Social and Technological Transformation of Farming Systems:

Diverging and Converging Pathways

Proceedings of the 12th European IFSA Symposium
12th - 15th July 2016 at Harper Adams University, United Kingdom

Volume 3

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Harper Adams University

IFSA INTERNATIONAL FARMING SYSTEMS ASSOCIATION EUROPE GROUP

Workshop 5.4: Exploring farmers' conditions, strategies and performances in a context of multi-dimensional policy requirements, market imperfections and globalisation: towards a conceptual model

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Farmers face various regulatory, factor, demand and financial conditions at different levels: global, European, national, regional and local. Regulatory conditions refer to the Common Agricultural Policy (CAP), environmental legislation, zoning laws, food safety standards, financial policies, competition policy, etc. Factor conditions refer to the access of farmers to land (including natural resources and ecosystem services), labour and capital on the one hand and external inputs (e.g., chemicals, fertilisers, energy) on the other. Demand conditions refer to the various output markets in which farmers sell their output. This ranges from global food supply chains to local food systems, and involves a range of organisational arrangements such as spot markets, contracts and cooperatives; payment for ecosystem services schemes should also be considered. Conditions related to finance and risk management refer to farmers' access to credit and risk management instruments aimed at capital investment, working capital, hedging, etc. These various conditions are interrelated: for instance, the CAP has significant impact on land markets (capitalisation of direct payments), risk management (payments are buffers independent from markets), output markets (tariffs, producer organisations), etc. But these interrelationships are not well understood.

The aim of the workshop was to analyse farmers' strategies for dealing with external conditions and to identify sustainable practices and policies in the agricultural and food sectors that support the sustainability of farmers in a context of multi-dimensional policy requirements, market imperfections and globalisation. The working group accepted papers that contribute to constructing a conceptual framework of market imperfections, policy requirements and their implications for farmers from various theoretical perspectives and disciplines, including but by no means limited to theories of risk management, farm business studies, political economy and structuration theory, social embeddedness, neoclassical economics and financial market studies, commodity and value chain analysis, food regime theory, political ecology and poststructuralism. This conceptual framework was built in order to capture the multidimensionality of conditions shaping farmers' strategies, vulnerabilities and performances (economic, environmental, social), the complexity of their drivers and their diversity across commodity sectors and regions.

At present, conditions, strategies and performances of farmers are variously defined and understood, depending often on the perspective of the stakeholders involved and the geographical and national context. To establish a more consolidated understanding of the multiple dimensions of conditions, strategies and performances, it is necessary to acknowledge and understand how these are understood and discussed among the range of stakeholders and disciplines involved.

How transaction costs shape market power: conceptualisation and policy implications

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Abstract: This paper conceptualises how market imperfections and transaction costs influence farmers' strategies for addressing changing external conditions. Such an integrated understanding is necessary for a new appraisal of the public policy role in order to develop robust solutions. We list the current changes affecting the agricultural sector and discuss how market power and adjustment costs may affect the spectrum of actions a farmer could take. Then we analyse the resulting new organisational forms emerging in agriculture. In particular, we focus on horizontal cooperation and vertical coordination. Finally, we question the changing role of government and how public and private mechanisms may reinforce each other or instead counteract.

Keywords: Market power, transaction costs, vertical coordination, cooperatives

Introduction

Primary production, that is agriculture, fisheries and aquaculture, forms the foundation of the food system. This key role induces a strong influence on society's welfare. That's why study of the agricultural sector efficiency should be of the highest importance for scientific research. The theory of market efficiency has evolved and the prevalence of market imperfections is nowadays fully acknowledged. In particular for farmers, the existence of transaction costs highly shape its structure and performance. Indeed, as economic agents, primary producers aim at generating a sufficient amount of income, but their financial conditions are highly dependent on public and private actors they are interacting with. Because of the existence of transaction costs, business interactions lead to market power inducing an unequal distribution of the cost of market imperfections.

In this paper, we conceptualise how market imperfections and in particular transaction costs influence the strategies that farmers will adopt following changes in conditions. Such an integrated understanding is necessary for a new appraisal of the public policy role in order to develop robust solutions. To do so, we first describe the nature of the farm and the market imperfections affecting it. We then list the current changes affecting the agricultural sector and discuss how market power and adjustment costs may affect the spectrum of actions a farmer could take. The following section analyses the resulting new organisational forms emerging. In particular, we focus on horizontal cooperation and vertical integration. Finally, we question the changing role of government and how public and private mechanisms may reinforce or instead counteract each other. We finish with our conclusions.

The nature of the farm and the farmer's web of transactions

A farmer converts a set of inputs into a set of outputs using a set of production factors (land, labour and assets) and a set of technologies. What the farmer does not produce himself needs to be bought from other actors through market-based transactions. Decisions are made based on the relative prices of outputs and factors of production that reflect their opportunity costs.

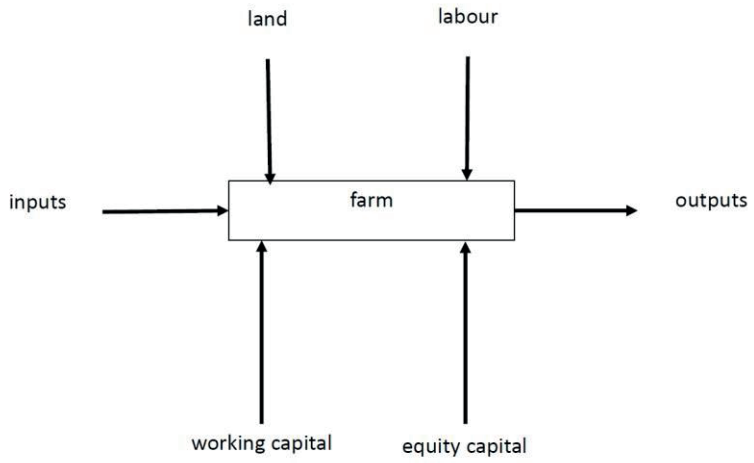

Figure 1. The nature of the farm

Overall, neo-classical economic theory posits that the resulting market-based equilibrium will efficiently allocate scarce resources, thus creating the highest welfare for society. However, this credo is based on four critical assumptions:

1. There is perfect information, that is, knowledge about all relevant issues exists and is distributed equally among economic actors. This ensures that the price formation is perfect in such a way that it includes all costs induced by production. Given that all actors are perfectly informed about prices which are themselves perfect, decisions are optimal.

2. There are no adjustment costs, that is, consumers can change supplier without cost, producers can change buyer at no cost or producers can change their production orientation freely. Hence, farmers can perfectly adapt to changes in the conditions and move to the newly optimal resource allocation.

3. There is no uncertainty on production, prices, and all necessary information to take optimal decisions in the long run. Hence, farmers take decisions in a non-probabilistic setting and optimise based on certain output. There is no risk associated with their decision.

4. Economic actors behave rationally, that is not opportunistically.

Both empirical evidence and new theoretical advances have contested these conditions. Williamson (2000) introduced the more realistic "science of contract" instead of the too

theoretic “science of choice”. To understand the motivation of this shift, one needs to clearly identify how real transactions differ from the neo-classical assumptions. Differences can be grouped under five classes of market imperfections: imperfect information, externalities, uncertainty, bounded rationality and the existence of transaction costs. Because the structural changes in the conditions of the agricultural sector and food production have led to a new appraisal of the latter of these five market imperfections, we will shorty describe the first four and focus on the fifth one. Yet it bears emphasis that market imperfections are intrinsically interacting such that the study of one cannot be completely disentangled from the appreciation of the others.

A first market imperfection is that **information is often imperfect** and distributed unequally between actors so that some parties have informational advantage. Asymmetric information induces some cost of monitoring in order to incentivise agents to behave according to one’s interest and to prevent moral hazard. In the same vein, imperfect information also affects consumers who are often blinded about the intrinsic quality of products. That is why often a producer needs to signal the type of products he sells in order to attract the consumer valuing his product the best and to capture the highest share of the surplus. Finally, society’s welfare is affected by missing information about resource scarcity. Indeed, as water, land, pollution, etc. are difficult to measure, they are not integrated into the price formation mechanism and hence environmental externalities are often not considered in the choice of resource allocation.

Second, there is **uncertainty** about production and prices. This is particularly the case in agriculture, as nature, which is often unpredictable, is one of the main determinants. Moreover, when products are commercialised, the literature identifies three types of risk: primary, competitive and supplier-based (Sutcliffe & Zaheer, 1998).

Third, an agent’s **rationality is bounded**. Indeed, human beings are limited in their capacity to foresee all possible states of the world and the associated set of probabilities and output. That is why they tend to behave opportunistically, making relationships unstable.

The fourth and most important market imperfection is that the simple fact of selling production induces costs, so-called **transaction costs** (Coase, 1937). Indeed, transactions in markets are not frictionless and hence inflate opportunity costs by other costs associated simply with the fact of entering the market. Transaction costs can take two forms: they can be proportional or fixed (Key et al., 2000). The former increase proportionally with the number of units exchanged and are associated with transportation and imperfect information. The latter act as a lump-sum tax and include the costs of search for customer or salesperson, the negotiation and bargaining costs and the cost associated with monitoring - that is screening, enforcing and supervising (Key et al., 2000). If they do not induce subsidies or higher prices, the key point here is that usually these costs are borne by actors upstream, i.e. farmers. Hence, to save on transaction costs, farmers may engage in long-lasting relationships with suppliers and buyers.

Transactions costs coexist with another type of costs: **adjustment costs**. Indeed, when farmers decide to alter their input mix and/or output mix in order to respond adequately to changes in conditions, new transactions may have to be organised. These potentially lead to

new relationships and hence new transaction costs. The resulting adjustment costs act as barriers preventing exit of a given type of production and hence reduce the potential of the market to readjust to the new optimum. Farmers' adaptation to the new conditions might induce two types of adjustment costs: short term versus long term change in the cost structure.

First, we define short run adjustment costs as those that only relate to the amount of inputs, with given levels of quasi-fixed and fixed inputs. Operational decisions are made in the short run within the framework of strategic choices and relate to the amount of inputs and outputs. These decisions are determined by the relative opportunity costs of all inputs and outputs and are facilitated by **working capital markets** (including supplier credit and buyer advance payments).

Second, adjustment costs can result from changes in the long run. These are linked to strategic decisions which are decisions in the long run related to the technology set used and to whether to make or buy certain inputs or factors. These decisions are facilitated by **equity capital markets** in case not enough own financial resources are available. Hence, they also affect the level of debt of the farmer.

