. This will induce a loss of competitiveness which cannot be compensated by public subsidies (Schubert *et al.*, 2017, p. 46) – and this despite the high level of global demand, which also implies higher prices. As a consequence, Europe is likely to lose the role it used to play on global markets for agricultural products and give place to emerging global players like Brazil, Argentina or Russia, especially when it comes to con-

ventional products. The majority of European agriculture thus comes to feed the domestic market. However, European products still have a good reputation in terms of sanitary quality and therefore keep on exporting on niche markets.

The food market is shaped by the increasing role of high-tech solutions in the food sector and by a high demand for convenience food by European consumers. Food chains are dominated by downstream actors, both retailers and food processors, who have become even more globalized. They have however developed specific product lines for the European markets given its specificities / exigencies regarding sanitary issues.

Food diets are mostly made of transformed products, selected for their convenience. This includes ready meals and frozen food and the demand for eating out or to go is also very high. Paired with a strong concern for healthy lifestyles, the quest for convenience also increases the demand for functional, enhanced and enriched foods, as well as for food supplements. The market share for organic food is not very significant, the EU average being about 6%.

Under this configuration, consumers are concerned about the safety of food products, but they have little knowledge about the origin and the processing of their food. The average cooking time is decreasing. Consumers are ready to pay a higher price for the convenience of the food they consume, so the share of the food budget in the overall household expenditure of European households is on the rise and ends up amounting for about 15%.

Finally, the development of technology is dominated by private research and by the search for higher productivity and higher competitiveness under the new regulation constraints linked to the increased demand for safe products. The research and innovation system is dominated by the three biggest players in agritechnology, but they tend to invest less in the European market as new regulation constraints make it less attractive than it used to be the case. Agritech companies continue however to play a key role in European agricultural system (both European and from abroad). Research and innovation is focused on precision agriculture and big data based solutions (satellite data, private data…).

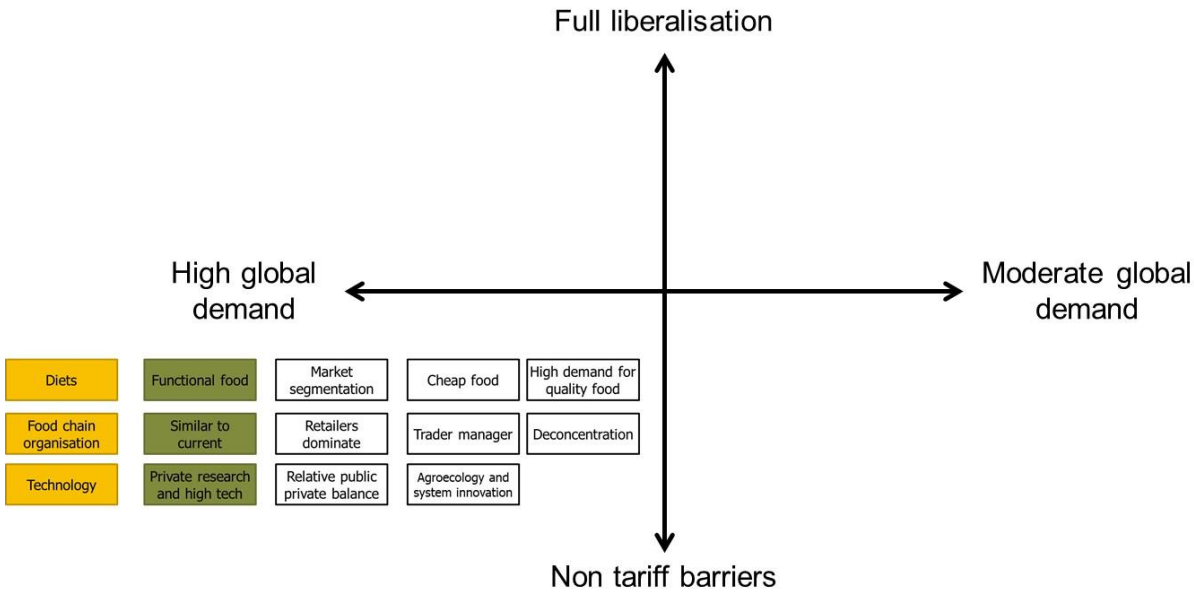


Figure 23: Illustration of the narrative "Europeanization"

4.2.2 Potential changes in conditions at the farm gate

- Demand: consumers' demand evolves towards more and more stringent safety / sanitary regulations, imposing new constraints on producers e.g. regarding the use of pesticides or GMOs for animal feed.
- Market access: access is linked to farmers' ability to comply to more and more stringent specifications. Producers mainly sell to large and globalized processing companies whose market power is high, with potentially important consequences.
- Price levels / volatility: price volatility remains important; even if European production is mainly sold on the European market, global buyers still consider that world market prices are the reference price for negotiation (even though premium are added due to the high level of sanitarian / safety offered by European producers).
- Factor access (land, labour, finance): it could be increasingly hard to find workers in the countryside given the growing urbanisation trends encapsulated in this narrative.
- Regulation and policy: policies essentially focus on the sanitary aspects of agricultural products and, to a lesser extent, on climate change issues.
- Technological: regulatory constraints tend to lead input providers to invest less for R&D in Europe; as such, producers have access to less performing genetic material and to fewer molecules. As the European market nevertheless remains an important one, some investments are made in farm machinery coupled to big data.

4.2.3 Effects on the strategies of producers

Under this scenario, farmers are still under an important pressure from downstream actors and do not find easy alternative outlets based on quality or territorial criterion. They are moreover pushed to respect highly stringent production standards that imply a lot of reporting. In such a context, a continuous enlargement, intensification and specialization is likely to remain the most logical strategic option for producers, and alternative strategies will not easily be adopted given the limited demand for quality food. However, the important regulatory constraints will pose new challenges for producers, forcing them to innovate.

4.2.4 Key sustainability issues and possible solutions to address them

Under this scenario, the most important sustainability issues would be similar to the ones happening under the competition scenario. However, the way in which they could be handled might differ given the overall context in which the scenario deploys. These issues concern mainly:

— Socio-economy of farms: 1) risk of decrease in producers' income due to a weakened position in food chains; 2) lack of resilience due to high price volatility and high specialisation; 3) barriers to entrepreneurship due to high investment needs; 4) coping with farm decline for farms unable to follow the modernization imposed by the demand.
— Environment: 5) potential impacts at the farm level could be restricted to certain aspects, but will remain strong at the landscape and global level.
— Societal aspects: 6) macro-economic (and political?) risks pertaining to the decline of Europe as a key agricultural exporter; 7) risks of decline of rural communities' vitality.

