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EUROPEAN FORUM ON NATURE CONSERVATION AND PASTORALISM

Contributing to the European debate on agriculture and environment: relevance and challenges of an agroecological scenario approach

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Acknowledgements

We thank Guy Beaufoy for his smart reading and fruitful comments. He considerably helped in the improvement of this document, including editing.

List of acronyms

AE: Agroecology

BAU: Business As Usual (scenario)

HNV: High Nature Value

NGO: Non Governmental Organisation

SI: Sustainable intensification

TYFA: Ten Years For Agroecology

UAA: Usable Agricultural Area

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1.1 Addressing the challenges of agriculture and environment in Europe: agroecology as the best candidate

The impact of agriculture on environmental resources in Europe has been analysed for decades (Baldock & Beaufoy, 1992). The recent history of the agri-environment issues — from the 80's — shows a clear evolution in the way of setting the problems. In the 80's-90's, the issue was to put environment on the agricultural agenda and propose tools able to "solve the problem", through incentive (agri-environmental payments) and/or regulations (notably the nitrate directive and, later on, the water framework directive and cross-compliance). After decades of stagnation in terms of progress, it has made been clear that the issue was not only to adapt practices, but to propose a new paradigm for agriculture, compared to the "conventional" productionist one.

Two main candidate paradigms can be identified. The first one is "sustainable intensification". It stands on the idea of "*simultaneously improving the productivity and environmental management of agricultural land*", (Buckwell (dir) 2014) while in practice it is unclear what is the balance between the two goals; SI might cover a wide range of situations. However, a key idea of sustainable intensification is to propose environmental management rising standards compatible with the present organisation of agribusiness and the continuation of high levels of production. The question is whether this objective is consistent with a demanding environmental agenda: beyond resource efficiency, how can sustainable intensification address altogether biodiversity, the impact of pesticides on environment, antibiotics and the major challenge of increasing carbon storage in soils? to quote only some of the issues arising from some forms of intensification.

The second paradigm for change is agroecology. This concept started in the 1970's, with Miguel Altieri's work in Central America. Compared to the sustainable intensification, it proposes a more comprehensive approach and encompasses social, economic and organisational changes. One of its strengths is to combine technical aspects — notably the use of local semi-natural resources and local knowledge — with social ones. It acknowledges that technical issues are central - while they are the material link between our environment and our societies -, but that they need to be put in a wider frame. This allows a socio-technical perspective for thinking through the needed changes, which sustainable intensification tends to omit, notably because it keeps the existing socio-economic organisation unchanged.

Box 1: The principles of agroecology

The following principles are those set out in the project 'Agro-Ecological Innovation' of the IFOAM EU Group, TP Organics and ARC2020. They are based on (Stassart, et al., 2012)

"*As the definition of agroecology is rather wide, a better understanding of the concept can be obtained by exploring the principles that guide researchers, practitioners and social actors active in the field of agro-ecology. The following list proposes such a set of principles, however not to be understood as a closed framework.*

- *Recycle biomass, optimise and close nutrient cycles.*
- *Improve soil conditions. This means in particular improving organic matter content and biological activity of the soil.*
- *Reduce dependence on external, synthetic inputs.*
- *Minimise resource losses (solar radiation, soil, water, air) by managing the micro-climate, increasing soil cover, water harvesting...*
- *Promote and conserve the genetic diversity of crops and animals.*
- *Enhance positive interactions between the different elements of agro-ecosystems, by (re-) connecting crop and animal production, designing agro-forestry systems, using push-and-pull strategies for pest control...*
- *Integrate protection of biodiversity with production of food.*
- *Integrate short-term and long-term considerations in decision-making. Aim at optimal yields rather than maximum yields. Value resilience and adaptability.*
- *Contribute to the transition towards sustainable agriculture and food systems. Identify lock-ins that impede this transition and propose pathways to unlock them. Propose new governance structures that support innovative niches of sustainability.*
- *Acknowledge the similarities and linkages between agricultural systems in the global North and South. The North can learn from agro-ecological experiences in the South and vice versa. Because of the increasing globalisation, the transition towards sustainable food systems asks for integrated and simultaneous solutions in North and South.*
- *Investigate existing power relations, decision-making processes and opportunities for participation in food systems. Investigate the role of citizens and consumers in food systems.*
- *Valorise the diversity of knowledge (local / traditional know-how and practices, common knowledge and expert knowledge) in the definition of research problems, the definition of people concerned, and in finding solutions.*
- *Promote participatory research driven by the needs of society and practitioners, while at the same time guaranteeing scientific rigor.*
- *Develop knowledge and innovation systems that conserve and allow exchange of agro- ecological knowledge. Special attention should be paid to local knowledge, which is a scarce resource in itself and due to its specificity is difficult to disseminate.*" (IFOAM EU Group, Arc2020, TP organic).

Agroecology is gaining in importance in the research and policy agenda. It is establishing itself as a common concept for a coalition of NGOs proposing a radical change of European agriculture. For its upholders, of whom we are, one of its main advantages is to propose a holistic change, addressing the real nature of challenges to be addressed. The statement is that the current system is so locked-in and impacts so much the environment that solutions can only be found in a complete re-design of not only the farming sector, but the whole agri-food chain. It appears as the best candidate able to encompass environment, rural development, animal welfare and food security concerns. Indeed, its principles allow a comprehensive roadmap for a European agriculture reconciled with nature and consumers and… farmers, altogether. AE proposes a conceptual frame able to address issues that, until now, are addressed separately. In this regard, it can be seen as a major change in the pressure for change from different perspectives and gives the hope to build a consistent coalition amongst civil society.

However, when it comes to giving flesh to agroecology in Europe, the image blurs or becomes patchy. Examples of farming systems matching the AE principles are given, but the analysis is frequently fragmentary, not fully revealing if all the dimensions of AE are addressed (Guillou, et al. 2013, Dumont, et al. 2014). When it comes to the food system, the narrative of "local markets are the backbone of agroecology" is dominant, but not sufficiently equipped. All the more, the European dimension of AE and food system is missing. The agroecology project may appear as a collection of local food projects mainly selling organic vegetables and poultry in local markets. But does this address the European agri food system? The question is still unanswered. And not being answered, it allows conceptual drift and, at end, anyone to capture AE. The example of the French Ministry of Agriculture's call for AE is a good one to pin the lack of clarity of the concept, as the awarded projects range from really demanding ones to other simply implementing "better practices" far from the AE vision.

Our intent is not to undermine agroecology by saying it is a weak concept. It is on the contrary to start from its present blind spots in order to challenge it in a strategic debate, notably from an EU perspective. Put in transition management's terms, our project is to contribute to make it become the next dominant socio-technical regime instead of an eternal niche. For this purpose, we need to understand the current dominant regime, how it is locked-in and the way it questions AE.

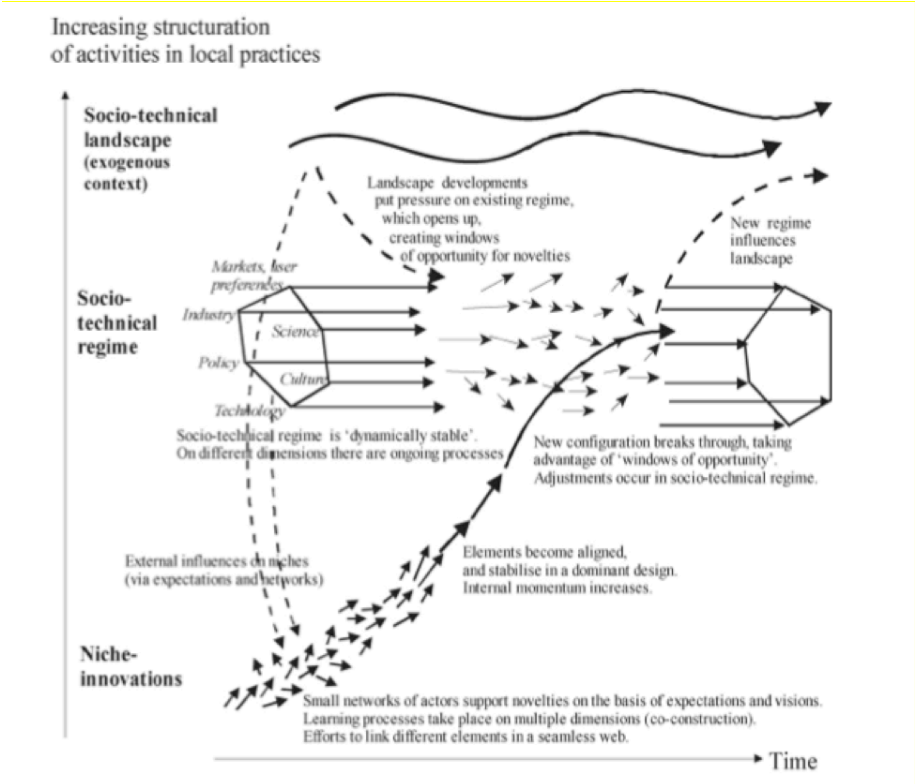


Figure 1: the multi-level perspective - a theory of change (Geels et Schot 2007)

1.2 Addressing an agroecological project requires an organised future study

Clearly, agroecology is a future-oriented concept. Not that forms of AE are not existing today — on the contrary, a large share of World and Europe's farms are indeed functioning according to AE principles when making use of local environment assets and local knowledge instead of imported agro-chemicals. We here defend the point that High Nature Value Farming (HNV), which is representing around 25% of EU28 UAA, is a genuine form of AE farming. But the AE project, to name it for convenience, is to go further to a strict conservation agenda and to reverse the present trend in which AE systems are disappearing under the pressure of industrial farming and large scale agri-food chain.