Two final remarks are worth stressing in order to completely grasp the nature of the farm and how its structural form determines the set of strategies available to the farmer following changes in market conditions. First, if consumers and producers were to be a single integrated entity, market imperfections in general and transaction costs in particular would not exist. As the overall agricultural economy evolved from auto-consumption to market-based production, transaction costs appeared and have tended to increase. Transaction costs explain why some farmers still do not find it profitable to enter the market in developing countries and prefer consuming all that they produce (Eswaran & Kotwal, 1986; Sadoulet et al., 1998; Goetz, 1992; de Janvry & Sadoulet, 1994). The second relevant observation is that during the last decades, there has been a shift from family farming to bigger but more specialised farms. This is mainly explained by the gains from labour specialisation and economies of scale. However, this new structural form required gradually more trade with external actors so that the decrease in family farming has changed the type and distribution of business costs. In particular, farmers now have to interact with external actors downstream, whereby they could lose part of their freedom and take the risk of bearing a higher share of transaction costs. Indeed, the division of tasks between different entities leads to power games inducing that additional costs caused by changing market conditions might be shared unequally within the chain of actors. Yet the potential concentration at the farm level is limited. This is explained by the seasonal constraints placed by nature, inducing the trade-off between gains from specialisation and the subsequent increase in monitoring costs due to moral hazards problems (Allen & Lueck, 1998). Because it depends on nature and its rather unpredictable events, the organisational configuration of the farm is more restricted than its closest structural identity, the firm.

Changes in external conditions

The structure of the farm greatly shapes how farmers will suffer from changes in external conditions and the potential answer they will be able to develop to cope with these changes. A change in conditions can affect either inputs, outputs, factors or technology (Porter, 1998). According to the market imperfections prevailing on each of these, a change in conditions in one of them will have a relatively small or large effect on the situation of the producer and the

set of strategies he will need in order to cope with the new conditions. Hence, the proportion of the farm's functioning that is market-based will greatly determine the intensity at which it will be affected by external conditions.

The spectrum of actions a farmer could take following changing conditions depends on two characteristics of his current business: market power and adjustment costs. First, the degree of market power is reflected in the ability of an actor to raise prices above marginal costs. It is inversely correlated with the competition the actor faces on a given market. That is, the lower the competition, the higher the power of an agent to rule the market toward its profits. Second, adjustment costs, as defined supra, are the costs of changing the trajectory of the farm. Hence, it is proportional to exit and entry costs of a new activity. In this measure, sunk costs play a big role as they are unlikely to be reallocated to an alternative activity and weight the level of indebtedness of the farmer. Hence, adjustment costs depend on the level of specialisation of the farm: the more the farm is specialised, the bigger the adjustment costs. Figure 2 shows at which level of the farmer's decision-making process both market power and adjustment costs may come into play. Market power is linked to the number and distance of potential inputs/outputs. It is negatively correlated with the number of potential competitors and positively correlated with their distance in terms of product and business characteristics.

Imagine that an actor in the farmer's web changes his behaviour, to reinforce his competitiveness or simply to answer to new regulations, in such a way that costs are transferred upon the farmer. These would be externalities or spillover costs. These spillover costs alter the opportunity costs the farmer faces, such that he may want to take action either to avoid the spillover cost by changing supplier or buyer, or by adjusting his farm plan according to the new relative prices. How much of the new costs will be transferred to the farmer depends on his market power and adjustment costs because it is intrinsically linked to the possibility of both actors in the relationship to switch to an alternative contract. Hence, the adaptation capacity of the farmer depends on the existence of an oligopsony or even a monopsony downstream and the number of similar farmers he is competing with. How much a farmer can distinguish himself from the rest of the sector and what distance he holds to his competitors in terms of the quality of their products, crucially determine the bargaining power he will have towards a buyer who needs the type of products he sells. Then how much the farmer is dependent on the actor he is dealing with will also shape the share of the burden he will not be able to escape from because of unevenly distributed power.

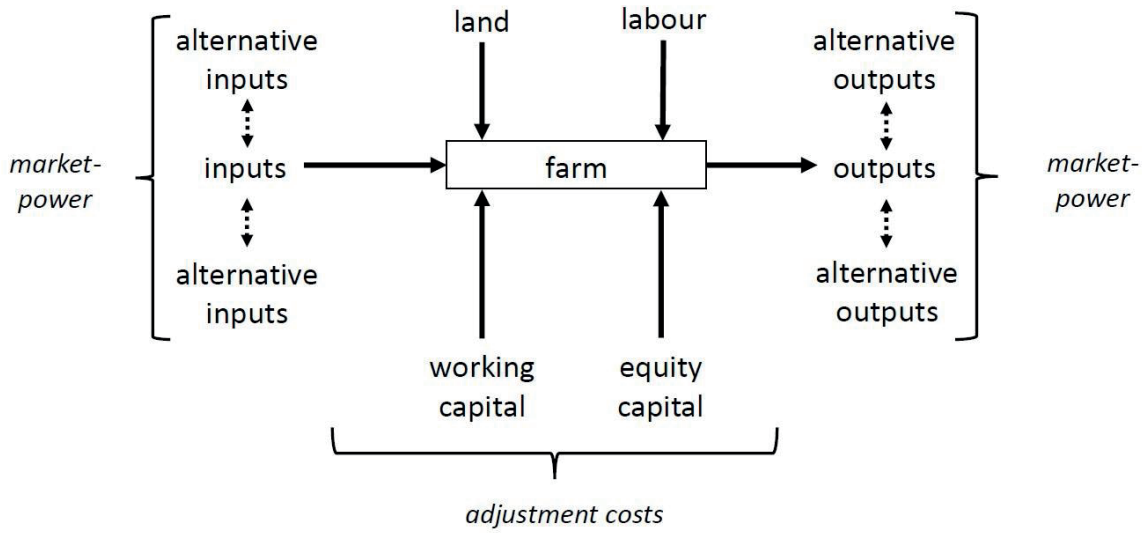

Figure 2: Market power and adjustment costs

During recent years, changes in conditions affecting the entire food market have required tremendous adaptations from farmers. The list of changing conditions is extensive, so that it is hard to provide an exhaustive description of it. At the top of these conditions, changing society's expectations towards farmers is the most prevalent one. While for decades the focus was on increasing farmers' income and welfare through agricultural extension and the resulting production increases, nowadays farmers are called to respect a set of "best management practices". The latter is designed by external actors whose main objective is food safety, resource conservation and environmental sustainability. In line with this, consumers' preferences are changing: not only do consumers want enough food, but they also require food to be of high quality, diverse, healthy and sustainably produced. In general, given the strengthening environmental pressure, farmers are asked for more sustainable management. This leads to increasing costs due to new regulations. Products must respect tight guidelines and high quality requirements which induce high transaction costs (Hobbs & Young, 2000). In addition, climate change has increased output uncertainty and hence risk associated with farming activities. Farmers, while being unsure about nature, not only need to cope with the risk of current choices but also need to undertake new investments in order to adapt their practices. Moreover, on the list of major changes in conditions, stands the reduction of global trade barriers. On the one hand, it enables price reduction through stronger competition and hence improves society's welfare. On the other hand, while farmers have to compete with an increasing set of competitors, national regulations are not always necessarily harmonised at a global level, leading to unfair, unstable and unpredictable competition. The growing role of financial markets also affects the scope of farmer's decision-making processes, making it enormously more complex and bringing tremendous uncertainty about price determinants. Finally, the decrease in the share of land still available increases the difficulty of starting a new activity and the level of farm's indebtedness due to high land cost. This observation reinforces barriers to entry, hampering young farmers from starting a new activity. It prevents new blood from entering the agricultural sectors and thus limits the potential for new ideas and reforms of the system as a whole.

Emergence of new organisational forms

To cope with the threat of increasing transaction costs following changes in conditions, farmers are engaged in two types of strategies. First, horizontal cooperation entails a collaboration among farmers to capture economies of scale or increase market power. Here, farmers take the initiative. Second, vertical cooperation entails a collaboration between farmers and other supply chain actors. Farmers are not usually in the lead here.

Horizontal cooperation

A first action small producers have found to be successful is the formation of associations to bargain collectively with sellers of inputs or buyers of produce. The mechanism behind this strategy is a reduction in the number of parties: as the buyer tends to a monopsonistic power, sellers act collectively to reduce the number of their voices and hence increase their bargaining power. One necessary condition for the success of this strategy is that none of the cooperative members deviate from the ex-ante agreement. Ensuring the latter commitment relies on two characteristics: (1) none of the producers should be big enough to undertake the contract alone; and (2) a large cost of deviating should be credibly announced or informally known and believed ex-ante.

Figure 3 gives a simple representation of this evolution of transactions, within a very simplified supply chain involving sellers and buyers. All production steps are assumed to be confined within the same enterprise. Letters distinguish sellers according to the set of products they sell. The same applies to buyers. Hence both S_A are two different farms which produce the same set of crops.

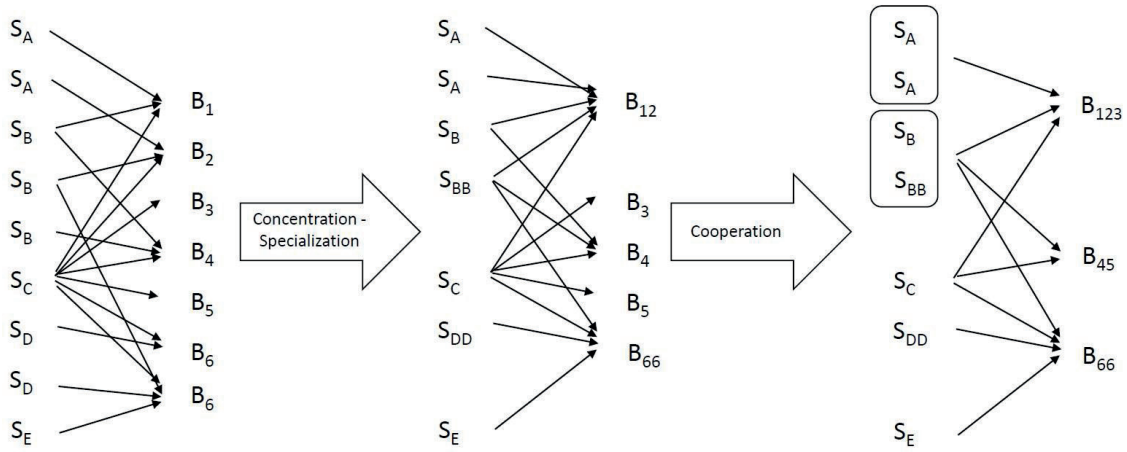

Figure 3. Evolution of transactions

In the first branch, many transactions take place between a high number of sellers and buyers. Then, sellers and buyers concentrate and specialise: some sellers merge with other ones of the same type while the same appear on the buyer side. Hence, in the second phase, the number of transactions is relatively reduced. Finally, in the last branch, some sellers decide to

cooperate: they bargain collectively with buyers. On the other hand, the fusion of buyers exacerbates. The number of transactions appears to be even more reduced.