Weakened position in food chains

As in the competition scenario, downstream actors of the food chain are putting an increased price pressure on European producers. However, as European producers provide them with higher quality products than what they can find on international markets, and as they need those to fabricate specific, highly traceable, end consumption foodstuff, the power imbalance between producers and downstream actors is less extreme than under the competition scenario. As such, **while the reinforcement of producers' organisations** would definitely benefit producers, it seems to be a bit less needed than under the competition scenario. On the contrary, **vertical coordination mechanisms, such as for example interbranch organisations** are more likely to develop and to play an important role, as food processors and even retailers will have to adapt their offer, hence their supply, to the specificity of the European market.

In the meanwhile, the level of competition between producers *within* Europe tends to increase sharply. This points to **the need to harmonizing social and fiscal norms across Europe in the agricultural sector** to ensure that producers inside the EU compete on a levelled playing field. Under such a scenario, one could also see national "champions" such as Arla Food, Frieds Campina, InVivo or Avril being supported by various means at national level with the aim of promoting each agricultural sector in a context marked by a fierce competition. One could speak about a sort of "national-sectoral withdrawal" from the part of states and national representatives of farmers to resist global actors.

Issues related to farmers' resilience in the face of increased price volatility and climatic risks

As under the competition scenario, producers would need to cope with increasing market and climatic risks, that could be similarly handled through the development of both **insurance schemes** and **public-private income stabilisation fund**. Again, that would require significant investments from the European Commission, most particularly to convince producers to enrol in such schemes.

Barriers to entrepreneurship due to high investment needs

Given the increasing size of farms and the progressive substitution of labour by capital, investment needs are likely to increase: following the enlargement trend, farmers will need to buy or rent more land, adapted machinery, etc. In addition to the situation depicted for the Competition scenario, producers under the Europeanization scenario will also have to modernize their equipment and production processes to meet the regulatory requirements pertaining to sanitary and, to a lesser extent, environmental issues. The development of **public-private financial instruments** might again be a good option in this specific context.

Lowering the environmental impact at farm and landscape level

At the farm level, the increasing stringency of environmental and sanitarian rules – in particular those pertaining to maximal residual limits of pesticide, water quality, and GHG emission – will lead farmers to invest massively in precision agriculture to limit the use of inputs and reduce the recourse to GMO-based animal feed. This could be supported by **the public-private financial instruments mentioned above** or, alternatively (or complementary to) by public subsidies orientated towards the furniture of public goods**.**

At the landscape level, the specialisation and continuous intensification of farms is likely to lead to a degradation of a variety of environmental impacts, especially regarding the decrease in biodiver-

sity (see 2.2). **The maintaining of extensive pastureland wherever they are located will be of utmost importance and could mostly rely on public subsidies** – as the demand for quality beef is not likely to increase.

On another note, the level of protein deficit could decrease due to more stringent non-tariff barriers regarding forest risk commodities, and in particular soybeans.

4.2.5 Overall impact of the scenario

At the farm level and from a socio-economic point of view, this scenario will lead to a growing competition between European farmers. The consequences of such a competition could be a highly uneven rural development if social and fiscal rules are not harmonized across the EU.

From an environmental point of view, main issues at farm level can be handled – at least partially – thanks to technological advances and by further developing green payment on a result-basis. However, overall environmental issues will probably remain important due to the high degree of territorial specialization and dependence over forest risk commodities such as soybean for animal feed.

From a sustainability transition perspective, this scenario (as more or less the Competition one) is most likely to lead to some kind of system optimization here and there, without giving existing niches many opportunities to grow and destabilize the current regime.

4.3 Scenario 3: Ecologization

4.3.1 The narrative

The key entry point to build this narrative is the high level of food safety demanded by consumers.

In 2030, under this narrative, trade is mostly ruled by bilateral agreements, making global trade rules almost obsolete. As a consequence, the level of global trade has slightly decreased compared to the present time. Imports into Europe are regulated by non-tariff rules on the basis of clearly defined sustainability criteria, following numerous contestations from civil society organisations on trade liberalization (e.g. Hübner *et al.*, 2017). In the meantime, the global demand for agricultural raw products has stabilized at a moderate level, following a due decrease in the demand for animal products and stricter regulation on biofuels.

European consumers are extremely aware about the safety and the environmental impact of food products. NGOs are very vocal on social and traditional media on issues like animal welfare, healthy diets and the role of agriculture in environmental degradation. The demand for products of higher quality and with lesser impact on the environment is strong. The market share for organic and other certified high quality products reaches 20%. Consumers are assisted in their choices by the development of sensors and public norms as well as applications developed by NGOs. In this configuration, we observe the beginning of a 5th nutrition transition with a strong reduction in the demand for animal proteins in favour of a rise in the demand for plant-based proteins. Consumers' willingness to pay for quality food is high and the share of the food budget in the overall household budget is around 18%. As far as the expenses on food are compared across Europe, countries are converging.

Supply chains are smaller and less commodified, which reduces competition between European countries to some extent. However, discrepancies between countries still exist as some countries have invested earlier in the transition of agricultural models through investments in research and

extension services and in the development of new markets and infrastructures, thus facilitating the conversion to eco-friendly production (especially organic). Given the strong bargaining power of well-organized producers and their more direct access to consumers, the added value is fairly distributed along the supply chain. A variety of retail brands exist to respond to the very specific demands of consumers. The market share of the big five national retail brands falls down to roughly 40%.

Concerning aquaculture, it moves towards plant-based feeds originating from sustainable agriculture and is cultivating native species in open water systems (with an efficient management of effluents) for a production that does not threaten human health (avoiding the use of antibiotics for example).

An important part of the research and innovation system is oriented towards agroecology and well-funded, mostly by public money. Action research, were researchers collaborate with producers' organizations is widespread, providing locally adapted solutions but also general solutions at the system level. In parallel, another part of the research and innovation system is oriented towards optimizing certain products and commodities. It is driven by public as well as private funds and research centres. Public-private collaborations are also common. The public sector plays an active role in orienting the European agri-food system towards more sustainability, heavily funding research oriented towards agro-ecology and regulating imports based on sustainability criteria.