Thus, the conceptual challenge that needs to be addressed for the AE project is dual:

- Show that the whole EU agro-food systems can be converted to AE without "going back to the Middle-Age". This would indeed be unrealistic both on the production side (too little food produced), on the consumers' side (too demanding in terms of diet and lifestyle, too expensive) and the global side (too selfish when there is a call to "feed the World"). But this being said, and the criticisms being identified, the demonstration is still missing.
- Show that pathways towards such a future vision are both possible and plausible. Such an assesment of the plausibility of the project is needed, simply because AE is not — and by far — the dominant paradigm in the present situation. The nature of the needed change for the agro-food system is such that it goes beyond simply adapting the present system, as already said. It is a more radical vision that needs to be designed.

Considering these two points leads to conceptually think the AE project as a scenario project. It is indeed a scenario matter to envisage long term radical plausible changes, to specify the ins and outs of an AE agro-food system, to better quantify the consequences of this assumption on land-use, on production and on diet notably in the context of climate change. There is a need for a combination of alternative narratives in the future, addressing socio-economic issues, with systematic and quantified analysis: in brief, the very substance of scenario (see box 2).

We may thus propose that the AE project is making a normative scenario come true. For this, we need both a desirable and feasible *image* of what would be an AE scenario and a plausible *pathway*, bridging present and future. In doing so, we put the scenario design in a strategic perspective. We assume that the policy debate, *senso lato*, is missing a plausible AE option and that it is a priority for stakeholders wishing to influence the future development of policies to be a force for bringing forward proposals. We indeed consider the debate on the different projects for European agro-food systems as a "future-oriented debate" (Treyer, 2009), that is the co-evolution process of:

- a corpus of representations of the futures in a specific field, in this case the future of agro-food systems, each representation being elaborated in reference to the others;
- a community of persons and institutions associated to the elaboration and discussion of these representations of futures.

For an AE scenario to be audible in the policy debate, it needs to exist in the future-oriented debate. Thus, when designing an AE scenario, one should pay attention to the content of the scenario (how does it relate to other existing scenarios on the future of agro-food systems? How does it make the corpus of those scenarios evolve?) and the way it can be discussed in the arena of discussion of the future-oriented debate (what are the rules of discussion of this arena? Who participates in the discussions? How can a new scenario access the discussions?). This document mainly focuses on what we believe are the basic requirements for an AE scenario to be able to exist in the future-oriented debate on European agriculture, that is (i) responding to the elements considered in other scenarios, in order to be audible in the debate (e.g. the global food security issue, see first section of this document), (ii) considering blind spots of the other scenarios, in order to improve the quality of the debate (by adopting a systemic approach, see second section, and by showing a transition pathway, see last section)[1].

Box 2: The key characteristics of scenarios

A scenario is a narrative about a plausible future[2] of a social, economic and technical system. It aims at revealing what significant changes can take place in a given time horizon (e.g. 2050, the horizon depends on the nature of the system taken into consideration).

It formally consists of an image and a path, i.e. a chronology of events explaining how to bridge the future image with the present one.

A scenario reflects values - hopes and fears – in a rigorous approach. It is founded on a past and present story of the analysed system, forming the "basis" of the scenario.

It is both an analytical and comprehensive, systemic approach. It combines qualitative and quantitative assumptions in a consistent story, or narrative. Scenarios help at identifying the external forces and the degree of freedom (choices).

Added-value of scenarios is not their capacity to predict what will happen, but to explore what may happen under different plausible assumptions. The design of their discussion is paramount. Their strategic goal is to question and re-open the spontaneous implicit anticipations of future. They support new objectives and/or new means of actions to reach a desirable future or avoid an undesirable one.

This being said, one could think that the conceptual issue is to embody the idea of AE, accordingly to a Platonic vision. In this approach, AE exists as an Idea and stands on sufficiently explicit criteria that would allow the building of the "true" AE scenario. Our understanding is that this approach is not adapted to the nature of the question. AE does not exist in an ideal World and, indeed, an AE scenario is necessarily a built process, based on assumptions, reflecting political choices and situated values. In other words, designing an AE scenario is a constructivist project, subject to errors and interpretations. This point is important to have in mind while our experience of similar projects is that people spontaneously put normative scenarios or projects in terms of: (1) firstly *fully explicit* what is

[1] An analysis of the rules of discussions of the future-oriented debate (actors involved, degree of pluralism of the debate…) could also be realised, notably in order to design a dissemination strategy for an AE scenario, but it is out of the scope of this document.

[2] Underlined items are those forming the usual vocabulary of scenario methodology.

the concept underlying the norm [here, AE, but it could be "sustainable development", "local market", "competitiveness",... — any embracing concept in fact] (2) and then we can *deduce* what is the according scenario/project. In practice, most time is spent on (1), with difficulties in explicating the concept as long as there is no concrete examples of its meaning... and thus (2) is frequently a postponed task.

Our point is that the appropriate approach is a combination of deduction — based on the existing works on the principle of agroecology — and induction — based on a scenario building approach. We assume that we have enough principles on AE to start a future thinking.

1.3 The aim of this document: showing the added value and challenges of building AE scenarios in Europe

Our aim is this document is not to propose an AE scenario for Europe. It stands on a preliminary level, identifying the methodological needs for designing sound scenarios, in the strategic perspective that we have set in the above lines. How to make an AE scenario convincing? could be the overarching question of our thinking.

The insights discussed in this document are based on discussions with a coalition of European NGOs and researchers. Those stakeholders were gathered by the TYFA project (Ten Tears For Agroecology — the "ten years" referring to early actions putting on the path towards an Agroecology image that would take place in a longer term, 2050 being a convenient horizon). Those discussions took place between 2013 and 2015 and led to the design of applied research projects. We felt that useful findings could be drawn from these discussions, which would propose a step forward in the setting of an AE agenda, going further than general principles and/or scattered examples.

This paper is a way to display the findings that came from those discussions amongst the TYFA community, but also at a wider scale, for the stakeholders involved in the transition towards a genuine environmental responsibility.

Box 3: The actors involved in the design/preparatory phase of TYFA

A "core group", consisting in different NGOs involved in different ways in agroecology has been gathered twice (March 2014 and 2015) in order to identify and discuss the key challenges of TYFA. The involved organisations were:

Aprodev, Arc 2020, Birdlife Europe, European Environmental Bureau, European Forum on Nature Conservation and Pastoralism, Friends of the Earth Europe, Greenpeace, IFOAM TP Organic, Pesticide Action Network, SlowFood, Sustainable Food Trust (Greece),

A "methodological group" consisting in different research bodies that contributed to the methodological design of TYFA, under the lead of IDDRI and EFNCP:

Université de Liège (BE), AgroParisTech (F), Wuppertal Institute (D), Institute of Social Ecology (Vienna, Austria)

The present document is organised in two main folds:

- One is dealing with the socio-technical dimension of the AE scenario: what should be in the image of the AE to make it fully convincing?

- One is dealing with the status of such an AE scenario in the future-oriented debate: how should it be positioned relatively to a “business as usual" scenario? How should it address the "transition" (= the pathway)?

But before dealing with those two central folds, we felt it unavoidable to address a preliminary issue: what is the meaning of proposing AE for Europe in a global perspective? Is it relevant? The issue is that while there are evidences that AE might bring higher yields in tropical countries, in which the concept had been developed, it might lead to *lower* ones in the temperate context of Europe. Is it realistic and acceptable to envisage this when the call for food security seems to coincide with an increase of production on all available land. The figure of the 9 billion mouths to feed in 2050 is a powerful one, endorsed by institutions like FAO, DG Agriculture, the European Parliament.

2 The Europe/global issue of agro-ecology

2.1 Agroecology in Europe: lower yields… (with current references)

The concept of agroecology was developed in the 1980's by Miguel Altieri, in the context of Central America (Altieri, 1983). Its fundamental statement was that not only crop diversification but more fundamental spatial organisation, at the landscape level, would bring a better resilience of the agronomic system and at the end higher production at the farm level. In this context, local resources (seeds, knowledge) are obvious factors for implementing both resilient and productive systems, that are minimizing the use of non renewable inputs. A reference paper by Pretty (2008) shows that in the context of developing countries, yields in systems having adopted "sustainability technologies" — whose principles are those of agroecology — are higher than when using conventional technologies.

But the European context is different and the above conclusions cannot simply be transposed:

- the temperate climate and less fragile soils make the principles of AE less obvious (the soil/climate conditions are more favourable in Europe);

- the technologies developed in Europe have been based on high level of chemical inputs and seeds accordingly selected in order to reach high yields on limited areas (the situation is different in other temperate countries such as the US or parts of Argentina in which more land availability entails lower yields).