What can be observed in general is that buyers' market-power has increased through the mergers leading to an oligopsony. However, the same appears on the sellers' side, even though their merging potential is intrinsically more limited. Moreover, within the cooperative, adjustment costs are reduced thanks to the possibility of shared investments. This limits the risk of hold-up from buyers. The main risk for collapse of the cooperative is that one member takes over the other ones. However, according to Allen and Lueck (1998), this phenomenon would be rather limited because of the moral hazard costs associated with nature. Hence, in our setting, it is more likely that S_A eats up S_c than S_A because merging with S_A would increase risk (because of the idiosyncrasy of shocks) and monitoring costs.

Vertical cooperation

Another tool is the development of new contractual forms. That is, actors write down bilateral commitments in order to avoid moral hazard problems and reduce transaction costs. Production and marketing contracts have been set in all subsets of the supply chain, from producers to processors and then retailers, so that actions are gradually more predictable and decided ex-ante. Hence, actors tend to coordinate. Vertical coordination is the means by which products move through the supply chain from producer to consumer (Mighell & Jones, 1963). To optimise production processes and costs, actors also gradually specialise more. Tasks tend to be harmonised or outsourced. This leads to very specific types of contracts in order to organise strategic alliances, joint ventures or franchising practices, among others (Young & Hobbs, 2002). Actors in the supply chain recognise each other to be complementary and take complex bilateral or multilateral well-written commitments in order to prevent agency issues.

Producers also rely on market segmentation in order to catch the biggest share of the consumer surplus. They do so by very differentiated products and the signalling of their quality to well-targeted consumers. It can also take the form of niche markets for new types of goods, facilitated by raising consumer demand for specific food products and by progress in agricultural biotechnology (Young & Hobbs, 2002). Signalling product quality is the key action to ensure good price reward of new sustainable practices. In this respect, labels are widely used nowadays. However, labels are very expensive and constitute a lump-sum cost. Hence, labelling needs not only to be well compensated by a much higher consumer willingness to pay but also by a catch of a non-negligible share of the market.

Vertical coordination may also have some disadvantages. *First*, because it induces thinner and hence more volatile spot markets, it increases risk for farmers not benefiting from contracts, and hence in particular smaller farmers and those from the developing world. Moreover, it increases the share of the market where the price in unknown and hence induces less transparent price formation and information (Young & Hobbs, 2002). Vertical coordination may thus increase information and negotiation costs for the farmer. Indeed, because long-term contractual obligations tremendously constrain farmer's future choices, engaging in one of these relationships means seriously comparing it with other potential alternatives. *Second*, the resulting increase in adjustment costs strengthen the positions of some actors at the cost of others. In particular, because contracts usually lock farmers into a relationship with retailers, the bargaining power of the latter is usually reinforced at the expense of the former (Hurt,

1994). An implication might be that retailers decide to change conditions and report the induced costs onto farmers because they do not have outside options. *Third*, another increase in adjustment costs comes from the investment in very specific assets following specialisation choice. Hence, not only adjustment costs are raised by the one-shot transaction cost of changing relationships but also by the disinvestment and reinvestment costs associated with a very specific production process. Another additional cost, which might be considered as non-rational, lies in the emotional costs for farmers of adopting a more systematised and blinded way of producing, where he does not necessarily see the final output of the chain he is part of. Finally, the requirement for sophisticated production skills and capital constitutes a barrier to entry for some producers. It is then likely that retailers will concentrate their contracts on a small group of producers in order to limit transaction costs (Boehlje, 1999). *Fourth*, when actors are organised in supply chains, additional costs will fall on each of them given that specific practices must be applied in every step of the production process. Hence, if competition is high in one stage of the supply chain and induces aggressive strategies, this might oblige upstream producers to change their practices and hence bear new costs. The probability that farmers will not be compensated for these new costs is inversely correlated with the level of their outside options. Hence, farmers with low market power might find it more secure to invest in additional transaction costs in order to safeguard their economic interests and to decrease the risk of being subject to opportunistic behaviour. *Fifth*, the organisation in supply chains may strengthen vulnerable situations due to the existence of squeezed actors. Indeed, market imperfections for inputs and outputs may reinforce each other leading to a price-cost squeeze when the input is essential. In the same vein, spillover costs on a factor (e.g. land) means that the farmer wants to change his plan so as to obtain a higher return on that factor. This can be hindered by the fact that there is also a spillover effect on inputs (e.g., fertiliser)

Changing role of government: how public and private mechanisms may reinforce or counteract each other

The kinds of changes affecting the farming system are likely to call for a rethinking of agricultural policy as a whole. Economic theory states that without market imperfections the role of governments would be nil because prices would integrate all types of costs, assuming that consumers are able to determine what is good for themselves. However, as markets are not perfect, the traditional role of government has been to correct market failures and information asymmetries. That is why the main aim of political intervention is to remove the aforementioned distortions which affect not only producer welfare but also consumer welfare. This used to be done through the provision of public price reporting, publicly funded research and development activities, education and extension activities.

Yet, the role of government is complex and dual, having to balance between societal welfare and protection of producers (as food providers and individuals). One striking observation is the translation of increased requirements from society with respect to sustainability into public regulations, at farmers' cost. To counterbalance the resulting loss, institutional mechanisms that aim to reduce these new costs have emerged, such as the direct payments from the EU's Common Agricultural Policy (CAP). However, as support from the state has increased, requirements in term of farming practices have also raised considerably so that it is hard to conclude on the net welfare improvement for farmers. Moreover, as government keeps on providing subsidies, they also accentuate price distortion and thus unfair competition, so that

it incentivises farmers to look for solutions outside of the free market. In this respect, one meaningful observation is that the agri-food sector as a whole is experimenting with new tools to cope with the rising costs, reflecting a partial failure of the state.

Another relevant remark is that public support helps farmers start a new activity in the form of the CAP's second pillar payments, but exit support seems to be rather absent. This lack of flexibility, reinforced by specialisation trends, explains why some farmers keep on producing goods in a non-optimal or even unsustainable way. Those are consequences from sunk-costs, which calls for new agricultural policy.

Overall, the sector nowadays is characterised by a mix of private and public policy. First of all, there is stronger private sector involvement and leadership. This is mainly reflected by producers' associations. Economic theory predicts under-investment by farmers due to risk aversion, under-evaluation of potential return and lack of exclusivity and rivalry. This leads to a market failure whereby public investment is needed. However, due to technological advances, it is often now possible to secure investments (Young & Hobbs, 2002). Moreover, labelling is increasingly undertaken by the private sector, GlobalGAP being one meaningful example of how the number of different standards has risen sharply. However, a large increase in the number of labels increases the cost for the consumer to get the information behind each of them. This is a new potential role for the public sector: ensuring that trust of the consumer in labels is well-placed. However, the increase in contracting and vertical coordination also places the control of markets outside the scope of government. Transactions are less transparent and hence sometimes unfair. Illegal behaviour is also less likely to be correctly monitored by government. However, monitoring could take place thanks to the existence of some informal mechanisms. Indeed, because actors are organised in well-integrated supply chains, where they often meet, they are likely to hold more information about each other than the government does. Moreover, as they are organised in supply chains, sanctions or reputational breach of one of them is likely to affect the entire chain of actors. That is why government may count on the whole chain of actors to monitor their own practices within a given supply chain. This informal mechanism would work only if threat is high, that is the probability of detection is high, and the cost of deviating is also large enough.

Finally, a remaining remark about governance mechanisms and their interplay lies in the heterogeneity and well-adaptation of the set of tools needed. Indeed, to analyse what is the need for policy from government, one needs to understand first what already exists. This is different according to the sector as the nature of the products determines the type of relationship that prevails and hence the extent and type of market failure. Some sectors have been characterised by market failure for ages and have hence developed solutions to cope with it while some other sectors face new market failures which affects the position of certain actors who do not always have the tools to fix it. In the latter situation, there is room for new governmental policy. In any case, new governmental forms will likely be of a hybrid type, that is, a mix of elements from both markets and hierarchy (Phil, 2000).

Conclusions

In this paper, we reflect on the structure of the farm and the farmer's web of interactions. The existence of market imperfections has now been fully acknowledged and researchers investigate their nature and how they impact farmers. We list these market imperfections and

focus on the prevalence of transaction costs. Indeed, the simple fact of selling products induces these types of costs. Moreover, the change in farms' structural form has required gradually more trade with external actors so that the type and distribution of business costs has changed. However, market imperfections not only affect farmers but also interact with each other. Hence, according to the market imperfections prevailing on each factor of the farm, a change in conditions on one of them will have a relatively small or larger effect on the situation of the producer and thus the set of strategies offered to him.

This being said, we show that market power and adjustment costs play a particularly big role in how a farmer will suffer from a change in a given condition. This will determine the share of the burden the farmer will have to bear because of unevenly distributed power. In particular, gradually more powerful retailers combined with reinforced stringent regulations, heavily affect farmers. To cope with it, farmers are engaged in two types of relationships. First, horizontal cooperation entails a collaboration among farmers to capture economies of scale and increase market power. Second, vertical cooperation entails a collaboration between farmers and other supply chain actors. In the first form of collaboration farmers take the initiative, while in the second one they are usually not in the lead.

The new structural form of the agricultural sector as a whole calls for a rethinking of public policy. Indeed, the fact that private actors are experimenting with new tools to cope with raising costs partially reflects a failure or inadequacy of policy intervention. Overall, the sector nowadays is characterised by a mix of private and public policy. Interestingly, the closed interactions between actors of supply chains might induce new incentive and mechanisms as sanctions and reputational breach of one of them is likely to affect the entire chain of actors. Finally, the set of tools needs to be well-adapted to the nature of a given sector, as this determines the type of market failure and the already-existing solutions actors have put in place in order to cope with them. However, not only does government need to give well-targeted and heterogeneous solutions to different sectors but they should also not under-estimate the need of unlocking farmers stuck in non-optimal situations, that is help transition between the different sectors.

Acknowledgements
The work has been developed within the project SUFISA - Sustainable finance for sustainable agriculture and fisheries (Horizon 2020 Grant agreement no 635577).

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Adaptation strategies and performances of three producer groups in times of change: lessons learned from the application of the CSP framework in three case studies

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Abstract: This paper aims to contribute to the further development of the theoretical framework of the Conditions-Strategies-Performances (CSP) framework by testing it in three case studies. The CSP framework helps to explore farmers' conditions, strategies and performances in a context of multidimensional policy requirements, market imperfections and globalisation. The basic assumption sees conditions as drivers for farmers' strategies that then result in performances of the sector. The approach consists of four steps aiming to identify changes in framework conditions over time, resources among relevant groups of primary producers, adaptation strategies and finally, to explore the related social, economic and environmental effects. The practical application is based on three case studies, two farmers' cooperations in Germany and Sweden, and the carp farming sector in Franconia. Results show that the approach provides a suitable conceptual framework. Its particular strength is the holistic nature of the assessment and that it focuses on changes, dynamics, strategic decisions and impacts that matter in societal terms. However, a wider application requires the operationalisation of the framework with sufficiently meaningful indicators and data and other questions emerging from the application of the CSP concept.