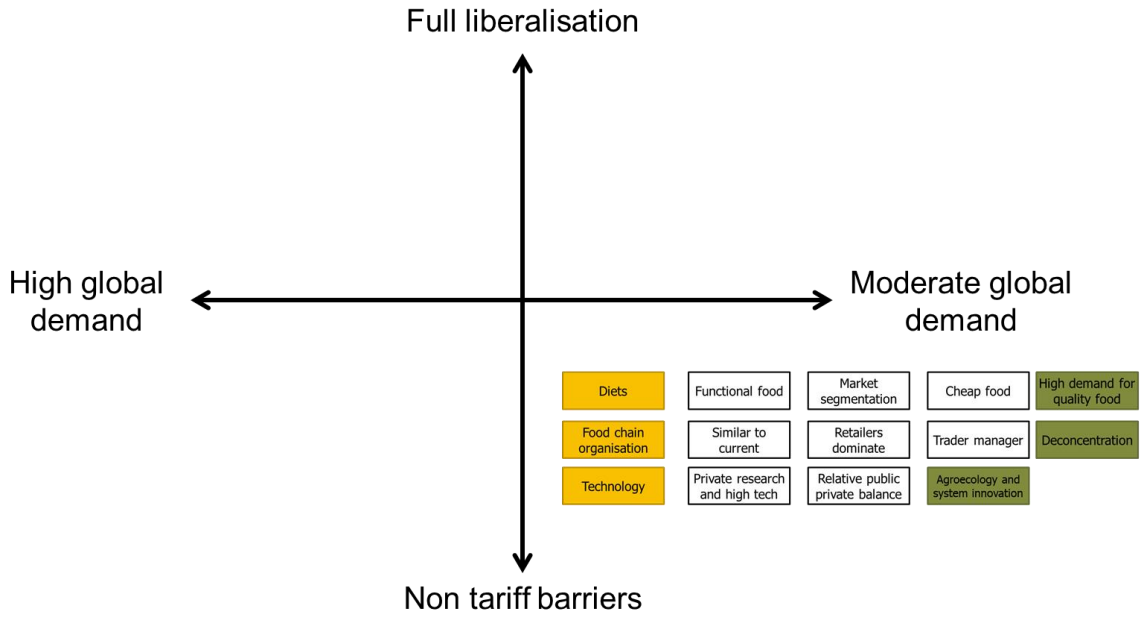


Figure 24: Illustration of the narrative "Ecologization"

4.3.2 Changes in conditions at farm gate

- Demand: under this configuration, the demand for high quality and environmentally friendly agricultural products grows significantly.
- Market access: farmers access these new markets by complying to a number of quality and sustainability (both environmental and social) criteria.

- Price levels / volatility: prices paid to agricultural producers are usually higher. Volatility is much less an issue, as producers have access to local / national markets and depend less on international markets.
- Technological: given the relatively well funded public and private research on agroecological practices, farmers have access to innovation; whether they are able to afford it depends on the nature of agroecological practices (low tech or high tech).
- Regulation and policy: environmental regulations imposed to farmers are stronger in this configuration.
- Ecological / environmental: farmers benefit from the restoration of natural resources essential to produce food.
- Socio-demographic: restoration of the faith of consumers in farming practices, and re-valorization of the work achieved by farmers.

4.3.3 Effects on the strategies of producers

Under this scenario, current "alternative" strategies, characterized by a moderate to high level of diversity of productions at the farm level and a multifunctional approach to agriculture, including rural development issues, could be strongly favoured given the evolution of the context: high consumer's demands for high quality product; innovation system centred on agroecological practices and multi-functional agriculture; relative "market protection" vis-à-vis international competitors thanks to new non-tariff barriers, which in turn decreases the pressure for price competitiveness, etc.. On the other hand, agro-industrial strategies seeking precisely to achieve a certain level of international competitiveness at the expense of the environmental and rural development, that today dominate (see 2.1), could become way less attractive. For producers already engaged in such strategies, there can be important locks-in limiting the possibility of conversion and calling for the deployment of strategies pertaining to the "coping with farm decline" cluster (see 1.1.2).

4.3.4 Key sustainability issues and possible solutions to address them

Under this scenario, five of the 12 sustainability themes could be concerned. They pertain to all the three boxes identified (socio-economy of the farm, environment, societal aspects) and read as follows:

- Socio-economy of farms: 1) risk on incomes due to difficulties to commercialize higher quality products; 2) barriers to entrepreneurship due to (i) investment and labour needs for transitioning towards agroecological practices, (ii) highly technical aspects of agroecological systems and (iii) impossibility for some farmers locked into conventional farming practices to transition;
- Environment: 3) environmental impacts are likely to decrease at both farm and landscape level;
- Societal aspects: 4) food security issues; 5) macro-economic issues related to a progressive decrease in agri-food exportations.

Risk on income linked to commercialization issues

As under this narrative a significant number of farmers are likely to increase the environmental quality of their products to respond to a growing demand, and with the aim of raising the added value of their production, they will nevertheless have to develop new marketing channels to do so.

While direct sales systems through traditional markets or through the internet managed by producers themselves could find outlets in urban or peri-urban areas, they will not be sufficient to dispose of the whole production. **The support of local governments to develop further existing short food chains** (Augère-Granier, 2016) as well as **green public procurement systems** – despite the many difficulties that exist today (Neto *et al.*, 2016) – will be essential in this respect. In addition to relying on these short supply chains, **producers' organizations** could also be strengthened along with cooperative systems, through a renewed support from the part of public authorities, in the wake of recent discussions (Agricultural Market Task Force, 2016, p. 42).

For farmers, taking part in such organizations will also a be way to exchange best practices (see below), solutions, services and equipment's to better respond to consumers' demands for always better environmental, animal welfare and health standards.