Those two factors combined make the yields of production without inputs (i.e. those of the organic farming requirements) lower in Europe. Fiessbach, et al. (2001) show that in Switzerland, yields are around 20% lower between organic farming (biodynamic and "organo-biologic" farming) when compared with conventional farming. In (Guyomard (dir) 2013), statistical comparison in France shows nearly half yields for organic wheat and barley, when compared with conventional ones.

Caplat (2015) and other authors discussing Guyomard (op. cit.) point out that simply comparing crop yields "with" and "without" fertilisers and pesticides is not relevant for two main reasons: (a) the seeds used in most organic farms are the same than the ones used in conventional ones, thus not selected to grow without chemical inputs (b) the productivity should be compared at higher levels of space and when comparing systems fully adopting AE principles (multicrops, agroforestry,…). (Caplat 2015) rightly points that organic farming, and AE, is much more than "conventional farming without chemistry". He states that in the agronomic and present socio-technic contexts, it is unavoidable that organic farming has lower yields in Europe — which is not the case in North America for instance — and that closing the gap is a matter of fundamental change in research and policies.

2.2 Why lower yields in Europe are not a concern for global food safety

2.2.1 Some figures to frame the debate

Lower yields in Europe are a concern only if one assumes that Europe needs to export its commodities in order to feed other countries. This vision founds the "we need to feed the 9 billion World's citizens" narrative that indeed implies high yields if Europe is to export. Different lines of argumentations contradict this narrative.

Firstly, an implicit underlying statement of the "we need to feed the World" narrative is that Europe is currently feeding the World. Which is not the case. For cereals, a key commodity for the basic supply in calories, EU28 exported 22-24 Mt in 2011-12 and 2012-13 but in the meantime imported 16 Mt, thus a net export of 6 Mt to be compared with the 2,500 Mt of cereals produced in the World — figures from (Agreste 2015). Thus, in broad terms, EU28 has a net contribution of 0.24% (!) of the cereal supply outside its boundaries. It should be remembered that global trade of cereals represents 12% of the total production, thus 88% of production is produced and consumed at a domestic level.

In comparison, EU28 imports the equivalent of 12-16Mha of soya beans, mainly from South America (Chemnitz et Becheva 2014). Those figures can be compared to the equivalent 1Mha mobilised for the above net export of cereals from EU28. In short: the net land use on cereals and soya, the two main commodities in terms of impact on land use, shows that EU28 *imports* the equivalent 11-15Mha, mainly for its meat production. To put it simply, the present situation is that the World feeds EU28[3].

In a future horizon, it is frequently argued that the increase of population — the 9 billion people in 2050 — means the need to increase the global production by 70%. (De Schutter 2010) reminds us that this estimate assumes an average meat consumption increasing from 37.4 kg/person in 2010 to 52 kg/person in 2050 (+40%), in which half of cereals would be used for animal feed. Agrimonde (INRA ; CIRAD 2009), estimates that a 3,000 Cal/day in 2050, with 2,500 of vegetal origin and 500 from animal product would entail an increase of overall production (as measured in calories) of +28%. The main conclusions of this short discussion are:

1. Due to its lack of large (new) agricultural area and already high yields, Europe is not and has not the future possibility to be a significant raising contributor to food security (as simplified as a supply of calories)
2. A key variable is meat consumption. A limited decrease in meat consumption will have a major positive impact on the "need" for higher yields, in Europe and elsewhere. It has been observed that the global production already covers more than the needs of the World population and, with a more vegetal based diet, could feed 10 billion persons (Foley et alii 2011).

[3] For our purpose, the analysis is led on physical quantities. In monetary terms, EU28 agrifood trade balance is nearly balanced, with a recent net surplus. This surplus is mainly due to wines and quality products, not to commodities.

2.2.2 The food sovereignty dimension

On another level of analysis, more fundamental, the issue about food security is not a global supply one. Many authors point that the main issue is poverty in developing countries. The observed food crisis and the remnant high level of undernourished people is caused by a lack of resources to buy food or, in some cases, by lack of rural infrastructures to display food in some areas.

In this context, improving agricultural production for small farmers in the developing countries should be the priority for two reasons: it is the basis to fight rural poverty — and thus urban poverty also — and it allows a local food supply, less dependant on import. Olivier De Schutter (op. cit.) argues that agroecology is an appropriate way to increase agricultural production, especially in the context of developing countries (Pretty, op. cit). In this vision, at a more global level, less exports from developed countries, mobilising industrial agriculture are not only not needed — because of local production — but are to be limited in order to avoid uneven competition with local markets, that need to be protected.

In short, lower yields associated to agroecology in Europe are not a concern for a food safety issue considered as a food sovereignty one. On the contrary, they might lower the pressure on local markets outside EU28, although it must be acknowledged that this pressure does not primarily comes from Europe but mostly from South America which today is the main low-cost food exporter.

One should note that this analysis does not mean that there is no point in thinking some strategic stocks for commodities. For example, Egypt is a structurally dependent country on food import (self sufficiency in food supply is out of reach given the limited amount of land and the high population). Supplying this country, and others that are on fragile balance, is a responsibility for countries able to export, notably Europe. But the meaning of this responsibility greatly varies if the cereals or commodities exported towards these countries are the ones left after pigs and poultry have been fed, or if this export is combined with a greater sobriety in our food consumption models (human first, pigs and poultry if possible).

2.3 To what extent lower yieds in Europe are a concern for Europe?

The above short discussion tends to demonstrate that the risk of lower yields in Europe associated with agroecology is not a radical issue from a global perspective, on the contrary on some aspects (less pressure on developing food markets). But burning questions remain: wouldn't lower yields in Europe radically alter the European food economy and model?

2.3.1 The food supply perspective

In the worst assumption for yields in an AE scenario, is halving those yields for cereals only acceptable from a food supply perspective? There is no simple answer to this and, in fact, answering them would mean designing the still missing agroecological scenario for Europe. It is clear that a strong reduction in yields[4] would mean a radical change in the overall EU production, while livestock consumes around 50% of cereals. More scarce cereals would mean a strong decrease in livestock production based on grain, and the consequent

[4] Let us remind that the half yield in cereals is a lower simplistic assumption as it mainly stands on "the same system without chemical inputs", without mobilising the principles of agroecology.

imported soya. Reversely, more grass based (extensive) production and more legumes might have beneficial impacts on health and environment, including water resources. This option can positively be envisaged from a diet perspective (the present EU diet is too rich in meat and dairy products), all the more when considering the 30% wasted food.

The question is the extent of this reduction in terms of livestock consumption. With regards to this issue, Greenpeace proposes the concept of "*Ecological livestock [that] are default land users, i.e. they don't monopolise land that is required for other intrinsic elements of the agriculture system and they do not compete with humans for prime arable land. Their role is to exploit the use of biomass not accessible to humans and to make efficient use of agriculture wastes, surpluses and marginal biomass. A "default" livestock diet is one "that provides meat, dairy and other animal products which arise as the integral co-product of an agricultural system dedicated to the provision of sustainable vegetable nourishment" (Fairlie 2010)*" (Greenpeace Research Laboratory 2012). This concept provides an analytical framework for thinking the relative share of cropland (for direct human consumption) and grassland (for animal products) at EU scale, consistent with an AE option. Even without available quantified figures, and with the worst assumptions on yields, it can be assumed that there is sufficient room of manoeuvre agroecology would not mean EU crisis in terms of food availability. Just to give an idea and working on order of magnitudes and focusing on cereals only, which is a simplistic approach: the present production is 1.6 t of cereal/person in EU28 while 0.3 t brings the calories for one person/year. There is room for strategic export outside Europe, even with lower production. The main issue is the relative share of livestock in our diet and in land use.

Beyond the simple availability calculations, envisaging a radical change in the EU diet is not as simple as it may look on paper, notably for socio-economic reasons (less production might mean higher prices, protected markets in a way). Such aspects will be developed in the next pages of the document. But addressing this crucial issue also needs to address the counterfactual one: what are the consequences on keeping the present "high yields track" on environment, health, agri-food economy and social inside and outside EU28? And firstly, is it technically possible to follow this goal? Yields in Europe have reached a plateau for a decade. If the causes of such a stagnation are still discussed, it is reasonable to envisage that a reduction in crop availability is a plausible option in the medium-long term. We will discuss the comparison of the agroecological scenario with the business as usual one in a specific section further in the document, but we should not forget at this stage of discussion on yields the reasons for envisaging such reduced yields: this is not an end it itself, but it is a way to open to alternative ways of farming, while the present ones are causing more and more negative impacts. High yields are not a compulsory assumption for Europe. There is at least one alternative!

2.3.2 The trade balance perspective

Our purpose here is not to make an extensive analysis of the EU trade balance, but to give milestones. The EU agricultural trade net balance has varied around equilibrium (e.g. -5.3 billion euros in 2008 and + 7.7 billion euros in 2010) [5]. While the overall agricultural

[5] 2008-2010 data. All data in this subsection from *L'agriculture dans l'Union Européenne, informations statistiques et économiques 2011* - DG Agri, 2012

production weighted around 355 billion euros in 2010, the net balance represents around 2% of the overall value. This estimates is highly subject to commodity price volatility[6].