Keywords: Agriculture, aquaculture, framework conditions, adaptation strategies, sustainability, performance indicators, farm management

Introduction

Primary producers in the agricultural, aquaculture and food processing/marketing sector face various challenges when they want to produce in more sustainable ways. Policy and legal frameworks, factor and product markets, as well as biophysical and farm-specific conditions constitute a complex framework for food production, processing and marketing. Conditions that affect financial and risk management play a particularly important role as they impact not only on the current economic situation but also on the future competitiveness and viability of farms and food businesses.

The connections between framework conditions and the strategic and management decisions made by entrepreneurs are difficult to understand because of the diversity of constellations and the complexity of cause-effect relations. For the same reasons, it is difficult to design (policy) measures that are universally effective in supporting the introduction or maintenance

of sustainable practices. Both together pose a major challenge for policy makers. Crop production, animal husbandry, or freshwater fish production and the related businesses need effective orientation and support in order to manage the increasingly difficult economic situation while at the same time counteracting environmental and climate change impacts. Societal expectations regarding the sector's sustainability, a more efficient use of resources, and product and process quality tend to be rather high while the willingness to pay more for higher qualities and more sustainable production systems is rather limited.

This paper wants to contribute to the elaboration and operationalisation of a CSP-based methodology for capturing the complex interrelationships between external and internal conditions, (adaptation) strategies and (sustainability) performance. The basic theoretical framework used is inspired by Porter's 'diamond of determinants' (Figure 1) (Porter, 1990).

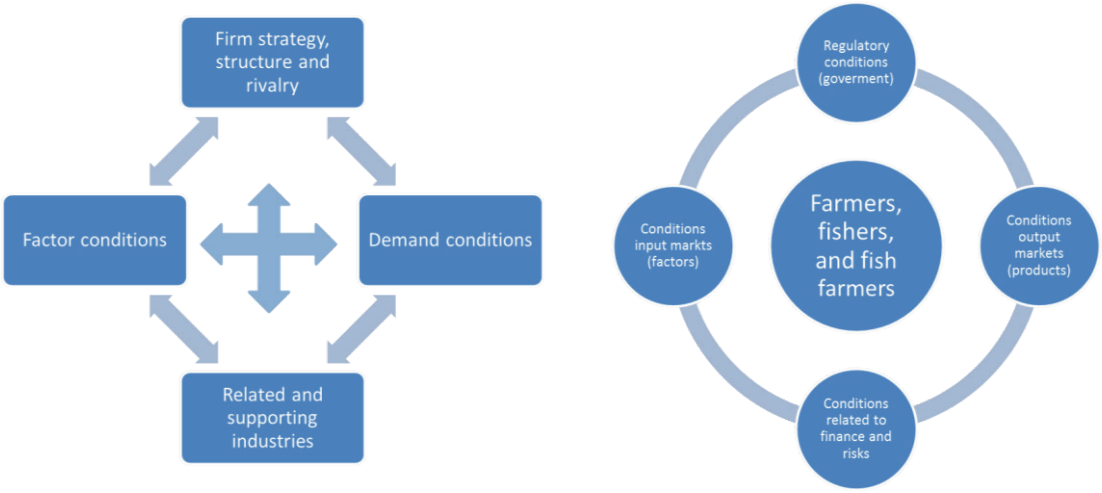

Figure 1 a) Determinants of National Competitive Advantage (Porter, 1990) **b) Multidimensional frame-work conditions for SUFISA**

For SUFISA[1], we have expanded the multidimensional framework of conditions (SUFISA, 2015). The basic idea is to make visible and better comprehend the complex interrelationships and feedbacks between conditions, strategies and performances (CSP).

In our contribution, we will use data from three case studies undertaken in the course of the EU funded HealthyGrowth[2] and SUCCESS[3] projects for a practical testing of the CSP

[1] The Horizon 2020 project 'Sustainable Finance for Sustainable Agriculture and Fisheries – SUFISA' is funded by the European Commission (EC). The purpose of SUFISA is to identify sustainable practices, policies and markets in the agricultural, fish and food sectors that support the sustainability of primary producers.

[2] At the centre of the Core Organic II project HealthyGrowth are 19 case studies in 10 European countries and in Turkey.
Research teams studied producer cooperations such as farmers' associations or cooperatives, food processing enterprises, wholesale and retail companies, as well as consumer initiatives - including the related supply chains for organic food.
(www.coreorganic2.org/healthygrowth)

[3] The Horizon 2020 project Strategic Use of Competitiveness towards Consolidating the Economic Sustainability of the European Seafood sector (SUCCESS) is funded by the European Commission (EC). According to the Blue Growth Strategy of the EC, SUCCESS aim to consolidate the economic sustainability and competitiveness of European fisheries and aquaculture sectors.

framework. We expect that the experiences from this practical application will support the further operationalisation of the CSP framework.

Methodology

Background of CSP framework development

The Horizon 2020-project SUFISA wants to apply the CSP framework in order "*to identify sustainable practices and policies in the agricultural and food sectors that support the sustainability of farmers in a context of multi-dimensional policy requirements, market imperfections and globalisation"* (SUFISA, 2015). Our understanding of the term farm or farmer includes fish farming even without mentioning explicitly aquaculture. The basic idea is to capture the multidimensionality of conditions that influence farmers' strategies, farm vulnerability and sustainability performance. We will use a systems approach in order to capture more effectively the diversity, complexity and dynamics in the interrelationships between conditions, strategies and performance. Related to this, a system approach will also support a more holistic integrated analysis, which in turn seems more commensurate with the complex policy-related questions addressed in SUFISA.

Our approach uses a combination of quantitative and qualitative methods. In its final application it will also support stakeholder engagement and participatory assessments.

Conditions, Strategies and Performances

Conditions, strategies and performances of farmers are variously defined and understood, depending for example on the particular perspective of a stakeholder or researcher and the particular geographical or cultural context. In the following sections, we will briefly sketch out our understanding of the key terms and assumptions applied.

Conditions

Porter's work on competitive advantages was the starting point for the development of the CSP framework. Porter argues that "*competitive advantage is created and stained through a highly localised process"* and that "*differences in national values, culture, economic structures, institutions, and histories all contribute to competitive success."* (Porter, 1990)

Figure 1 contrasts Porter's competitiveness determinants (Figure 1a) with the framework conditions that affect decision-making in the agriculture, fishery and aquaculture industries as applied in SUFISA (Figure 1b). In fact, primary producers in the farming and fishery industries face a wide range of regulatory, factor, demand and financial conditions at local levels (which in turn are affected by global, European, national and regional conditions). Legal and policy frameworks include those derived from the Common Agricultural Policy (CAP), environmental legislation, zoning laws, food safety standards, financial policies and competition policy. Factor conditions include access to land, labour, capital and external inputs (e.g. chemicals, fertilisers, energy) and the related costs.

Demand conditions refer essentially to the requirements as formulated by consumers, processors and retailers in various markets. The markets and outlets in which farmers sell their produce range from global food supply chains to local food systems, combinations and hybrids or nested markets (Van der Ploeg, 2015), and they imply a range of organisational arrangements such as supply contracts or marketing associations.

Strategies

"The core of strategy work is [...] discovering the critical factors in a situation and designing a way of coordinating and focusing actions to deal with those factors". (Rumelt, 2011) A strategy starts with the definition of long-term objectives, and defines particular courses of action as well as the allocation of resources necessary for carrying out these actions. Even when decision-makers claim not to have a formalised strategy, the management of the enterprise (or chain) is normally oriented through strategic considerations and decision-making. There is a rich variety of possible strategies (Mathur & Kenyon, 2011).

(Sustainability) performance

The CSP framework relates to performance in the three sustainable development dimensions. Decision makers in policy and administration want to know if adjustments in legislation or a new policy programme will have positive effects on farmers' economic situation or the protection of national resources. The CSP framework therefore encompasses a performance assessment. In our testing, we build on the EU-funded GLAMUR project that aimed at assessing the contribution of different types of food chains to sustainability goals of the society. Di Masso et al. (2015) explain that economic performance indicators were relatively easy to agree. Indicators are based on the key business and financial ratios resulting from returns, costs, assets, etc. For sectoral or regional analyses, they highlight indicators like the number of farms surviving a trend of closures, the mean farm income and dispersion are relevant figures, as well as the number of persons living from farming (including family members, farm employees, and seasonal workers.) They saw economic viability as a primary condition for the assessment of farm or food business projects. (Di Masso et al., 2016)

For the assessment of environmental performances, a long list of indicators is available. The use of indicators depends on the particular situation of natural resource use and nature conservation. (Kasperczyk & Knickel, 2006) Sustainability indicators offered by businesses usually relate to traceability and transparency of food chains and the communication of quality attributes. Policy programmes sometimes require the assessment of (positive) environmental effects. Data availability in respect to environmental indicators is a well-known constraint.

Social aspects represent an important sustainability dimension. GLAMUR teams tested several attributes e.g. livelihoods and social integration in the community and the need for generational replacement (e.g. the importance of young farmers'/breeders' associations to foster young labour). Partly, the social dimension emerged as the most relevant aspect of sustainability performance for local stakeholders. (Di Masso et al., 2016)

Other sustainability issues: ethical dimensions can be of particular importance in the agrifish-food sector and; the assessment of food chains often lacks indicators referring to taste. (Di Masso et al., 2016) Moreover, the issue of potential impact of food products on health is often subject to debate. This 'performance' requires at least an open dialogue.

CSP framework and practical application

The approach consists of the following working steps:

(1) Identification of major changes in market, regulatory, institutional and territorial conditions over time;

(2) Assessment of social, economic and other resources among relevant groups of primary producers;

(3) Analysis of (adaptation) strategies pursued (e.g. regarding the management of the chain and risks);

(4) Exploration of the related social, economic and environmental effects (sustainability performance).

Since the analysis focuses on the interrelationships between external and internal conditions, (adaptation) strategies and (sustainability) performance, the first important step is to express conditions, strategies and performances in absolute and/or relative terms, and - if possible - to relate them to different points in time. This will then allow us in a second step to relate the producer groups' strategies to changes in (framework) conditions on the one hand and to performances on the other.

For the practice test, we will apply the concept to three illustrative cases:

- *Öko-Korn-Nord* w.V., a farmers' association for organic cereals and legumes, located in Lower Saxony, northern Germany;
- Upplandsbondens, an organic beef farmers' association in central Sweden;
- Carp producers who run traditional low-intensity fish farms in Central and Upper Franconia (Aischgrund area), southern Germany.

The empirical analysis presented in the following section is based on qualitative interviews with managers or other key persons who know the particular situation well and the strategic plans of primary producers.