Increased investment needs, in infrastructures, equipment and knowledge

Under this scenario, at the farm level, the main issue will be the increased investment needs for the development of ecological systems (trees, hedges, new crops, livestock…), new equipment (adapted to the growing of new crops and livestock infrastructures) and access to knowledge. The financing of those investment needs could come from both public and private sources. However, while the **coming of external / private investors in the agricultural sector** is a significant trend in today's agriculture in Europe, these latest have rather directed their attention to highly specialized and large structures, rather than diversified and multifunctional ones. Hence, it seems unlikely that financial instruments relying on private investors could be sufficient to cover investment needs under this scenario. This means that **public subsidies dedicated to specific investments will be essential to support farmers in such a transition process**. The logic of such subsidies would be different than the one which is behind existing pillar II measures. They will indeed not intend to compensate for the extra production cost associated to eco-friendly practices – as the demand for high quality products will grow strongly, leading to higher price allowing farmers to cover their production costs. On the contrary, their main aim will be to accompany costly investments. Given the different views and opinions among European Member States, such a support to agroecological transition in Europe will have little chances to happen if European countries do not converge on a common vision for the allocation of subsidies. In addition, there will be a need to dedicate substantial thoughts to reframing both the amount and the allocation process of public subsidies, in order to make sure that these latest (i) go to the people actually investing in agroecological infrastructures, equipment and workforce; (ii) cover the real investment needs, particularly in the case where agroecological farming would be costlier than anticipated (for instance, high-tech agroecology with expensive weed management equipment).

Need for additional labour force and knowledge

Another important issue at the farm level will be the need for knowledge and additional workforce (particularly in the case where agroecological farming will be based on low tech). **Investing in training programs on the farm and beyond the borders of the farm** will be highly needed, considering the rural exodus and the ageing of the farm workforce, as well as better adapted subsidies such as **subsidies per worker** (instead of subsidies per hectare). **Extension services will need to be strengthen and reorganized** in order to be able to accompany such a shift in production systems (Dockes *et al.*, 2011). More specifically, the privatization trend that has characterized the last decade will need to be reversed, or advisory companies trained themselves, if small scale produc-

ers are to be well accompanied under the scenario. As Labarthe & Laurent have well demonstrated (2013), this privatisation has led small farms to be less considered and even, to some extent, left aside by advisory companies. One way to manage this situation would also be to rely more on **stronger producers' organization and institutes** (such as the local CIVAM in France), able to provide their members with technical advice, machinery and labour. Providing these organizations with the possibility to establish **partnerships with research institutes** (such as in the framework of the PEI-AGRI) will also be essential.

Transition beyond the reach of a number of farmers

Although public support to help farmers become more sustainable will be essential, transition to more sustainable agriculture will probably be out of the reach of a number of farmers in Europe (for instance, the ones who have invested heavily in agroindustrial farms). Solutions need to be found to **help** these **farmers exit the sector** (early retirement policies could be developed and extended to more countries than it is actually the case, see (Davis *et al.*, 2009), rural employment policies favouring reconversion could also play a role) and **transmit their assets**: while land could be transmitted to new farmers, the issue of agroindustrial equipment will be more difficult to address (especially in livestock intensive areas such as Britain: new models to be found such as reproducing farms feeding the livestock farms more evenly distributed across the territory? new activities within the buildings? etc.).

Food security issues

Beyond the farm gate, an issue that might rise under this narrative could be a decrease in the European food production, which might be an issue for food security in Europe. Policies supporting the nutritional transition towards less animal-based protein diets could be a way to decrease the needs and make the offer better balanced with the demand. This could be influenced by **nutritional campaigns and consumer education** or even more effectively via financial incentives on some products compared to others. Furthermore, access to quality food will depend on the existence of **subsidies or food programs for low-income households**. This raises the question whether such an issue could be addressed via separate sectoral approaches or if it requires, as advocated by some, the development of a fully integrated agri-food policy (iPES Food, 2017b).

4.3.5 Overall impact of the scenario

Under this scenario, impacts are likely to be as follows.

Socio-economic impacts at the farm level could be quite positive, but this would require the implementation of a number of measures. First, efforts need to be invested in the development of outlets and short to medium food chains. Specific subsidies to accompany investments in the development of ecological systems will also be needed, as well as a strengthening / reinforcement of agricultural extension services in order to accompany the transition.

From an environmental point of view, the scenario will deliver high benefits to both farmers and the whole society.

From a broader societal perspective, rural areas are likely to be vibrant and attractive in terms of quality of life, employment and tourism. New jobs could be created in the agricultural sector but also in the rest of the food chain (advice, start-ups for direct marketing etc.). Health risks should be minimal under this configuration. However, consumer prices are relatively high compared to the other configurations. This makes access to quality food more difficult for modest households.

From a transition management perspective, this scenario is characterized by a high pressure on the dominant socio-technical regime coming from broader changes in norms, institutions and beliefs in the landscape. This first allows existing niches to grow, and to progressively reconfigure the whole dominant regime. While it is highly unlikely that by 2030 the current dominant regime could have fundamentally shifted towards multi-functional and eco-friendly agriculture, this scenario brings about structural changes that could well support a profound redesign of the whole agrifood system by 2050.

4.4 Scenario 4: Dualization

4.4.1 The narrative

In 2030, under this configuration, global markets are liberalized and European agri-food actors are competing with new global players from emerging countries, often more competitive. At the same time, the global demand for food is moderate, which limits the opportunities of European actors to increase their value added on global markets.

The European market for agricultural products is highly segmented. Retailers offer a great variety of products from low-quality, discount food to high-quality, certified products that they sell for a higher price, sometimes within the same store sometimes via specialized subsidiaries. Segmentation is high within retail groups but also across retail groups. One of the 5 big European retail brands has specialized in discount products, whereas another one has sold its discount subsidiaries to specialize on high-quality, certified products, merging with and buying off small specialized retail chains. This process of mergers and acquisitions is consolidating the oligopolistic structure of the European retail sector and strengthens the bargain power of the retail sector within the food chain. This allows the retail sector to sort of “dictate” the prices payed to the producer even more than today. Its dominant position within the food chain also allows the retail sector to influence agricultural practices to some extent. Given the strong presence and high number of labels, an important amount of producers adapts their practices to the requirements of more or less heavy certification processes.

The high market segmentation corresponds to a highly fragmented consumers’ demand. Consumption patterns are strongly individualized but the overall demand for quality food is high and continues to grow. At the same time, demand for discount products is also high. Consumption patterns differ widely, along factors like level of education, income, place of residence, political orientation and age. The share of the budget spent on food as a share of the overall household budget varies between 10 and 16 %. The market share of organic products is around 14%.