This net balance consists of the result of exports/imports flows representing around 80-95 billion euros. Sometimes exports are higher than imports, sometimes it is the other way round. The main exported items are drinks and spirits (15-18 b€), processed food (cereals, fruits and miscellaneous products, 15 b€) dairy products (6-8 b€), meat products (6-7 b€) and cereals (4-6 b€). The main imported commodities are fruits (12-13 b€), coffee and tea (6.5-8 b€) oil seeds and principally soya bean (7.5-9 b€) and oils and fats (6-8 b€).

As a whole an agroecology scenario would mainly impact the export capacity for cereals and dairy-meat products in terms of volume (Solagro 2014). While drinks and spirits would have to change their production pattern in such a scenario, there are room of manoeuvre for technical adaptation - organic farming is an increasing reality in the sector. As a whole, the resulting equation is rather complex to set while the likely decrease in cereal and livestock production can be fully or partially offset by price variation (less products accessing market would mean higher price for those commodity, all the more that they would have a specific quality on the world market), less imports on soya and overall net consumption (less meat produced, but less meat consumed as well)[7].

In addition, the import/export balance is clearly an important factor for economics, but it is not an end in itself. It makes sense to export what Europe is irreplaceable and good for, with intrinsic added value - namely drinks and spirits - taking into account environmental and social conditions. And this is feasible. Reversely, it makes sense to import coffee or other tropical products that are now part of the European food culture — the level of such imports can be discussed, but they are not bad in nature — under the same environmental and social conditions. But for other products, like the cereal and dairy/meat/poultry ones, the gross value of exports should be assessed against:

- added value — when the production costs of meat are higher than the market prices, what is the meaning of producing for export?
- direct public costs — intervention but also sectorial supports
- environmental and social costs, including health ones.

Some imported products such as soya and palm oil should also be assessed against a sustainability grid, taking into account the fact that Europe can and should produce substitutes to those commodities and that, in absolute terms, their consumption should be reduced.

Again, our purpose here is not to give the last word on this complex trade issue, but it is at least that make the debate going on against the argument "*your agroecology scenario is nice, but it will ruin the agrifood trade balance when Europe is desperately looking for export's share*".

[6] For example, between 2005 and 2014, the overall agricultural value of EU27 varied between 290 and 370 b€.

[7] Such a shift could have important consequences on the Brasilian or Argentina's trade balance and agriculture, as those two countries heavily rely on soy export. While this goes well beyond the scope of this paper, but could be considered at some points in the debate.

3 The strategic socio-technical content of agroecological scenarios

3.1 Clarifying the framing before the content

The previous sub-section was meant to establish the principle of an AE scenario for Europe in a global perspective. But it does not give any prescription of the content of such a scenario. Such content is highly dependent on the matters of interests such a scenario wants to address or, on the contrary, keeps unaddressed. Such framing will have consequences on the "resulting variables" — or the desired outputs — that the scenario wants to address. Consequently, the choice of the resulting variables will determine the one of "explanatory variables" — or driving forces. For example, one can apprehend the difference between a scenario addressing landscape management, which will be based on geographic factors and one addressing food production at EU level, which will be based on structural and agronomic factors. Not that those two issues cannot be addressed jointly and consistently, but the angles of analysis will be different and one can imagine a "landscape scenario" which does not analyse food production issues and vice versa, a "food production" scenario which leaves blank the page of landscape management.

While food issues and environmental management ones are clearly central in the scenario, they are not the only one. A comprehensive AE scenario must indeed consider a broader set of issues if it is to follow the principles of agroecology put by (Stassart, et al. 2012) [presented in Box 1], which call for a holistic view of the concept. On a technical stand, this approach emphasises linking production (yields, diversity of products) with ecology and the optimisation in the use of local resources. But the approach also puts the development of agroecology in a wider socio-economic, political and territorial perspective.

3.2 A scale issue: the need to upscale and downscale - the meso level

Consistent with this framing of agroecology which focuses on the local level, many authors conceive the development of AE as a bottom-up and grass-root based process. This approach also allows to capture a wide range of matters of interest for civil society groups: local employment, local environmental management (dealing with biodiversity, landscapes, soil conservation, water protection — all issues that can only be properly defined and managed at a local level), local governance and autonomy. This local entry also helps to think of the diversity of agricultural products, seeds, knowledge, institutions and cultures at their very root. There would be a logical contradiction in thinking agroecology from a centralised point of view. If we assume that AE is also supporting multifunctionality, then an AE scenario needs to capture local dimensions.

In addition to this local perspective there are at least two reasons to think also at the EU level. A first, “technical” one, lies in the fact that food security issues can only be analysed at this level: there is a need to check that the sum of individual AE experiences will produce enough food and in a balanced way to cover the needs of future EU diets. An AE scenario needs to provide a balanced share of cereals/fruits and vegetables/meat/dairy/drinks

(including alcoholic ones) at EU level, and abroad. In this perspective, the iconic image of self-supplying regions/countries — rather strong in some approaches of AE which tend to promote self sufficiency at local and regional level — can be called a "regional trap" and must be identified and avoided (Clancy et Ruhf 2010). The assumption of regional self-sufficiency leaves unaddressed the fact that all the regions are not equally populated and/or producing the different kinds of food forming the EU diet. This is al the more true that for political and statistical reasons, self-sufficiency is today mostly thought of and promoted at the level of administrative regions, while is no reason that they coincide with consistent production and consumption basins. In short, some EU regions are exporting some products towards other EU regions, which are importing[8]. This is the case in present and we assume that it should be the case in future, notably because extensive livestock systems are taking and will take place in peripheral regions. For biodiversity and food efficiency reasons — *cf.* the "ecological livestock" or "default livestock" concept above — such regions should play a joint role in food production and biodiversity conservation in the future, which the assumption of self-sufficient regions does not allow[9]. There is thus a need to keep a European perspective in the analysis, all the more that local production basins and community play a major role in the AE scenario.

Besides that, there is also a second reason for taking a European perspective to build an AE scenario. It lies in the fact that as of today, lock-ins are not only technical or commercial but also political. That is to say, the political and institutional framework at both the EU and national levels drive the agro-food system towards its “reproduction” rather than towards a radical change compatible with an AE project. There is thus a need to both (i) take into account the lock-in effect of European policies to explain / understand the current situation, (ii) identify possible political levers to bring about changes in those policies and (iii) clarify the possible political as well as socio-technical pathways through which a given change in the politico-institutional framework could contribute to the achievement of an AE scenario.

As a whole, an AE scenario should then articulate bottom-up and top-down approaches. It cannot fully stand on only one perspective. It is neither the local application of a centralised productive plan, which would allocate production to optimal areas, nor a consistent image magically resulting from the up-scaling of local initiatives. There is a need to take into account vertical (sectors) and horizontal (territories) roles of agroecological systems in order to address economic, social and environmental issues.

Having said that, there is clearly a need for intermediate levels of analysis, between EU28 and local situations capturing multifunctionality. A typology approach, trying to capture the diversity of eco-agrarian situations (soil, climate, structures, social context) while proposing the most synthetic understanding of this diversity is a key methodological challenge. We have proposed such a typology that can contribute to this conceptual task (Poux 2013), but other approaches should be mobilised in order to cross different angles of analysis (see for

[8] Not only densely populated area import some products. Ireland is a net exporter of livestock products and could continue to be such in an AE scenario — at a much lower level — but will import fruits at least. Rural Irish communities deserve the right to eat the oranges they cannot produce.

[9] This discussion does not mean that reducing material flows between regions is not consistent with the AE scenario. The search for spatially balanced production is a central challenge in the design of the scenario.

example the nitrogen assessment showing the differences between EU regions in (Leip 2013)). This "meso" level of analysis — between micro and macro — will have to play the key role between both the upscaling and downscaling analysis, embracing a range of diversity, if not all the diversity.

3.3 Agrarian systems as vertical/horizontal analytical frames

The multifunctional dimension of agroecology implies having analytical objects able to render different dimensions of farming in a comprehensive manner.

3.3.1 A "vertical" perspective: a combination of EU agrarian systems to feed European citizens

A relevant entry point from an AE perspective is the issue of fertility, as the closing of nutrient cycles is one of the key characteristic of AE systems. Here comes the issue of the nitrogen cycle which can be naturally closed — without use of synthetic nitrogen — through the mobilisation of nitrogen fixing crops (legumes) in crop rotations and/or fertility transfers from natural pastures, being fertility sources, to cropped area through manure. Without going into detail in this document, this perspective calls for regional analysis in which the balance between livestock and crops production and the resulting land use in terms of pastures/nitrogen fixing crops/pit crops[10], allowing fertility management at local scale[11] are key descriptors. The agricultural practices forming the management system of fertility (nutrient and pest control) are central in the analysis and relate to the issues of yields discussed previously.