Interviews with HealthyGrowth case study partners of Öko-Korn-Nord and Upplandsbondens took place between 2014 and 2016. The case study on carp producers is part of a pilot study[4] carried out in the SUCCESS project.

Testing the theoretical framework with three case studies

The following sections briefly present each case study within its regional and sectoral context. In Step 1 of the CSP analysis, we identify periods that farmers perceived as particularly challenging or, in some instances, represented severe crises. The description of the conditions explains why the particular crisis hit farmers and/or the farmers' organisation. We will focus on those external and internal conditions that can be seen as central drivers (or determinants) of strategic adjustments. Other conditions play a role too but are only referred to as far as they are helpful in understanding the kind and scale of adjustments.

We pay particular attention to relate (adaptation) strategies with decision-making processes. Limitations in available data are identified and possibilities to overcome them discussed.

[4] This preliminary study on carp producers is based on a literature review and on personal communication with Dr Martin Oberle, Head of the Bavarian Department of Carp Farming, in 2015 and in early 2016. In-depth interviews with fish farmers and stakeholders representing various private and public agencies will take place in summer 2016 aiming to verify this preliminary analysis.

Figure 2. Logo of *Öko-Korn-Nord*

Farmers' association Öko-Korn-Nord

Until the early 1990s, the organic *Bohlsen* mill purchased grain directly from organic farmers. With an increasing number of suppliers, the mill's manager initiated the foundation of an independent producers' association (*Erzeugergemein-schaft*). The aim of this cooperation was to make contracting, quality testing, grain storage and logistics more efficient for the mill while at the same time safeguarding the opportunity to sell the total harvest under fair price conditions for the farmers. Today, *Öko-Korn-Nord*, is a so-called 'profit-making association' (w.V.). It constitutes a medium-size grain trading enterprise with significant storage capacities and quality testing facilities for a variety of organic cereal and legume crops. *Öko-Korn-Nord* is located in northern Germany and has around 100 member farms but also purchases from non-members.

Step 1: Identification of significant changes in conditions over time

We can cast two spotlights on the development of the farmers' association: the first focuses on 1991/92, and the second on 2003/4 (Figure 3).

In 1991/92, when the crop farmers' association was founded, commodity markets for grain had been in surplus for more than a decade. Each year, farmers faced a significant problem with marketing their produce. We summarise for the first spotlight:

- Market conditions were challenging for organic crop farmers in northern Germany. The market for organic food started to grow in line with the development of the green movement in the wider society. However, organic crops from relatively remote areas still received little public recognition;
- Policy conditions were relatively favourable with significant market intervention on the EU-level. On the regional level, the Ministry for Agriculture supported strongly the foundation of farmers' associations;
- At farm level, capacities for storage and marketing were limited. Instead, farmers used to sell to local traders.

The second spotlight relates to the period 2003/4 when market conditions were completely different. Cereal imports were higher than exports, and the relationship had turned into a demand market. Moreover, the demand for organic food including flour and other cereal products surged in Germany. EU market policy had changed in the meantime with the introduction of per hectare payments and an alleviation of trade policy measures.

Step 2: Assessment of social, economic and other resources of businesses

In 1991/92, organic farmers were weak players in the market. Most organic producers were small and medium scale family farms. The economic dependency on the local organic mill that expanded significantly was obvious. Back at the time, farmers sometimes perceived the prices paid by the mill to be unfair. On the other side, the mill enterprise itself was in a difficult situation, like many other smaller mills, because of the rapidly expanding scale of a few larger-scale corporations who processed increasing volumes in central plants. The concentration in food processing was accompanied by the rapidly increasing market power of retail

enterprises – all of it resulting in an increasing pressure on prices. Processors like *Bohlsen* mill suffered from this increasing pressure, which they (partly) passed on to the organic farms.

In 2003/4, the farmers' association had grown significantly with investments. Due to the substantial change in the general market situation, farmers now had the opportunity to sell independently and even sometimes realised higher prices than with *Öko-Korn-Nord*.

Step 3: Analysis of (adaptation) strategies pursued

In the early 1990s, farmers had expected the surplus situation to continue in European grain markets; rising prices were not in sight. Farm strategies therefore clearly focused on joint marketing.

Their aim was to establish a stable strategic cooperation and to implement a fair pricing system.
The 'pooling price model' introduced then consists of a baseline price for an annually defined standard grain quality. The baseline price is guaranteed for all farmers even when natural conditions cause very poor grain qualities. Farmers receive top-up payments for above standard qualities (e.g. high protein content or particularly good baking properties). For farmers, the membership of the association and use of the pool price model were significantly reducing risks (*ÖkoKorn-Nord,* 2016).

With respect to the fairness argument, members even discussed a pricing model that takes the real costs of production into account. However, as such a strategy would have increased the sales revenues for the least competitive farms this strategy was rejected (*Öko-Korn-Nord,* 2014).

In 2003/4, some farmers quit membership aiming to regain control of their sales while the majority continued with the well-working joint marketing. Fairness and incentives for quality production are still central in the association's strategy. Farmers' decisions to stay with *Öko-Korn-Nord* have become one option among others. Now, it depends on individual conditions and capacities. Consequently, *Öko-Korn-Nord* started to reflect on strategies helping them to remain attractive for members: excellent advice for growers; professionalisation of quality management; diversification of the product range; as well as improvement of marketing and communication have all become more important.

Step 4: Exploration of social, economic and environmental effects (performance)

The development of producer prices and of the income of member farmers compared to non-members might be suitable criteria for the assessment of the economic performance of *ÖkoKorn-Nord*. The proportion of farms that continued with organic farming due to membership compared with the average reduction of all (or of organic) farms in the area could be another indicator. While currently the related data for this quantitative assessment are not at hand, in principle they were available.

Qualitative assessments can for example show the positive impact of risk reduction in farming for family members. Regional level impacts include the effect the association has on the regional economy with its value added at the local level, the related tax payments, and the employment of 12 persons of different qualification levels.

Öko-Korn-Nord provides opportunities for organic crop farming with positive environmental impacts (in comparison to conventional farming).

The association has social performances through its engagement in the organic business network in the area, which supports organic start-ups, internships for young people, and supports environmental and cultural activities locally. However, these performances are difficult to assess due to the complexity of driving factors, and the lack of sufficiently disaggregated data.

We can also assume that the pool price had a direct effect on the farms' economic situation from the first year onwards. However, longer-term impacts on e.g. the viability of family farms in the area might be even more significant and should therefore be part of a CSP analysis.

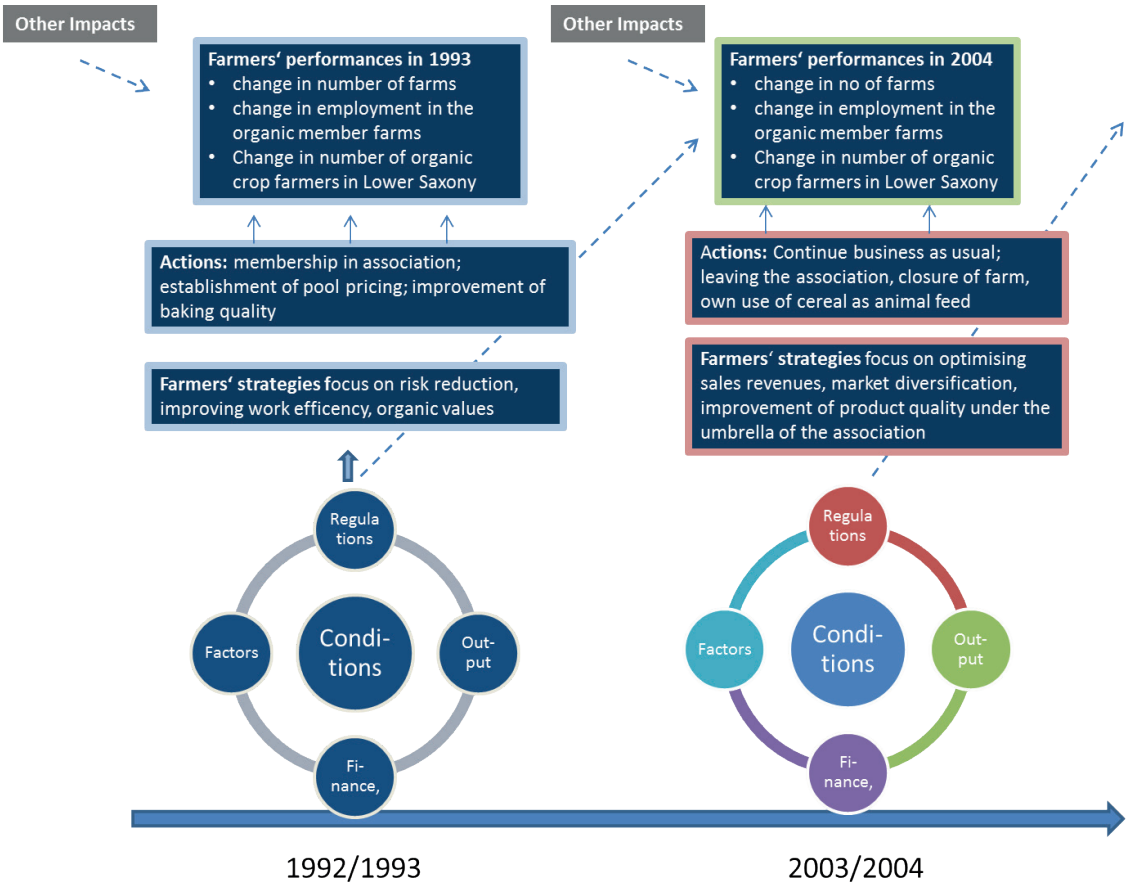

Figure 3. Visualisation of the CSP framework for two distinct points in time

Organic beef farming in Uppland, Sweden

Upplandsbondens (UB) is a farmer owned cooperative with approximately 100 members in the county of Uppland, Sweden. All member farms sell organically certified slaughter animals for beef, mutton, and pork production. The value chain in which the bulk of the meat is channelled consists of cattle farmers, the UB cooperative, slaughterhouses, meat wholesalers, retail shops and consumers. UB aims to produce, slaughter, pack and sell in the Uppland region alone. When doing this, UB uses its own brand "Upplandsbondens". However, since this is not possible (due to the market situation), UB sells the bulk of its meat on the national market. UB experienced several challenges in the course of its history since the start in 2006, the example we will focus on here was not due to external market or policy

conditions. Instead, structural conditions and the stakeholders' differing strategies caused the problems.

Step 1: Identification of significant changes in conditions over time

In principle, conditions for organic cattle farming were and are good. The area has numerous slaughterhouses with organic certification – a fact that many other regions cannot boast. This makes it possible for UB to select slaughterhouses in a way that would not be possible for a similar cooperative elsewhere. The Swedish market for organic beef developed well during the last ten years.