There are many labels that address specific consumer demands, some covering demands for high ethical standards for animal welfare, some covering environmental concerns and others guaranteeing a fair price and fair working conditions for producers. Labels combining several of these concerns also developed. Consumers’ trust in agricultural products and in the different labels is a frequently debated issue.

NGOs recognize retailers as important market players and push the segmentation even further by continuously asking for higher standards. In a fully liberalized market where public norms are low, they focus on pushing for ambitious private norms. They play an important role in scrutinizing certification processes. More notably, the demand for so called “super-labels” is on the rise. These

labels integrate most of these concerns in one harmonized certification process. They are developed in a partnership between big retail brands and NGOs like WWF. The fact that they are backed by an NGO raises the trust in the quality of the product which is why the demand for these "super-labels" is high although they come with a certain price.

In such a narrative, the power balance within the food chain is clearly in favour of the downstream sector, and more particularly of the retail sector, with the big five retail brands holding 70 % of the market share. The retail sector itself is largely dominated by the biggest five retail brands in each country. Big retail brands are competing against each other not only nationally but also across Europe. French and German retail chains have been particularly successful in expanding their business to other Member States. The competition between retailers in the new Member States is fierce especially among the ones who decided not to segment their offer towards more quality products but specialize on discount products. Afraid of losing their clientele in the old Member States where demand for discount products is declining, these retailers seek new consumers in other regions. Some retailers pursue a strategy of commodification and internationalizing their sources of supply whereas others are relocalizing their supply chains.

European producers are competing with each other on the single market. With big holdings in Eastern European countries who are producing with low labour costs, producers from old Member States focus more on producing quality food. This has also consequences in terms of the unequal distribution of environmental degradation.

The research and innovation system is balanced between public and private investments. R&D is mostly focused on improving products rather than innovating at the system level, although there is an important niche of research that is oriented towards agroecology – mostly funded by the dedicated public research fund at the EU level called "innovation for agroecology". Moreover, some European countries also have national research funds for research projects oriented towards agroecology, with France and Italy being the leaders. Digitalization is an important part of R&D in the agroecology as well as the mainstream research system. The Netherlands are a leader in providing solutions linked to big data and precision agriculture.

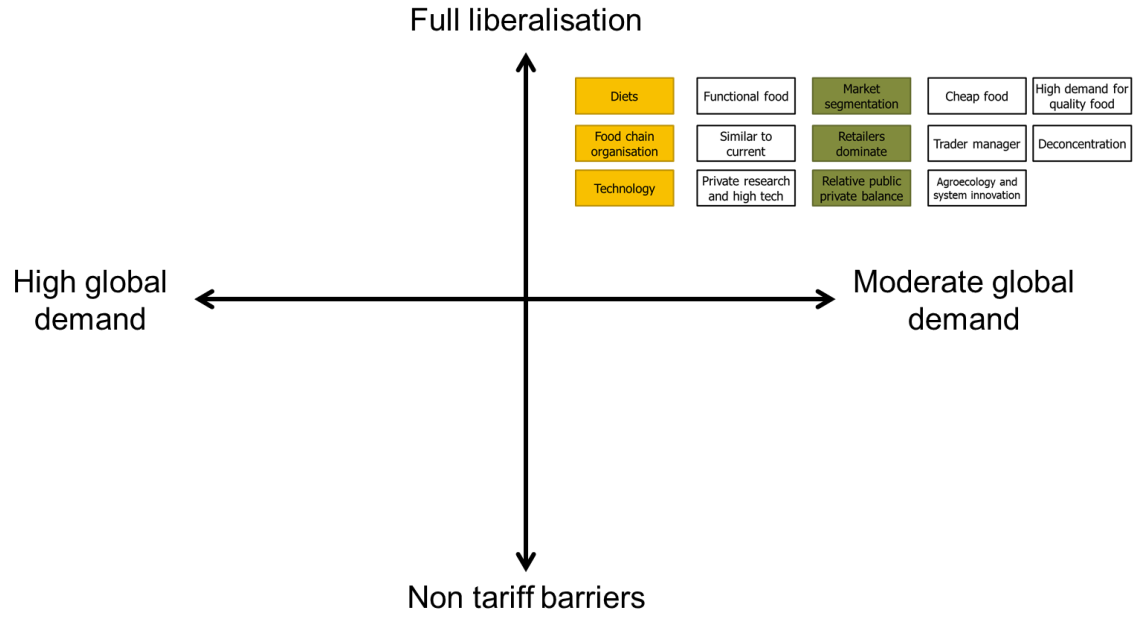


Figure 25: Illustration of the narrative "Dualization"

4.4.2 Potential changes in conditions at the farm gate

- Demand: given the high market segmentation, farmers have the choice to turn either to high quality food markets, often associated with shorter food chains, or to commodity markets;
- Market access: the conditions in terms of market access depends on the above-stated choice of farmers: the ones turning to agricultural commodities markets will access these markets on the condition to be competitive; farmers turning to high quality food markets will access these markets upon quality and sustainability criteria;
- Price levels / volatility: farmers turning to low quality markets will face increased competition from abroad and be subjected to the volatility of price levels on international markets, with increased risks given the low international demand;
- Factor access (land, labour, finance): for farmers turning to markets facing competition from abroad, the most difficult factors to access will be land and finance; for the other farmers, it will be labour;
- Technological: given the balance between public and private research funding and the growing niche of agroecological research, farmers of both categories generally have access to innovations corresponding to their production mode;
- Regulation and policy: environmental regulations are kept at their minimum level, with the dominance of private norms and standards;

4.4.3 Effects on the strategies of producers

This narrative might be the one reflecting the most present trends observed in agriculture, as presented in section 2. In this dual agricultural system, producers can seek added value either by quantity, by quality or by developing a hybrid model, based on a strategy that is decided at the farm level but embedded in specific territorial configuration. Market conditions, logistical aspects

(harbour, transportation facilities or not…), labour costs, arrangements between producers and other factors within a region, influence the choice of one of the thee strategies.

Agro-industrial strategies seeking to increase competitiveness are followed through an increase in farms size, economies of scale, a shift from labour to capital and an increase in land and work productivity, would not be at threat in this scenario. They could combine also with:

- a reduction of expenses (either for the only benefit of profit maximization and/or for the benefit of quality);
- the development or reinforcement of other farm functionalities or activities (rural tourism, multi-activity, subcontracting, production of energy or valorization of by-products).