If we cross this angle of analysis with the need to have "meso" levels of analysis, the concept of regional agrarian systems can usefully be mobilised as one will have to distinguish between different situations, considering the climate-soil fertility (thus the possible balance between cropped/non cropped area) and other geographical factors of agronomic interest (slopes, mountainous context, climate). Taking into account climate change impact is necessary in this view. Trade-offs of commodities and animals between agrarian systems must also be considered (e.g. cereals exports towards livestock areas, transhumance or other livestock transfers).

From the European perspective of supply of food evoked above — exporting agrarian regions to importing consuming ones — the issue is to quantify whether the amount of crops and livestock products will be (a) sufficient in order to meet dietary needs, that might change, as we will discuss further; (b) combined in such a way to allow fertility management. The scenario exercise *Afterres 2050* is a very detailed and good example of such an approach, mobilising in-depth agronomic reasoning for closing a food supply/demand while minimising the use of inputs in 2050 at French level (Solagro 2014).

[10] We here mobilise a grid in which we distinguish between land use able to be a source of fertiliser (nutrients), namely permanent pastures and nitrogen fixing crops and the other land use through crops that are net user of nutrients, being thus "pits" as the biomass (e.g. grain, fibers,...) is exported from the agro-ecosystem.

[11] I.e. without envisaging long distance nitrogen fertility transfers, neither under organic nor synthetic forms.

In combination to this "metabolic" analysis of agrarian systems, another useful perspective in order to strengthen the credibility of an AE scenario is to analyse their socio-economic and structural dimensions. The combination of production factors, land, capital, labour, biological factors, knowledge in different farming systems should be consistently described accordingly to the functioning of agrarian systems. The needs of different productions in terms of workload, capital and machinery must be analysed at the farming system and regional levels. Furthermore, the economic balance of such systems must be understood in broad terms (how is value-added formed? what is the importance of economy of scale? what is the structure of costs and related risks?).

3.3.2 An "horizontal" perspective: addressing territories and spatialized issues

The above perspective of agrarian system analysis mostly emphasises on a "vertical", sectorial approach of land use. It is used in a productivity and production perspective in which the different European agrarian systems are components of a wider agrifood system, and more and more of an energy supply system.

But if we consider the multifunctional dimension of agroecology this vertical analysis needs to be complemented by another one, taking into account territorial issues such as landscape management and the related biodiversity and natural risks items notably. This territorial angle encompasses more qualitative dimensions such as the vitality of rural communities, the cultural value of farming, which can be considered as secondary - if considered at all - when only focusing on the "vertical" analysis. This horizontal analysis of agrarian systems is more complex and shall mobilise history, geography of different kinds (physical and human); it should envisage the relationship between farmers/rural and urban communities in which not only the provision of food matters but also the one of resource management and recreation. The spatial distribution of jobs becomes a specific issue in this vision, notably justifying the maintenance of farming in peripheral regions, which does not really matter in the "vertical" vision. For example, in some regions heavily depending on the export of food commodities (e.g. Ireland for beef, Andalusia for olive), the share of agriculture might be very significant in the absence of alternative sector of economy.

This "vertical" vs. "horizontal" visions relate to the question of the optimal land use, and notably the issue of the share of extensive livestock. For example, *Afterres 2050* (ibid.) is a typical of a scenario mainly built on a "vertical" vision, in which the optimal land use stands on farming systems able to supply food and energy chains. For example, in the 2050 image, land is "freed" from extensive livestock for energy crops. This assumption is arguable from a food and energy point of view, but puts a burden on biodiversity management — and notably the share of high nature value farmland. Another arguably desirable combination of agrarian systems, addressing horizontal issues in a more balanced way, would be on the contrary to maximise the share of extensive land for livestock production, arguing on the lack of competition with edible food from these areas combined with the provision of multifunctional landscapes. One can argue that these "functions" are more inherently associated with farming than the supply of energy, that can be obtained from other sources (wind, solar).

Our purpose, again, is not to present an exhaustive analysis of the subject, but to point (a) how different [agrarian system] analysis perspectives must be combined in order to address

the different dimensions of agroecology, vertical and horizontal (b) how the framing of the desirable social "functions" of agroecology can lead to potential conflicts between food production, energy production, landscape, biodiversity, climate change mitigation/adaptation, rural communities,... We assume that the line between extensive and intensive land use is probably one of the most structuring of the debate.

3.4 Changes in diets and food chains

The above discussion between the "vertical" and "horizontal" functions of agrarian systems should not oppose the two items and/or put a hierarchy between them. Agroecology stands on the key assumption that producing a healthier food, in a sustainable way is indeed the best way to reach the "horizontal" functions. When confronting this statement with the recent history of agriculture and food systems, it is clear that changes in farming systems and the food system should be consistently thought in the AE scenario. Unsustainable diets and food systems have made unsustainable land use at EU and global levels.

This question deals with two issues:

1°) changes in the diet, and notably the share of meat/diary products in EU diets consistent with a sustainable EU land use (provided that the EU food footprint is reduced to the import of non-substitutable products such as coffee, cocoa, etc. (see above).

2°) the organisation of the food chain, taking stock of the fact that an AE scenario would go against the present trend of spatial specialisation and intensification of food supply basins, imposed by the development of agri-food industries.

3.4.1 The diet issue (1): livestock

The issue of diet is a rising one over a decade . After the *Livestock's long shadow* publication (Steinfeld 2006), the question of the ecological consequences of the meat production/consumption appears as one of the most structuring issue. It has been extensively investigated, although as far as we know no synthetic quantification(s) of a desirable diet(s) do(es) exist for Europe.

If one can assume that all types of AE scenarios will necessarily envisage a radical decrease in meat-dairy consumption (of several tens percentage to give an idea[12]), the debate about how far it is necessary/desirable to go can be analysed with the following milestones, structuring potential visions.

A radical and extreme vision will defend a purely vegetarian diet. Animal products are neither necessary from a health and dietary perspective nor desirable for climate and ethic reasons (slaughtering, animal conditions for dairy livestock). This vision is arguable in principle but raises serious concerns: notably cultural and environmental[13]. Fairlie (op.cit. 2010) argues that removing all kind of animal products from our diet would cause problems in land use — maintenance of grazed landscapes — and would not be the most efficient land

[12] In *Afterres 2050* (Solagro, op. cit.), it is estimated that the French diet should be halved between 2010 and 2050 to meet dietary recommendations. France is a high consuming country for those livestock products.

[13] The issue of accepting or not the idea of animal slaughtering is of another nature, that is out of the scope of agroecology, that puts animal production in its core principles.

use as herbivores value land producing non edible food for humans. As already evoked above, he calls for a "non-regret" land use (grazing livestock on pastures) which is kind of win-win as it produces food from otherwise useless land and valuable landscapes and biodiversity.

Beyond the case of grazed areas, livestock is also a key variable in the use of legumes in cropping systems: while legumes are necessary in closing the fertility cycles in crops systems, their agronomic share goes beyond the requirements from a strict human diet. In brief, agronomically well-designed systems would provide with more proteins that humans may eat. From this perspective, some other agroecological inspired visions, such as *Afterres 2050*, defend a land use based on relatively more intensive livestock systems (increasing the relative share of cropped legumes compared to semi-natural ones), allowing a remaining higher share of land for other purposes (exports, energy crops) and a limited share of outdoor grazing, causing uncontrolled GHG emissions.

Diversity of livestock systems and consumption patterns should prevent the vision of a unique optimal system. The "horizontal" vision is also applicable in the diet analysis. The Irish and the Spanish lambs are not the same and do not meet the same cultural demand; a map of the social value of cheeses could be drawn across Europe.

Again, our intention is not to give a clear-cut answer to this issue of the desirable share of meat/dairy products in an AE scenario. It is to recall that (a) this share should radically decrease (b) by doing so, it considerably lower the "needs" for high crop production (c) the balance between the level of livestock production and land use should be carefully analysed, having in mind the multifunctionnality discussion carried above.

3.4.2 The diet issue (2): health, pesticides and antibiotics

Another structuring issue about diet in an AE scenario is the case of pesticides. The debate focuses on an area between two clear situations:

- the present one, in which pesticides are a major "silent" threat on human health. Although many uncertainties remain in the precise causal chains, it is more and more plausible that the present use of pesticides has huge health impacts: cancers, Parkinson's disease, endocrine disorders,... Pesticides are a major systemic risk for human health, however complex is the analysis when trying to apprehend the detail.
- a situation without pesticides (taking stock of the remnant effects of some of them), which would radically tackle the systemic risk.

The in-between situation is difficult to characterize, beyond the fact that everyone will converge on the idea that there is a need to reduce the use of pesticides. But till which degree? The issue is not only to meet the legal standards in the end of the food chain (i.e. in the end foodstuff in the plate). Water contamination is also a (sometimes underestimated) issue that calls for a systemic prevention. In addition, some experts estimate that the standards are far too high if one takes into account the "cocktail effects" of *combined* pesticides. Thus, it seems quite complicated to define a "safe" threshold of pesticides beyond 0.