Spotlight 1: Since the cooperative aims for production, sales negotiations and development of the (local) label "Upplandsbondens", it has been seeking partnerships with several slaughterhouses, wholesalers and retailers in the region. This has proven a challenge from the start because it has been very difficult to find one or two suitable partners. This challenge continues over time. One promising partner went out of business, for example. The most important marketing channel is now a Stockholm-based meat wholesaler who delivers to retailers all over the country. It is a strong market partner. Together with UB, they have evolved on the organic meat market. COOP, one of the three dominant retailers, sells the UB meat under its own organic label, and thus the consumer is unaware of the meat's origin. While the farmers are paid premium prices, the brand and identity of the meat is lost and thus consumer loyalty cannot be developed.

Spotlight 2: In 2014/2015, UB set up cooperation with a local meat wholesaler. The idea was that UB meat remained in the region with local slaughtering, cutting, packaging, and sales to local supermarkets via this wholesaler. However, UB and this wholesaler did not share the same view on the importance of organics and they had difficulties building trust between themselves. Consequently, the UB label is hardly used, and the local market is not catered for, as was originally the idea. This situation is challenging because UB does not have any resources for self-organised marketing activities. Thus, UB seeks for alternative solutions.

At the same time, conditions on the organic market are strong. The demand for Swedish organic meat is high on the national market – in supermarkets and in public procurement. In 2014, the organic market grew 38% (Ekoweb, 2015) and in 2015 the growth was just as strong. Thus, the national market could absorb all the meat from UB. However, the structure and the orientation of processing and sales enterprises make conditions difficult for the farmers' cooperative.

Step 2: Assessment of social, economic and other resources of businesses

The fact that UB has attracted so many members (107) is a strength when negotiating with any business partner. On the other hand, the cooperative does not have any employees but works with voluntary labour and with a working board. The farmers in charge are always responsible for both the cooperative and their own farm business. Management capabilities at UB have often been lacking due to limited experience or lack of time on the part of the key people. In addition, the age of most board members – as well as the member farmers - is quite high, which is another issue for UB.

Board members have difficulties keeping the cooperative together; they need to satisfy members who want to go for the best price (slaughterhouses outside the Uppland region)

and members who care more about developing the local “Upplandsbondens” label and the local embeddedness of the meat sold via the UB cooperative.

Step 3: Analysis of (adaptation) strategies pursued

Spotlight 1, 2006: Farmers founded the cooperative Upplandsbondens (UB) in response to the poor opportunities for organic beef farmers to get a fair price for their products. The strategies of the cooperative have been focusing on the identification of suitable market solutions, the negotiation of the highest possible price for its members (*vis a vis* slaughterhouses and wholesalers) and the locally-based quality production, processing and marketing of the organic meat under their own label “Upplandsbondens”. However, UB has always had problems finding a stable and reliable local partner enterprise that would support the cooperative’s local sales’ strategy.

Since inception, more and more farmers decided to join the cooperative, mainly because the board members have been able to negotiate good prices for the slaughter animals. In 2015 most organic beef farmers in the region were members. In addition, the UB board helped farmers from other regions negotiate prices for the national market.

Spotlight 2, 2015: The strategy of UB focuses on meat sales in large supermarkets, but also on meat boxes available via the homepage. Due to the ongoing issue of the lack of a local partner, UB has accommodated its volumes of meat via a national wholesaler that caters for one of the largest retail chains in Sweden. In this value chain, the UB meat cannot be identified as such, but only as organic meat from Sweden. Due to the large number of slaughterhouses used by UB, sometimes slaughter animals travel longer distances. For some members, this is a natural thing, for others this is unthinkable because UB’s animal welfare strategy focuses on journeys that are as short as possible. Thus, UB tries to take into account the different strategies of its members and combine them with the cooperative’s own strategic orientation. This is often difficult due to potential inconsistencies. However, the strong market for organic meat absorbs UB’s produce despite the weaknesses in management and marketing.

Step 4: Exploration of social, economic and environmental effects (performance)

UB is able to realise high prices due to the strong demand for organic meat in Sweden and due to the successful cooperation with the national wholesaler. Both organisations work well together. Farmers are satisfied with the negotiation of good prices with the wholesaler. According to UB itself, the fact that the cooperative negotiates with one voice *vis a vis* slaughterhouses and wholesalers makes a world of difference. Slaughterhouses would prefer individual negotiations with farmers but UB works hard to prevent this. Thus, UB is able to influence the future of organic farms in the region in a positive way. It helps to improve the economy of the member farms, to increase awareness about high quality meat among consumers and farmers, it helps to sustain semi-natural grasslands (which are high in biodiversity) and it is able to provide the Swedish organic market with domestic products.

In contrast, UB has not yet been able to establish a stable marketing concept with the UB label building on the local origin. While there is a good slaughterhouse infrastructure in the Uppland region, and while it is adjacent to the larger Stockholm metropolitan area, the number of potential market partners (wholesalers) is very limited and the partnership established in 2014 did not take off. The identity of the UB meat is thus lost. The consumer cannot distinguish it from other organic meats. This implies that UB cannot build either

consumer loyalty or communication with its consumers. In a situation where the organic market does not grow as it does today and where competition between producers and retailers intensifies, UB has no means of profiting from its local embeddedness.

Carp farming in 'Karpfenland Aischgrund'

Carp aquaculture has an almost 1,000 year old history in Germany (Füllner et al., 2007). Today, after trout, carp is the second most important species farmed in German fresh waters (Destatis, 2014). In 2013 carp had a self-sufficiency rate of 76 % in Germany. This is remarkable, because it contra-trends the picture of the total German fish and seafood market, where 88% of the products come from abroad (FIZ, 2015). The Aischgrund is one of two important carp producing areas in Germany. In contrast to Upper Lusatia (Saxony), the Aischgrund in Central and Upper Franconia (Bavaria) is predominated by smallholder farmers who make their living from both aquaculture and agriculture. According to local fishery authorities, around 3,500 carp farmers produced between 2,000 and 3,000 MT of carp in 2013 (Vordermeier, 2013). The average per farm accounts for less than two ha[5] of ponds. Only 21of the local fish farms were large enough for specialisation in carp production.

Figure 4. Logo of the Corporate Carp Marketing Association

Step 1: Identification of significant changes in conditions over time

In the long-term, the German carp market is following a decreasing trend. However, the shrinking differs between periods and regions. According to estimates of the local authority, Aischgrund production fell from around 7,000 MT in 1992 to around 6,000 MT in 2004 (Vordermeier, 2013). Since 2005, this trend has been weakening resulting in a relatively stable supply and demand on the local market for carp. At the same time, the steadily decreasing trend continued on the national market. Although the situation seems to be more favourable than in other regions, we identified four significant challenges which Aischgrund carp farmers are facing:

- Low profitability reduces the attractiveness of the sector (Oberle, 2010). Young talents move out, and the average age of farm owners rises constantly (Bätzing, 2014);
- Low price imports from the neighbouring Czech Republic put pressure on local markets;
- Increasing losses characterise production. Due to environmental conservation objectives, the population of several fish predators recovered and led to high fish losses (Brämick, 2013). In particular, the cormorant causes a high predation pressure. Another concern is the growing beaver population.

[5] *Statistics of Aischgrund fish production: average pond size - about 0.4 ha; total of cultivated ponds - around 7,000 ha (Oberle, 2014)*

Step 2: Assessment of social, economic and other resources of businesses

Since mediaeval times, carp ponds have characterised the landscape and local culture in the Aischgrund. Local fisheries authorities provide support for the community of carp farmers. Carp farming is a cultural asset for the area enhancing the identification of local dwellers with smallholders' carp production. Due to the long-term tradition and the favourable image of the production system, carp meals are common in the area. Local people, who have eaten carp since childhood, continue to consume it (Bätzing, 2014). They contribute significantly to ensuring the local demand. Significant carp imports even show the potential for an increasing local supply. Traditionally, carp farmers use earth ponds and rear carp in polyculture with other species. This ensures a variety of sales products and a significant potential for a further differentiation of the product range. All these conditions improve farmers' opportunities.

In contrast, the smallholder structure is a problem. Farmers with small farms tend to slow down the diffusion of innovations, in particular when they need to address risk taking and financial investments. Access to finance is a particular issue.

Step 3: Analysis of (adaptation) strategies pursued

Since the middle of the 1990s, the different stakeholders of the region have critically analysed their market situation. Along with other engagements, the association '*Karpfenland Aischgrund e.V.'* was more and more active. Since 1999 the association has linked stakeholders such as carp producers, county authorities, fisheries authorities, tourist managers, gastronomy, farm stores, processors etc.). (www.karpfenland-aischgrund.eu).

The association has been aiming to enhance and coordinate the marketing of regional carp. All actors of the value chain were involved, including tourism and gastronomy. In 2013, the association changed significantly. Professional staff was hired for the first time, aiming to enforce the honorary engagement of the member organisations. Today, the association coordinates different cultural and re-creational activities related to carp production in the 17 Aischgrund districts (www.karpfenland-travel.com).

Regional stakeholders developed the strategy to certify the regional carp species "Aischgründer" as Protected Geographical Indication (PGI) according to EU law. This local value chain cooperation established new processing techniques and developed simultaneously innovative carp products like fillets with cut fish bones, smoked carp fillets, carp burgers and other new (convenient) fish products. Since 2014, the regional marketing strategy even encompassed the establishment of a local TV programme that, since summer 2015, informs about local farm production, cultural heritage or leisure activities (Lb Localbook Dietesheim, 2016).

Protection measures for fish stock against predators and beaver damage are very limited in traditional ponds. Wildlife conservation legislation is conflicting fish farmers' production. Under current legal framework conditions, farmers seem to be unable to establish any related strategies.

It is remarkable that traditional carp farmers did not develop strategies focusing on organic carp production. The rate of conversion is outstandingly low, although the niche market for organic fish is expanding (Lasner & Hamm, 2014). Even influential nature protection NGOs communicate to the consumers that carp farming is an ecological friendly aquaculture (Lasner et al., 2010).

Step 4: Exploration of social, economic and environmental effects (performance)

So far, it is difficult to conclude on sustainability performances. Information on the different types of performance is lacking, in particular regarding social, economic and environmental effects. Currently, it is impossible to give evidence of any causal relationship between actions taken and the demand for local carp and related tourist attractions.

Indicators of the tourism sector such as numbers of overnight stays and of visitors at the new carp museum will help with the socio-cultural performance assessment. Despite the mentioned restrictions, the lessons learned so far indicate that:

- returns from agriculture attenuated the pressure from the (stagnating) carp market. The additional income from arable farming helped to ensure fish farms' viability, measured in the number of remaining farms in the area;
- Aischgrund fish farmers are bound by tradition. Due to low profitability, farm succession, measured in young people trained and/or working in the sector, is a significant issue for the aging farmers' population. Consequently, the sector's performance on the employment of young people is low;
- the corporative marketing of *Aischgrund e.V*. contributed to stopping the downward trend in demand for carp in the area while in general the average trend of carp consumption continued to fall;
- carp production ensures the protection of the typical fish pond landscape in the valley of the river Aisch. This landscape represents the image for the socio-culture identity of the region and it is the key feature for the rural development strategy.