On the one hand, farmers already engaged in an enlargement, intensification and specialization development pathway (sometimes combined with cost reduction and by-products valorization) are likely to continue the same way, as the demand for undifferentiated, cheap, raw material remains high, both on the internal and on the export market. On the other hand, the growing segmentation of food markets and the growing demand for quality products by wealthiest consumers allow farmers that are already engaged in "alternative" production systems to consolidate their business in most cases, but also open opportunities for some conversions to organic farming or quality production. The most standardized quality production could possibly be carried out by bigger agricultural structures, sometimes through full delegation to subcontractors.

4.4.4 Key sustainability issues and possible solutions to address them

Sustainability issues pertaining to the continuation of productivist or agro-industrial strategies will remain important in this scenario, as well as those related to the development of diversification / alternative ones. We will however not address them in details here as they have already been discussed in section 4.1.4 and 4.3.4 respectively. There are however other aspects that are specific to this narrative which will need to be handled. We will specifically focus on four sustainability aspects:

- On the socio-economic impacts at farm level: 1) there are risks incurred for small scale / eco-friendly producers (in terms of both income and access to production factor / entrepreneurship capacities) due to their spatial and political coexistence with agro-industrial ones; 2) there are income issues for eco-friendly producers that relate to the potential internal competition between them (seeking to meet the stratified solvent demand for quality food); 3) entrepreneurship capacity of some small scale farmers engaged in conventional productions and unable either to transition towards eco-friendly approaches or to gain in competitiveness to compete on the international market will be at risk;
- On the environment: see 4.1.4
- On societal aspects: the growing segmentation of the agrifood market implies that poorest categories of the population are likely to eat low quality food from both a nutritional and sanitary perspective; hence the need to favour access to quality food among poorest and less educated consumers.

Establishing the links between farm strategies and potential impacts is especially challenging under this configuration since impacts are likely to vary a lot. Farms pursue different strategies and what the real impact of these strategies will be will strongly depend on what public policies will focus on. This configuration could be considered as a moment of transition in which clear signals

are expected from public policies to encourage a development of the agro-food system in one direction rather than the other.

Handling the coexistence of segmented forms of agriculture

The existence of two-tier agriculture and the coexistence of models can lead to frictions that might be difficult to solve (Sonnino & Marsden, 2006). If we take the example of the collective use of material and infrastructures (shared equipment, regional slaughterhouse, milk collection services, etc.): their present organization could lead to difficulties for small-scale farming if they are not re-designed in a more integrative way (leading either to dual infrastructures or to the establishment of infrastructures taking into account small-scale farming constraints). To address these potential difficulties brought by the coexistence of two types of agriculture, designing regional tools (regional slaughterhouses, medium scale processing manufactures and industries, shared equipment adapted to different levels of motorization…) adapted to both types of agriculture might become a challenge that could be faced through **a growing involvement of local governments, in partnership with private sector actors** (both in terms of financing and implementation).
Local governments have long been asked to take on a growing role in food systems functioning. While many of them have expressed the desire to do so, they currently often lack technical skills and human and financial resources, and the regulation framework is not that favourable to them. The likelihood for such solutions to fully develop will thus depend on both the evolution of the regulatory framework and on the interest of local governments.

The existence of different models dealing with different food chain distances and levels of standardization could also lead to specifications and regulations that are formulated in a flexible way (depending on food channels and/or food transportation distance for example). Designing standardization and specifications at different levels (taking both local supply chains and long distance chains into account) imply a strong level of dialogue at different scale, both geographically and at the institutional level.

With a reinforcement of farm concentration, distant farms progressively merging and legal framework for farming shifting towards the more mainstream framework of companies, land regulation and protection for land users tends to be reduced in different Member States. According to specific land situations in Member States, access to land will mainly depend on access to farm leases or access to land property. Changes in the land market legal framework towards a r**einforcement of land regulation on environmentally sensitive areas, more support to land acquisitions for small-scale farming around major consumption areas** would be essential tools to limit the exiting of small scale and eco-friendly / multi-functional producers – if there is still a wish to do so by 2030. This is at least what has been called for recently by the European Parliament (PE, 2017) and aligned with the reservation expressed by the European Commission in its communication of October 18th.
At this stage, European analyses mainly concern land market though, whereas land use shifts mainly result from land leases transfers in many Member States. **Harmonizing land regulations by aligning tools and institutions concerning access to leases, access to land shares and access to land property (without disturbing too profoundly the institutional landscape of land regulation) would be important solutions to explore further.**

Managing the way out of agriculture for small-scale farmers involved in mainstream production

In this scenario, some small-scale farmers will take the turn on quality production and multi-functional farming whereas some others will not be able to, leading to farmers leaving their farming activity. This process of farmers' eviction has been effective for a long time, but the possibilities for farmers leaving agriculture to start another activity are different nowadays (in a context of structural unemployment) than during the post-war boom period (and its context of full employment). Farmers will therefore have to be supported (economically, technically and socially) both to close down their farm business and to find a new activity, through for example **early retirement schemes.** Examples of such support already exist in some European areas and could be strengthened (see Davis *et al.*, 2009).

Thwarting potential internal competition between eco-friendly producers

In this narrative, producers globally do not have a significant influence on the price set within the different market channels. The price is very much set by the retail sector that dominates the food chain. The bargain power of farmers is very low. With producers being price takers, the prices paid to producers will keep on following their downward trend, especially for low quality products. Prices paid for high quality products are relatively higher, but could also face internal competition between eco-friendly producers, leading to a price decrease or difficulties for the production to be sold. The potential reinforcement of competition among small-scale famers could be driving down prices on quality products and reducing the economic attraction that the engagement in quality initiatives represent. If we take the example of the organic farming label: competition on organic products could lead to social practices that might neglect certain dimensions of sustainable development and/or lead to political pressure to modify its present specifications (which can, in turn, potentially erode the reliability of the label and generate a degradation of the whole organic products sector). In addition, the increase in the demand for quality products does not mechanically imply an increase in the offer at the European level, as a number of barriers can obstruct the offer, such as: the configuration of the market, access to land for new entrants (as already evoked) and/or the financial, technical and organizational security offered to producers wishing to start quality and eco-friendly production. Presently, the situation of the market for organic products paradoxically results from a dependence on non-EU countries to cover demand (which can lead to long-distance importation which is inconsistent with the idea of eco-friendly production). In order to avoid substitution by importation for quality production and to support the development of eco-friendly farming at the domestic level, those barriers have to be mitigated by policies both helping to diminish those barriers for quality production increase (and potential internal competition among eco-friendly producers) and by assuring access to quality production. **The investment by local governments in specific infrastructures dedicated to local supply chains combined with the generalization of public procurement could help avoiding competition among small-scale farmers.** However, a more affirmative role of local authorities in local food systems implies both legal frames adaptations and coherent budgets along strengthened subsidiarity.