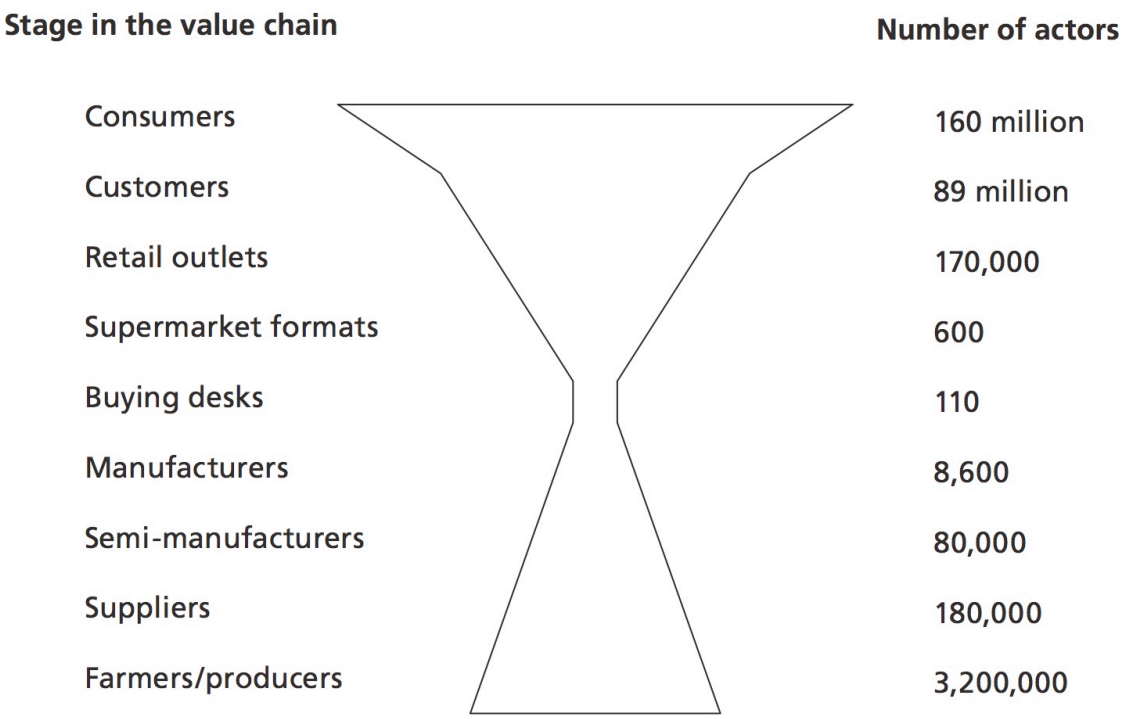
This human health issue — combined with wider health issues in the environment (how can we accept sane Humans and ill fishes and other animals?) — calls for a radical preventive approach that is indeed a sufficient condition for an AE scenario.

One cannot exclude that the search for the "safe" threshold is out of reach by principle, but the burden of proof should be reversed (the proof of harmlessness should be strongly justified) and the interest of playing with such a line should also be assessed. At the end, is there such a difference between hardly no pesticides and no pesticides at all? Is it worth being negotiated?

The issue of antibiotics used for animal rearing in an industrial way is another burning issue. The risk of resistant strains "selected" by the undue use of antibiotics is susceptible to cause a potential major crisis. The model of industrial livestock is fundamentally questioned.

3.4.3 Food chains

Food chains have to be considered in two different ways when trying to develop an AE scenario for Europe. First, the current structure of European food chains is undoubtedly one of the key drivers of agricultural change all over Europe. Both the oligopolistic structure of the input segment and the monopsonistic structure of the retail segment have determinant impacts on the possibility for farmers to go for certain technical or commercial options (e.g. Dries, Reardon & Swinnen, 2004 analysing the consequences of the rise of supermarket on the agricultural sector in central Europe).



The European food chain funnel (from Grievink, 2002, *in* Humphrey, 2006).

In this perspective, one of the question an AE scenario needs to address is: to what extent is the structure of current european food chains an obstacle to an AE transition, and how to overcome it?

But the reverse perspective is also to be considered: how do European food chains look like under an AE scenario, considering a new geography and intensity for animal products on the one hand and the absence (or quasi absence) of pesticides on the other hand? Without answering those questions, one can already envision some possible trends (Pimbert, Schmutz et Wright 2014). The most obvious consequences would be less standard products, more volatility in supply and larger supply basins/or smaller collecting points as the spatial density for one given product will be less. In brief, economies of scale on standard products will not be the common rule any longer. Having these principles in mind, the scenario analysis should be build on the understanding of the food chain, addressing several issues:

- The technical organisation of the food chain: flows of commodities between sectors (and notably understanding the share of human food and animal food flows) and the technical drivers of such flows (energy, transport chain, etc.). Labour intensity of the chain should also be assessed.
- Relationship between upstream suppliers (seeds, fertilisers, pesticides, machinery) and downstream retailers should be analysed — what are the converging and diverging interests?
- The economic organisation of the food chain and the share of value between the different links of the chain, and notably the role of finance rationale in critical choices (concentration, mutual dependence of agri-food industries and retailers) and the strategy with regards to export/import should be analysed. Economic conditions for a higher share of small and medium enterprises should be specifically analysed.
- With regards to the two above themes, difference between "old" EU15 MS — holding the highest share of companies — and "new" EU13 MS, which are seen as new fronts for developing agro-industries should be considered.
- The consumers' perspective should also be crucially analysed, with emphasis on understanding behaviours and consumption patterns (health, ready meal due to allocation of time) and mutual relationship between retailers and consumers (reciprocal influences, role of advertising and consumers associations).
- Taking into account different food patterns across EU28 must be considered in the analysis, while local farming systems imply to meet the demand of different food cultures. Share of vegetables / starch and animal products and origin of fat should ideally be considered.

3.5 Agroecology: a comprehensive change of socio-technical regime

In the previous paragraphs, we have mainly considered the technical and economic dimensions of an AE image. These aspects are connected with a broad set of public policies which need to be considered in building an AE scenario:

- agricultural (aiming farms) policies

- rural policies
- environmental policies
- land and territory planning
- energy policies
- food policies
- market and wider economic policies (trade)
- research policies

Without detailing any further this policy domain, that would in practice mean building this key component of a AE scenario[14], two key ideas should be put forward.

The first one is that one policy alone cannot make all the changes required by the AE scenario. Notably, the "horizontal" and "vertical" functions discussed above call for a combined approach of environmental and rural development policies on the one hand and food policies on the other hand. It seems to be challenging to fully integrate environmental criteria such as landscape and biodiversity and improved soil management in a food chain policy alone. And reciprocally, a sum of territorial and environmental policies does not automatically address the specific needs of different food chains. To this regards the research agenda is crucial as agro-ecology is meant to propose technologies that no longer oppose the provision of food and landscape/biodiversity and other environmental services at the farm level. It is part of the discussion whether a holistic approach of agroecology carried out in new research policies would completely resolve the tension between the horizontal/vertical or "only" considerably reduce it.

The second is the magnitude of change to be envisaged in the policy field. While the overall budget needed in an AE scenario is not necessarily significantly different than in a conventional/BAU one[15], policy goals are clearly radically different, in terms of both the beneficiaries and the contributors to the different policies. Changes in goals also entail changes in means — human, financial — and governance. While we acknowledge the fact that policy change — whatever its magnitude — would probably not be sufficient to fully drive an AE scenario, we make the assumption that it represents a key drivers. And in our view, a scenario exercise precisely intends to intervene on the policy process to help such changes to happen. The following section discusses those issues of change.

[14] If one acknowledges the socio-economic dimensions of agro-ecology, policies (in their wider meaning of structure and rules shared and adopted by a society, in our case the European society) form the matrix of the image: policies are the values, organisations and actions making the image desirable and plausible. It is not possible to describe the policies without the image and reciprocally.

[15] It is assumed that the development of industrialized farming, while frequently being presented as a "liberal" trend — understating that it develops under the sole effects of economy and with no need of public policy —, on the contrary requires strong policies as for the standards, public funding (CAP can be considered as a way to subsidize capital formation that farms would not be able to cover without public funds) and research.