Concluding reflection on the use and further development of the CSP framework

The lessons learned from the practical application of the theoretical framework are as follows:

- Unit of analysis: we selected clearly defined groups of farmers for the testing of the CSP framework. However, for a sound application of the framework, the definition and delineation of the unit of analysis will be crucial. The object of investigation could be an economic cluster, a network or even a supply chain. The development of policy recommendations might even require much broader categories like the national dairy industry or low intensity crop farming in south eastern Europe. Similarly, the description of conditions tends to be complex and the related strategies of individuals differ even between neighbours. For that reason, it is of core relevance to define clearly the object of investigation;
- Researchers' perspective: it will be very important to discuss and make explicit different understandings and interpretations among researchers. Experiences from earlier projects with sustainability assessments show that transdisciplinary working groups are able to discuss and define suitable assessment approaches (GLAMUR, Sustainability A-Test). Such a participatory process though requires resources and time;
- Farm versus sector perspective: the CSP analysis can either focus on the analysis of the perspective of individual farmers or farmer groups, or instead take into account more the regional trends;
- Economic perspective: a fixed set of market, policy support and legal frameworks does not exist and conditions influence each other. Moreover, it will be impossible to relate directly conditions with certain actions and sustainability outcomes. Instead,

other economic sectors, international markets and speculation might drive the costs of land, machinery or fuel. Commodity prices depend on global demand and trade policies. It will not be possible to capture all sectors of the economy and their interferences. How can we delineate the sector analysis in meaningful ways?

- Dynamic perspective: conditions, strategies and situations or performances are never static. Producer and input prices follow short and long-term trends and are characterised by price volatility. Time lags, due to e.g. information gaps and inertia, take place and hamper the analysis of causal relations between conditions (as perceived by farmers), their strategic planning and actions taken. Sustainability performances are sometimes difficult to connect with individual farmers' actions.

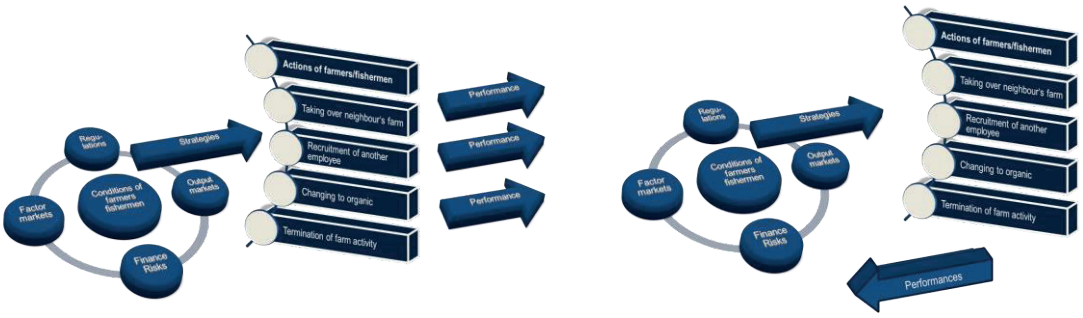

Figure 5. Different interpretations of interrelationships between conditions, strategies, actions and performances

We highlighted the particular importance of business-level actions and their dynamics as an additional level in the analysis. Strategies are not always consistent with subsequent actions. The analysis of strategy documents, e.g. financial investment planning, might explain what was expected to happen but they do not necessarily provide evidence of real actions. This issue is of particular importance for the application of the CSP framework in projections and in ex-ante policy impact assessments (see Figure 5).

With our discussion, we highlighted the challenges that we need to overcome when applying the CSP framework. The stepwise application of the CSP framework shows that the theoretical approach helps – in principle – to capture the complexity of the external and internal conditions and their impact on decision-making processes. The systematic analysis of the interrelationships between conditions, strategies, action(s) taken and sustainability performance is more difficult than assumed initially. However, an approach that takes into account changes in farmers' decision making and their (potential) impacts on the sector's productivity and sustainability represents a promising further development of the common methods for policy or market projections.

Acknowledgements

The German producer carp case study presented in this paper is financed by the EU H2020 project SUCCESS (grant agreement no 635188). This publication reflects the views only of the authors. The European Union cannot be held responsible for any use which may be made of the information contained therein. Moreover, the authors acknowledge the financial support for the project HealthyGrowth provided by the national agencies, in this case the German Ministry of Food and Agriculture with the Federal Programme for Organic Agriculture and

other forms of Sustainable Agriculture (BÖLN) and the Swedish Ministry for Rural Affairs. Both are partners of the FP7 ERA-net project CORE Organic II.

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Strategies for sustainable farming: an overview of theories and practices

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Abstract: This paper aims at developing a conceptual framework for the analysis of primary producers' strategies through the creation of three inventories of the conditions in which they operate, of the possible strategies they can implement, and of the related performances. The inventories and the description of the decision-making process are based on a literature review in which contributions from different fields of research are gathered. Starting from the Porters' model for farm competitiveness (Porter, 1998), farms' internal characters and eight groups of external conditions are identified. The former are gathered into two components: the "Farm" (assets and other elements of the farm as a structure and business, e.g. core business, location, logistics, land, technology); and the "Household" (elements characterising the farmers' household context, e.g. off-farm income sources, familiar composition and needs). External conditions are referred to the whole farms' business environment. They are grouped as follows: Factors, Demand, Regulation & Policy, Finance and Risk Management, Technological, Socio-institutional, Socio-demographic, Ecological. Then types of strategies are listed, ranging from risk management contracts to financialisation, from diversification to networking, from multifunctionality to part-time farming. Finally, types of performances are identified, ranging from the business oriented ones to the ones focused on households' welfare and to the broader environmental and social impacts. This framework can be used as a starting point for the analysis of the complex relations between conditions, strategies and performances characterised by time lags and feedbacks, and to explore opportunities towards producers' sustainability.

Keywords: Primary producers, sustainable farming, decision-making, inventory, farming strategies, farms' performance

Introduction

This paper explores primary producers' pathways towards sustainability through a comprehensive inventory of the conditions in which they operate, the strategies they implement and the subsequent performances, which in turn affect farmers' conditions. The work relies on a literature review aimed at integrating rural studies, rural sociology and agricultural economics' literature. It aims to provide a conceptual framework for the analysis of primary producers' development trajectories, in relation to the conditions they have to deal with.

In our setting, conditions refer to the whole farm's business environment influencing farmers' behaviours. Strategies are meant to cover the range of actions consciously adopted by the producers in order to achieve given performances with an expected effect on the farm

trajectory. Absence of actions, i.e. acceptation of the current states or trends, is also considered as a strategy. The consequences derived from the strategies (that can be also unintended or unexpected) which are relevant for the farm's sustainability are identified as performances. Hence, a reference concept in our work is sustainability: strategies will be identified and described in their aim to contribute to a sustainable development trajectory, first for the farm but also for the farming system as a whole.

The use of this concept is twofold. First, we refer to sustainable finance. As economic agents, primary producers aim at generating a sufficient amount of income, but their financial conditions are highly dependent on public and private actors, such as government regulators (including the EU's agricultural and fisheries policies), the financial sector, suppliers, the food industry, retailers, etc. Second, we refer to the multi-scaling and multi-dimensional notion of sustainable agriculture and fisheries. To deal with it, we rely upon the classic definition of sustainable development as "*the capability to achieve today's goals without compromising the future capacity to achieve them"* (UN 1987, statement 27).

The concept of "primary producer" is another key element of the framework, which follows a producer-centred approach. Since the decision-making process is at the core of our analysis, by "producer" we refer to the decision maker at the firm level (the firm being an agricultural farm, an aquaculture farm or a fishing company). In other words we refer to any person (or group of persons) who takes substantial decisions regarding the farm management.

Through a producer-centred approach the conditions' impacts on individual strategies selection and implementation can be visualised and organised, to be then assessed case by case through specific researches. This does not deny the relevance of other higher levels of analysis (sector, territory, food system) where "emergent" features and processes can be highlighted. However, even in this micro approach, those emerging elements (like for example Marshallian economies, or environmental degradation processes) are accounted for, as long as they influence producers' strategies and performances, as will be shown in the following.

The second section develops the canvas of conditions, strategies and performances (CSP), whereas the last section summarises the outcomes and opens the way to possible uses of the framework.

Conditions, strategies, performances

The decision-making process

The choice of a CSP approach is explained by our aim to unpack the producer's decision-making process, summarised in Figure 1. The central element is the primary producer described above, who reacts to internal and external conditions according to his own characteristics. Internal conditions are composed of characteristics of the farm and the household the producer belongs to, while external conditions are the external environment constraining producer's decision-making. Actions and strategies adopted in response to those conditions lead to performances, whose observation might incentivise the producer to recalibrate his reactions to conditions. The producer has a role in shaping the internal conditions; he can also influence, to a minor extent, the external ones.