Addressing the issue of quality food access disparities

The most worrying consequence of this configuration is its negative impacts on the equal access to quality food for consumers. Hence, negative impacts on health risk to be unequally distributed, with obesity and mortality rates from non-communicable diseases being particularly elevated

among poor and uneducated consumers. To what extent the access to quality food will be unequal will also depend on the nature and the ambition of public policies. Nutrition and educational campaigns and more transparent and accessible information could be one approach. Many other policies could be led or reinforced: limiting the impacts of housing rents to favour access to quality food consumption, food programs for low-income households, public procurement schemes for schools (associated with cooking programs for example), strengthening the European Food and Nutrition Action Plan and promoting cooperation between health, agriculture and industry ministries.

4.4.5 Overall impact of the scenario

The overall impact of this scenario on environment and rurality shares some common features with the competition narrative in geographical places where eco-friendly production will not easily settle (potentially mainly on most productive and easily mechanized lands). The most important issues that will need to be faced concern both disparities in rural dynamics (depending on the possibilities for farming activities to be kept) and disparities in food nutrition among the population.
In the light of sustainable transition studies, the scenario presents two main features:

- on the one hand, alternative strategies tend to develop, which correspond to a development of the "niche" – though far from the level at which it could destabilize the dominant regime.
- on the other hand, the dominant socio-technical regime remains almost unchanged, due to the fact that evolutions in the overall socio-technical landscape are not strong enough to put pressures on actors of the regime.

5 Discussion and conclusion: on solutions and their relevance in a variety of situations… and ways forward

This last section build upon a recapitulative matrix putting together each scenario (in column) with the different solutions identified, some of which being used in several scenarios, some in only one. This allows to discuss scenarios (in section 5.1) and solutions (section 5.2) in a comparative manner. The section and the report concludes by a reflexion on the main limits of this preliminary work and presents how the next steps will allow to address these latest.

5.1 On scenarios

A comparative analysis of the four scenarios can be carried out by reading the columns of Table 4. One comment and three results can be drawn from this analysis.
The comment relates to the significant number of sustainability solutions we have developed in each narrative, but also to the fact that these solutions differ quite notably from one scenario to the other (except between Competition and Europeanization). This well illustrates two facts. One is that each food system narrative encapsulates specific sustainability issues; the other is that under each narrative, specific power relationships develop between actors, which make some solutions more likely to be implemented than others, even if the solutions that are unlikely to be adopted would be highly desirable from a purely sustainability point of view. As a consequence, each narrative *frames* to a certain extent the level of sustainability that it will be possible to reach in the end. In this perspective, our food system narratives play a role that is similar to the one

played by the shared socio-economic pathways, although we built them using a forecasting rather than a backcasting approach.

Regarding the results – that pertain to the level of sustainability than can be reached under each narrative – three out of our four scenarios are based mostly on current trends regarding the five structuring variables we used (trade, demand, diets, food chains, technology): Competition, Dualization, and Europeanization (this latest though implying the adoption of stringent non-tariff barriers, reversing an ongoing trend). On the opposite, the Ecologization scenario is a breaking scenario that involves the reversal of the ongoing trend of most variables – except the one of global demand. With that in mind, the comparison of the four scenarios allow to yield three highly preliminary and qualitative results which we would nevertheless like to share here:

1. In the three scenarios we built by prolonging current trends, the level of sustainability reached by 2030 is low on average. Of course, all scenarios imply trade-offs between the three dimensions we distinguished (socio-economy of the farm, environment, societal aspects). But in all three scenarios, producers' strategies continue to be mainly oriented towards agro-industrial and productivist approaches; and it proves hard to "correct" the negative externalities such strategies generate, both from an environmental and from a societal point of view. Even from a farmer perspective, the economic viability of the farm continues to depend on different tools and financial instruments; and the nature itself of the farm business could well radically change by 2030 if the level of capital intensity continues to increase along the concentration-specialization-intensification trend.

Table 4: scenarios and their associated solutions (source: authors)

		Scenarios (relevance of each solution in each scenario)			
Issues	Solutions	Competition	Europeanization	Ecologization	Dualization
Income (and lively country-side)	Increase the role of local governments in food systems development and management			+	++
Income	Green public procurement			+	+
Income	Develop / strengthen producer organisations	++	+	++	++
Income	Develop interbranch organisation and vertical coordination through contractualization		++	++	+
Income	Social & fiscal norms harmonization in the agricultural and fisheries sectors to limit competition distortion between MS		++		
Entrepreneurship	Increased land regulation				++
Entrepreneurship	Opening the agricultural sector to financial actors (both public and private) to facilitate investments / modernisation + regulate those investments	++	+		+
Entrepreneurship	Public subsidies to support eco-friendly investments		+	++	+
Entrepreneurship	Early retirement systems / asset-transmission tools	+	+	+	+
Entrepreneurship	Strengthening / reinforcing extension services			++	+
Resilience	Insurance schemes	+	++		++
Resilience	Income stabilisation tools	++	+		+
Environment	Maintain / develop subsidies in support of multi-functional agriculture and fisheries	++	++		++
Environment	Increased environmental conditionality to strengthen environmental performances of farms	++	++		++
TOTAL number of solutions	14	7	10	7	13

2. The number of solutions needed to reach a certain level of sustainability is maximal under the Dualization scenario, which is also the closest to a Business-as-Usual scenario. This is a direct consequence of the fact that dominant and alternative strategies not only co-exist on territories, but also compete with each other for the access to most production factors (and especially land and subsidies). As such, three types of solutions are needed under this scenario: those aiming at increasing the sustainability of productivist strategies; those aiming at increasing the sustainability of alternative strategies; and those needed to manage the competition between the two, to make sure that they will both keep on existing – as it is and will probably remain an explicit objective of the Commission.
3. Putting the Ecologization scenario in perspective with the three other scenarios well illustrates a fundamental result of transition management studies: it shows that for alternative (and possibly more sustainable) strategies to become dominant (or quasi dominant) and alter the dominant socio-technical regime, what is needed is much more than changes in sectoral / agricultural and fisheries policies: without radical changes in consumer behaviours, trade policies and research policies, those strategies could possibly develop thanks to voluntarist policies, but not at the level they reach in the Ecologization scenario.