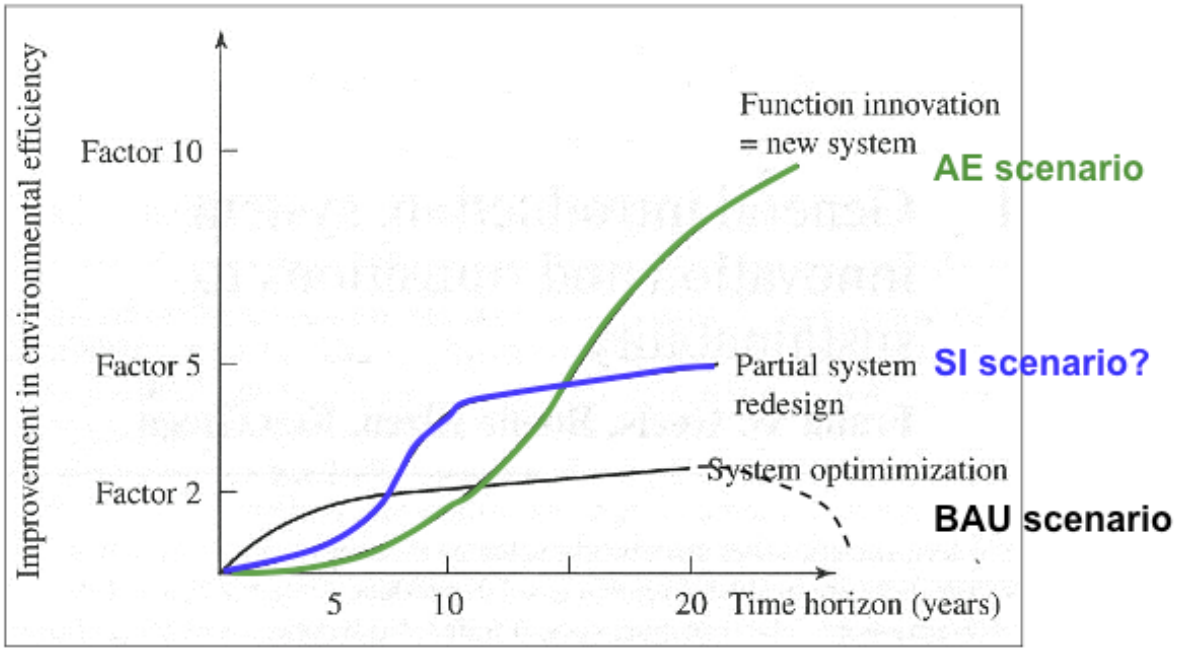
4 Introducing/positioning AE scenarios in the socio-political debate

The two previous sections focus on the framing and content of AE scenarios, highlighting several principles and conditions necessary to ensure the building of coherent and systemic scenarios. However, the potential impact of scenarios does not depend only on their content, but also on their status and the way they are discussed in the debates around the issues they address. Indeed, a foresight exercise on AE can be considered as an intervention in a "future-oriented debate" (Treyer, 2009) on the future of agro-food systems. The following section aims to give insights on the way AE scenarios can fit and gain some weight in those debates on the future of European agro-food systems.

4.1 Dealing with competing narratives

As already outlined in the introduction of this document, debates on the future of agro-food systems are framed by some competing paradigms, which consider different directions for change of agro-food systems. The EU's Standing Committee on Agricultural Research has identified two main narratives supporting underlying paradigms for the future of food systems (SCAR, 2011): a productivity narrative and a sufficiency narrative. The productivity narrative is consistent with the current dominant productivist agro-food regime, arguing for an increase of production in order to feed a growing global population, relying strongly on technical innovation, such as genetic engineering (Vanloqueren & Baret, 2009). Agroecology can be linked with the sufficiency perspective, that relies on agro-ecosystems both productive and respectful of ecosystems and on changes in diets and food chains to meet food security, health and environmental challenges. A third paradigm, sustainable intensification, could be seen as an alternative way between the two others, while in fact, despite efforts to lower dependency on non renewable inputs, its main objective remains an increase in yields (Levidow, Pimbert, & Vanloqueren, 2014).

These three narratives also diverge on the patterns of innovation underlying their main assumptions, which are particularly relevant in a scenario perspective, as those patterns reveal the speed and extent of change considered for each paradigm. Two extreme patterns can be identified in innovation research: system optimisation or system innovation (Barbier & Elzen, 2012). System optimisation relies mainly on technical change and tries to fix existing problems without changing existing systems. On the contrary, system innovation involves a complete redesign of the systems concerned and therefore involves different types of changes (on practices but also on regulations, organisations, infrastructures, markets…). Obviously, the perspective defended in this paper on an European-scale AE project implies a system innovation pattern. Figure 2 illustrates the different patterns of innovation and relates them with results in terms of environmental efficiency. We argue that the system optimisation pattern can be associated with a business-as-usual (BAU) scenario (very low redesign of food systems but still a small improvement on environmental efficiency through technical adjustments), and that sustainable intensification can be considered as a partial system redesign. An AE scenario should follow a system innovation pattern.



Weterings R. et al. (1997), in Barbier, M., & Elzen, B. (2012)

Figure 2: Different patterns of innovation can be associated with the paradigms underlying the scenarios[16]

This figure also highlights two important issues to position AE scenarios in the debates on the future of agro-food systems, that both entail methodological challenges:

- the need to provide some kind of assessment of the scenarios and to compare them. Indeed, Figure 1 shows the effects of innovation patterns in terms of environmental efficiency, but as we assume that AE scenarios should capture multifunctionality, on what other criteria should scenarios be assessed? And how to assess a combination of criteria?

- the need to show a pathway of change, to highlight the different innovation patterns followed by each scenario, and also to identify some conditions for change.

4.2 Building a different assessment framework

Being able to give an idea of the potential effects of the changes considered in AE scenarios is an important condition for them to be audible in the debate. It starts with assessing the final image in the scenario that should be credible and desirable. However, the issue of assessment is always tricky in foresight exercises, because of the uncertainties (i) on the future state of systems, (ii) on the future salience of assessment criteria, when compared to present. To what extent the matters of today will still matter in the future? The choice of those criteria, and of the hypothesis on the future state of systems, have major consequences in terms of results of the scenario building process. For instance, an agricultural scenario considering that soil fertility will remain constant in the long run ignores some current signals on soil quality degradation and possible negative long-term effects of current practices. Assessing scenarios only in terms of crop production may favour

[16] The addition of the dotted line suggesting a collapse in the BAU in terms of environmental efficiency is ours.

productivist scenarios, while criteria on employment, environmental issues, farm dependency on inputs… call for alternative radical scenarios and are indeed the reasons for building such scenarios. Therefore, assessing an AE scenario implies to build a specific assessment grid. In fact, those two activities (building a scenario / an assessment grid) are intrinsically linked. Indeed, scenarios, as they reflect underlying worldviews and values, carry (more or less explicitly) an assessment grid. Comparing scenarios is a way to reveal sometimes implicit criteria, and is in itself a form of assessment. In the case of AE, building a business-as-usual (BAU) scenario, in order to formalise the project underlying the productivist paradigm, therefore appears as crucial.

4.2.1 The importance of the business-as-usual scenario

Indeed, if the productivist paradigm is clearly explicit on some assessment criteria (the amount of food production, competitiveness), mostly quantitative, it leaves aside numerous blind spots such as the number of farms and farmers, key environmental issues such as biodiversity and landscape and climate, health risk management. Therefore, we believe that building a "business-as-usual" scenario, according to the productivist paradigm assumptions, is a key methodological requirement in a foresight exercise on the future of European agriculture. Indeed, formalising this BAU scenario, in the same systemic approach as the one advocated in the previous section of the document, would reveal the positive and negative outcomes of the productivist paradigm. One can assume that the negative ones outweigh the positive ones but the effort of formalisation required by building a BAU scenario is a relevant way to check this implicit assumption.

From a methodological point of view, a forecasting approach is the best suited for building the BAU scenario, in order to extend current tendencies of the dominant agro-food regime evolution. However, this "extension" is not about drawing future lines based on the mere continuation of past trends. It is more about identifying the changes to come, if the current regulation system that has accompanied those trends is maintained. Therefore, an attentive analysis of communication documents published by organisations of this regime, explicitly or implicitly embedding an image for the future of agro-food systems, should be realised to identify their underlying assumptions. For instance, the sustainable intensification paradigm can be considered as a plausible way of evolution of the agro-food regime, already present in its discourse. It can then be the basis for a BAU scenario, although it implies significant changes. Current "weak" signals on the evolution of agroecosystems states should also be taken into account, as their evolution cannot be simply considered as an extension of past trends, as some breaking points might be reached in a close future. For example, the current trends can put high pressure on soil functioning that could undermine the basis of the conventional or sustainable intensification production systems.

To sum up, formalising a BAU scenario for European agro-food systems is important to show what are the possible deadlocks of the dominant regime. Communicating this scenario in a future-oriented debate should lead its participants to assess how this BAU scenario is feasible and desirable, and highlight who would be the losers and winners of this worldview.

The BAU scenario is also important in an assessment perspective, as its building will reveal the assessment criteria considered and neglected by the dominant regime. It will therefore provide a basis to build an assessment framework for an AE scenario. Indeed, in order to

have a place in the future-oriented debate, an AE scenario should be explicit, as much as possible, on the criteria addressed in the BAU scenario, otherwise it won't be audible. That is the reason why we discussed the way AE scenarios could be credible on the global food security issue. But its added value would lie mostly in making explicit the blind spots of the dominant paradigm, through a comparison between an AE scenario, undertaking those "forgotten" issues, and a BAU scenario. We need a holistic comparison of the two competing scenarios: how should it be conducted?

4.2.2 The narrative as a social assessment

An AE scenario represents a radical change of the existing agro-food system. While a "classic" comparative economic analysis could help to compare the AE scenario to the other narratives, it certainly not suffices as will be shown later. For example, the disappearing of jobs in the agro-chemical industries must be confronted against the creation of new jobs at farm and retailing levels. Changes of prices/costs reflect new shares in the whole value chain and thus new winners and losers: what is considered as a "cost" today can also be a gain in the future.