5.2 On solutions

Focusing on the rows of Table 4 enables to highlight different and complementary points, which can be stated as follows:

1. None of the solutions proposed in this document is totally new. Although additional efforts could have been done to imagine entirely new solutions, it is also worth mentioning that in the scenario development process, each time we identified a sustainability issue for which a solution was needed, we were able to find either a report proposing something close to what we were looking for, or even an existing measure that is, as of today, not widely implemented or still at an early stage of development for numerous reasons. In our view, this mainly points to the fact that over the three last decades, decision makers have mostly tried to accommodate the demand of heterogeneous and often competing visions expressed by numerous stakeholders engaged in the European agriculture sector, rather than assuming a clear orientation towards one or the other direction. As a result, the agricultural sector is today endowed with many policy tools and measures, each tailored to a specific issue, but which together do not form "a" policy, as they more than often contradict each other[21].
2. Amongst the 14 solutions identified during the scenario building process, some are used in all scenarios. They concern support to producers' organisations, measures to manage the way out of producers not able to achieve the changes needed to maintain their activity, and the opening of the agricultural and fisheries sectors to external financial actors. This relates to the

[21] The example of food chain organisation well illustrates this point. At the moment, two types of policy measures co-exist in the EU. On the one hand, some instruments, more particularly FTA, aim at increasing the volumes exported by the EU agrifood sector; on the other hand, other types of instrument intend to favour the development of short food chains or local food systems, as they are supposed to provide multiple benefits to farmers and citizens alike. It is often said that the co-existence of different policy tools is a way to nurture the diversity of the European agricultural system. However, such a statement might well miss at least three important aspects. One is the fact that the so-called "alternative" and "conventional" producers strategies not only co-exist, but also compete for acceding production factors (Sonnino & Marsden, 2006). A second one is that the different existing measures are not endowed with the same amount of resources, leading to structural imbalances in the support of one or the other strategy (e.g. the CAP second pillar budget has never exceeded 25 % of the overall CAP budget). Last but not least, as Knickel et al. have well shown, "the concentration of production and wealth in some regions, […] is directly linked with the marginalisation of other regions and farms" (2017, p. 3).

evolutions that are likely to apply in all scenarios, whatever the narratives we consider: the need to reverse fundamental power asymmetries in food chains; the fact that the agricultural sector is changing quickly – whatever the direction it will eventually take – and that following and adapting to those changes is often costly; and finally, what is today considered as a heavy trend but which could well reverse within the next 5 years: given the fact that public funds will continue to decrease and given the high level of capital intensity of the agricultural sector, external financial actors will be needed to ensure the reproduction of the system.

3. Conversely, some of the solutions we mentioned are implemented in only one or two scenarios. This is the case of measures pertaining to land market regulation, social and fiscal harmonization, and the strengthening of extension services. One should not understand here that such policy measures could only be relevant in the scenario in which they are mentioned. There are good reasons to think that whatever the narrative, such measures could yield interesting benefits for farmers and citizens. However, in the scenario development process, these solutions emerged as both relevant and potentially adoptable – given the social configuration implied by each narrative – only in one or two scenarios. One should note that they all pertain to domains that are as of today managed at the Member State level, where the Commission has no prerogative.

5.3 Limits of this preliminary screening and way forward

This report must be taken for what it is: a preliminary analysis of solutions and scenarios, which will feed a one-year process of refinement through participative workshops at territorial, national and European levels. In order to get out as much as possible from the subsequent steps, it is worth reflecting on the main limits of the work already achieved. We would like to discuss three of them and then propose how we intend to address them in the coming months.

1. A first limit of these preliminary scenarios is that they do not sufficiently take into account what is going on in other main agricultural regions: what is likely to happen abroad that could affect the European agriculture (e.g. the US embargo on soybean in 1973 and its impact on European agriculture)? Conversely, to what extent each scenario could affect world agricultural markets and agricultural sectors in other areas of the world (in a context where development NGOs often blame the CAP for its adverse effects on African agriculture for example)?
2. A second limit pertains to the level of details of the analysis of solutions. We remained very general although each solution could have deserved several pages of analysis and discussion on its own, regarding the mechanism lying behind its implementation which would impede its efficiency, the diverging views that today co-exist amongst European stakeholders that could influence whether or not it could be adopted, etc. At this stage however, our aim was rather to be able to present “the big picture”, that is to be able to situate each solution vis-à-vis (i) the kind of context in which it could be the most useful and relevant and (ii) the ways in which it could be combined with other types of solutions to contribute to raise the level of sustainability.
3. A third limit relates to the very general view we adopted to describe the food system narratives, the potential impacts they could have on producers’ conditions and the types of strategies it is likely to favour, and the way in which different solutions could bring about positive changes. We did not distinguish between geographies, sectors and types of farms, although for all these aspects, there will be different evolutions in Western and Eastern European coun-

tries, for the dairy sectors and for arable crop farmers, for mixed farming systems and for ultra-specialized systems…

In the course of 2018, we intend to address at least partly some of those limits in three main ways:

1. We will first carry out participative workshops in extremely diverse settings to refine these scenarios. Each workshop will shed light on the specificities of a sector and / or a territory, which we will then be able to use to finalize scenarios; this will also enable us to identify solutions we have not yet identified in this preliminary analysis.
2. We will also be able to mobilize new empirical data gathered under the WP2 of the SUFISA projects, most notably the Condition-Strategy-Performance inventory and the producer survey. This will give us a much more precise idea of how changing conditions are likely to affect strategies in a wide variety of situation;
3. Last but not least, we will carry out a series of interview and literature review to better understand how the 14 solutions we identified could effectively be adopted, implemented, and be impactful.

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