However, one needs to take a broader approach to fully describe those changes. It implies to propose another perspective on the goals of the agro-food system as a whole. We propose to complement this economic, reductionist approach, to a one based on the very content of each narrative. The narrative embedded in a scenario indeed expresses a worldview, that is, values and meaning, on which the assessment framework should be designed. Compared to a BAU scenario, an AE scenario would encompass a greater variety of dimensions, from technical to social and political issues (see previous section) and new forms of organisations to address the issues faced by the current dominant agro-food regime (environmental, social and economic current challenges). The consistency, credibility, desirability of the scenario and its capacity to address those challenges is in itself a form of assessment. The challenge is to ground this credibility and desirability in concrete transformations of the agro-food and political systems, not only in general principles (as it is often the case for the productivity narrative), but in revealing how the whole types of actors are impacted. This is why the articulation between micro, meso and macro scale changes is particularly important (see previous section), as well as "giving flesh" to AE, as outlined in the introduction.

Another criterion for assessing an AE scenario lies in its feasibility: is the image reachable? A way to address this question is to build a transition pathway from the current situation towards an image of an AE Europe, to show that a credible path can be built.

4.3 Addressing the difficulties: what transition for AE?

Some scenarios (most of them in fact) focus on describing a future image of a system, but don't propose a pathway between the present and this image, leaving possible transition pathways implicit. However, in the case of an AE scenario, built on a normative objective, considering seriously transition issues is essential. Firstly, it participates in the robustness and credibility of the final image by showing its feasibility. On another level, it is also a condition of access to the future-oriented debate on European agriculture: an AE scenario tends to be denied by the dominant actors of this debate, claiming it is impossible. In order to make an AE scenario exist in the debate, showing its feasibility through the rigorous

formalisation of a transition pathway is therefore a key condition. It would open the “field of possibilities” by consolidating a “taboo” scenario. One could note that the actors supporting the agro-food regime and the associated productivity narrative do not provide such an effort of formalisation. This is actually because stakeholders supporting AE are less powerful than the dominant actors in the future-oriented and policy debates, that they have to provide more efforts in terms of formalisation, as they bear the burden of proof.

However, building transition pathways is far from obvious. It requires identifying the levers of action that could undermine the current dominant regime, and organising them in a coherent temporal sequence. The multi-level perspective, developed for the studies of socio-technical transitions (see Figure 1) is very helpful in this regard, as it offers a heuristic framework to organise the reflexion on transition. A retrospective analysis, and the BAU scenario building, are also also valuable in this respect, as they can reveal the mechanisms at play in the evolution of the dominant regime, and the lock-ins explaining its self-reinforcing.

While it is difficult to give a complete and precise overview of the factors that should be considered to build a coherent transition pathway, three key points can already been highlighted.

The first is that we will need to look “beyond the CAP” to craft an AE scenario. While it is clear that the current CAP is not sufficient and is even an obstacle to an AE transition, this document has tried to shed light on the need to consider other policy frameworks, such as health, energy, research and education, trade policies… The case of the research policy fully illustrates this idea. One could think that its contribution to AE development mainly depends on the amount of funding that can be directed towards AE-oriented research programs. However, as highlighted by (Stassart et al., 2012), AE requires participative research programs, with applied results, which do not necessarily meet current standard academic assessment criteria, disadvantaging researchers in a more and more competitive research context. Therefore, the contribution of research to AE transition is way more than a funding issue: it is about at least protecting “research niches” for people involved in AE-oriented projects as a start, but more deeply about a redesign of the whole research model, with new steering criteria, new processes and partnerships. This redesign should be extended to a deep reform of knowledge transfer organisation and extension services, giving more room to bottom-up processes and local knowledge. These changes could not be complete without a redesign of education, with a reorientation of programs towards AE principles and methods, a development of continuous training, new teaching methods…

This leads us to our second point: the need to adopt a systemic perspective to reflect upon socio-technical regime changes. Common features of the different types of changes is that they imply designing new assessment and steering frameworks, associated with new distributions: a new distribution along the value chain, a new distribution of farmers on lands as the AE transition can not be reached with exactly the same farmers, a new distribution of activities between urban and rural areas, a new distribution of power relations… Which to sum up means a new distribution of winners and losers between the existing and coming actors. However, if new regulatory or organisational frameworks organising those new distribution patterns can already be designed, the main difficulty lies in the processes leading to those new frameworks. The challenge of building a transition

pathway is particularly strong for the very first steps: what can be the triggering event(s) able to deviate the agro-food systems from their path dependency? If it is quite convenient to think in terms of crisis (e.g. a sanitary crisis linked to pesticides, trigger of a broad mobilisation, that gains enough power to impose a ban on pesticides), past experiences has shown that crises do not systemically lead to significant changes in socio-technical regimes. The framing of socio-technical transition studies helps to reduce the weight of specific triggering events, showing that transition happens when a conjunction of conditions, that can take place in the landscape, regime or niches, is gathered (see Figure 1). It also emphasises the time frame of transition processes: it usually takes decades for a transition cycle to be complete.

The question of the time frame constitute our third point. In this respect, the example of agricultural modernisation in the 20th century is particularly enlightening. Indeed, after World War II, it took a generation (30-40 years) to radically change the structure of European farming and food systems. However, the policy model that set the basis for this radical change, that went beyond the agricultural sector as it was embedded in national post-war reconstruction processes, was designed in a short period of time. It took only ten years to go from the Marshall Plan to the Treaty of Rome founding the Common Agricultural Policy. Having this in mind, one can realistically thinks that the time frame of the transition pathway of an AE scenario could similarly be around 40 years. A major obstacle towards such a quick transition is however the existence of strong path-dependencies in current policies. A transition pathway towards an AE image should therefore start with quick policy changes in the ten to fifteen first years. A second lesson to be drawn from the "modernization story" is that change of the socio-technical regime depends of a shift in the priorities of both private and public actions. Agricultural modernisation happened because of a conjunction of interests between private firms, farmers' organisations and governments. A shift of priorities, towards the ones an AE project can actually address (such as environmental, health, social… issues), requires a new framing of what matters in our worldviews.

6 Conclusion: the spirit before the figures

The reading of the previous pages might cause dizziness when considering the complexity of the questions. Not only are the themes to apprehend numerous and complex; but the question of how, practically, to describe European and local dynamics, considering ecological, sociological and economical aspects altogether, is a truly challenging one. If one tries to figure out the format of the ideal document, it should be analytic and holistic, detailed and synthetic, narrative and quantified: in brief, short and long. To quote Paul Valery[17], the AE scenario enterprise has to deal with this intrinsic difficulty: "*what is simple is wrong, what is complicated is useless*".

In identifying this fundamental difficulty, our intention is not to say that there is no point in initiating any AE scenario enterprise. On the contrary, it is to stress on the fact that it is more than ever needed. Any work/research contributing to this future oriented vision is welcomed, all the more when considering the risks and the unaddressed issues associated with the continuation of conventional farming and food systems. Our intent in this document has been to propose a balance between the wider view in the understanding of AE scenario challenges and precise socio-technical issues dealing with a European vision of agroecology. By doing so, we want to propose a holistic frame in which different kinds of works can be undertaken. Local/global; based on farming systems, on food chains or on governance; emphasising on one particular environmental aspect (e.g. climate and carbon) or holistic: one can envisage different entry points. The important issue is to be able to position any work in a wider frame; what, we hope, this document can help for.

Coming back to our initial question — "*how to make an AE scenario convincing?*" our conclusion can however be more specific regarding the two different ways — but by no means opposed — one can choose to answer it. The first one is more quantitative, considering that decision makers and stakeholders can only be convinced by figures derived from robust models. Indeed, quantification is needed to check that fundamental laws of nature are obeyed (e.g. the fact that one cannot produce more than what fertility cycles allows); and such checking can mobilise a lot of effort in order to be fully equipped.

The second way of addressing the question is to point to values. The above discussion on transition pathways concludes on the necessary changes in worldviews in order to make another food system happen. To us, this social perspective is prior to any further valuation, notably of socio-economic order. The value of agroecology, even when converted in monetary terms in order to convince the above stakeholders, will firstly depend on its social interest. Quantification is needed to show that an AE scenario is feasible and, in many ways, more efficient that the BAU. In our case, it is useful in order to prove that we are not to eat only vegetables or local grazing beef in the future. But this alone does not allow showing that it is desirable, which is its first condition to happen — and thus making worth being quantified. In this perspective, the spirit — i.e. the values — of the scenario must precede the effort of quantification in the logic of the enterprise.

[17] French poet and essayist (1871-1945).

Working on the values might seem unconvincing, as if it seems "too easy" to change these values to give consistence to the AE scenario. But, not only to mention that it is not that simple to correctly apprehend what can be the future values of a complex society (avoiding any rosy simplification), it would reversely be a mistake not to consider changes in values and their consequent effects. History has shown that similar changes took place in the past. Present is blurred and bears anxiety in many perspectives, but there is at least one robust conclusion: it is very unlikely that the values and governance systems based on the "infinite world", and the related belief in growth, will be able to sustain for long. In a scenario perspective, we are then entitled to elaborate on alternative values. This does not mean that one only as to conceive a utopia to make it happen; but it is all the same likely that there is no way for such a utopia to take any consistency if it is not properly designed, discussed and put in the debate on future. How to make it, in which *fora*, is a discussion out of the scope of this document, but it is clearly its final perspective.

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