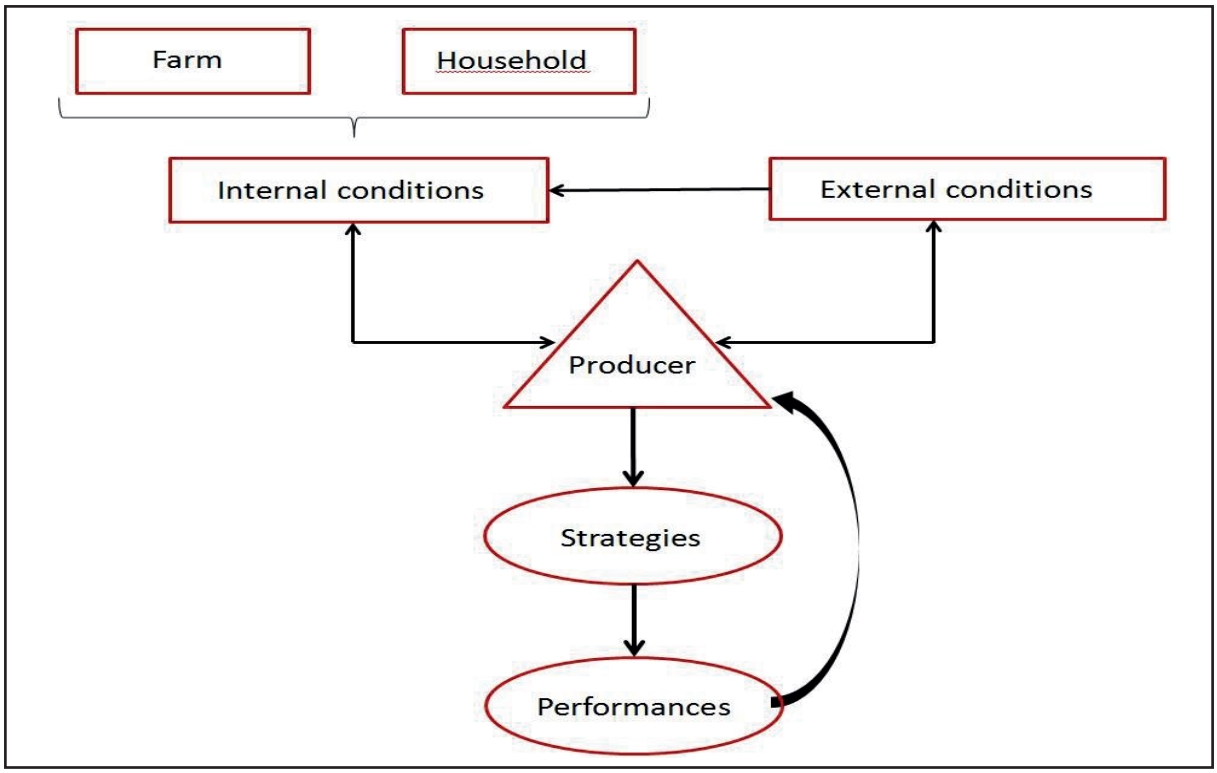

Figure 1. Producers' decision-making process

Following a producer-centred approach we aim to understand how different individuals react to different conditions with different strategies. Producers' internal characteristics encompass, among others, capabilities, attitudes, beliefs, social and human capital, values and preferences. Hence, the producer is not reduced to its “economic agent” facet that takes decisions based on rational thinking, but is enlarged in order to consider social and cultural aspects that may influence the decision-making process. Yet, only a reduced share of the conditions with a current or potential influence on the farm system are actually perceived by the producers, who are limited in their capacity to perceive, observe and interpret messages from outside.

A wide range of individual-based psychological, cultural and social characters are said to influence producers' decisions and strategies, like for example education (McDowell & Sparks, 1989; Wilson, 1996), succession status (Potter & Lobley, 1996), age and length of residency (Wilson, 1996). More abstract categories like values, beliefs and mental models are quite complex concepts, whose semantic richness is well summarised by Mills et al. (2013).

The nature of the interaction between conditions and producers’ characteristics lies in what the literature calls “attitudes”. The definition of attitudes best suited to be adopted in the analysis of the relation between conditions and strategies is probably given by Ahnstrom et al. (2008), who define "attitude" as a readiness to act, or a mindset that is used by an actor to act and judge in situations of decision-making. The attitude vis-à-vis risk is exemplary in this sense.

Conditions

Internal conditions

To understand the decision making process we start by the identification of the farm's internal conditions. To do so, we rely on an adapted version of a model developed by Porter (1998) that describes the elements relevant to farms' competitiveness.

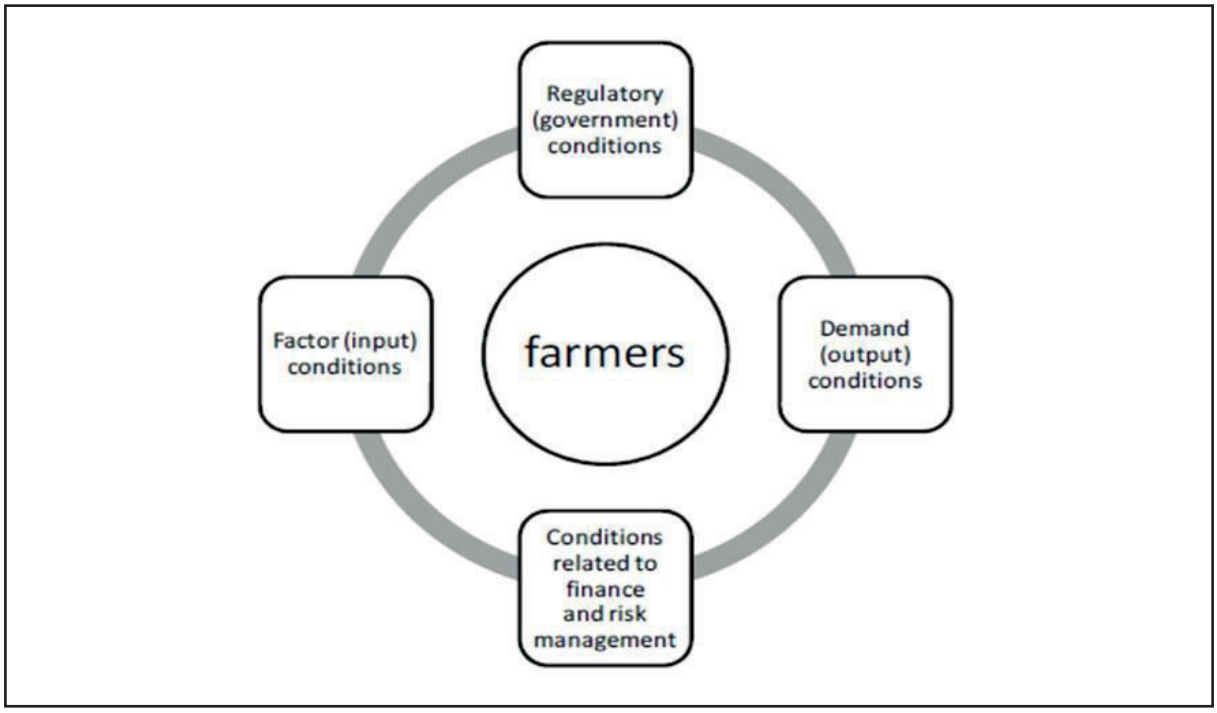

Figure 2. Multidimensional framework (Porter 1998, adapted)

The five elements will be disaggregated and adapted to design a model covering the multi-dimensional context in which producers' decision-making processes take place. Internal conditions correspond to the central element of the adapted Porter's framework, i.e. "farmers", renamed as "farm box".

We do not mean to confine the analysis into a reductionist representation of the farm as the sum of its components, neither do we consider the farm box as an isolated element immersed in an "external" environment. Such a reductionist representation has been contested from various perspectives (Noe & Alrøe 2012; 2015). There is an increasing awareness of the limits of a representation in which elements are defined per se, in favour of a relational approach where they can only be understood within a certain relational pattern.

The farm box conceptualisation is linked to the Agricultural Household Model (AHM) (Singh & Subramanian, 1986) which underlines that family farming strategies are not only aimed at business-related objectives, but also at enhancing family welfare. The AHM builds on the assumption that production and consumption decisions cannot be seen separately when they are attributed to the same entity (Taylor & Adelman, 2003). How to share the work, the trade-off between self-production and purchase of some goods, the choice between in-farm and off-farm employment, are examples of this interplay. A related feature is the role of farmland,

which is not only a space and an asset for the production, but also a guarantee for credit access and an asset to be transmitted to the heirs (Marks-Bielska, 2013). The consideration of this "household-focused" dimension is particularly relevant when an effective strategy in business terms reduces household wellbeing, leading to a "maladaptation" to changing conditions that negatively influences the quality of life (Criddle, 2012).

Following the AHM, the farm box is a conjunction of two elements: "farm" and "household".

The "farm" represents all the assets, resources and organisational aspects of the farm business. The traditional elements are assets as land and machinery (the so-called “capital”). In line with those, relevant aspects of the endowment to be considered here are the anthropic (settlements, infrastructures, etc.) and biophysical characteristics of the farm (soil, water, etc.). Labour characteristics are obviously also part of the traditional variables internal to the farm, as well as investment-related characteristics such as credit opportunities, level of debt, sunk costs and scale of production. An important element to be considered here is the farm path dependency which influences the farm’s capability to design and to implement new potential strategies. Hence, lock-in effects can also reside in the farm itself given the existence of sunk costs as well as technological and organisational constraining effects influencing the degree of path-dependency of the farm and its ability to adapt to new challenges.

The "household" accounts for the elements conditioning the decision-making process through the fact that the producer belongs to a family. Here are grouped, among others, household's values, interests and wellbeing. Gender composition is also relevant as both entrepreneurship and farming are stereotypically seen as a male domain and rural areas tend to be characterised by unequal power relations and uneven access to resources between men and women (Charatsari, 2015). Yet, with the decline of core business incomes and the rise of multifunctional and part-time farming, female work becomes more and more relevant for the household budget (Bock, 2006).

External conditions

External conditions are the set of elements that cannot be shaped or substantially affected by the producer but that influence strategies (as long as they are perceived by the decision-makers) and performances. The distinction between internal and external conditions is neither always clear nor stable in time and requires an analysis of the specific case.

The inventory of external conditions can be described starting from the adapted Porter's scheme (Figure 2). However, the four groups of conditions surrounding the "farmer" in that scheme do not account for the whole environment in which the producer operates. Hence, we expand the map as shown in Figure 3.

Before describing each element contained in Figure 3 it is worth discussing the different dimensions along which those conditions may vary.

- Conditions vary with the politico-geographical level at which they are defined. Some conditions are relevant to the local level, others act at a national or even global scale. Yet, a univocal label can rarely be applied to each condition in this regard. Figure 3 contains a tentative identification of the most pertinent level for each condition, to be then assessed case by case. The geographical scale is also relevant for the

consideration of producers' capability to influence its environment, which tends to be higher at the local/regional scale than at larger scales.

- Conditions' impacts on farms and their influence on producers' decision-making processes are sometimes direct, but they can also result from longer tortuous causal chains.
- Conditions change and evolve over time. Some of them can be regarded as "stable" conditions, which define the current context of action; but in some cases what influences producers' choices are changing conditions (like a CAP reform, or global warming). In this case they represent shocks or stressors the producer has to face, as well as new opportunities.

When changes in the conditions are particularly deep and unexpected, they may result in a "trauma" or "traumatogenic change" (Sztompka, 2004), which leads to a disorganisation of the actor's representation of the world and to a consequent psychological and/or cultural disorientation. The re-organisation needed to cope with the trauma can be complex and not immediate.

These considerations lead us to reconsider the scheme in dynamic terms. Following Porters' description of his diamond as a dynamic system (Porter, 1991) it is possible to consider Figure 3 in terms of a set of mutually influencing conditions, in which one determinant depends on the state of others, and changes in some conditions influences others. For example, mobile factors (skilled workforce, specialised services) may tend to concentrate in certain areas where regulation, policies and infrastructures look promising. This can create a cumulative agglomeration effect which, in turn, may lead to negative consequences like costs raising and displacement of local actors. Farms' strategies and performances themselves, far from being confined within the farm borders, are also crucial elements of this dynamic vision.

Figure 3 shows a wide-ranging, yet not exhaustive, lists of external conditions and their mutual influence on producers' decisions. Obviously not all conditions are relevant for each and every context: the intensity of their influence varies according to geography and sector.

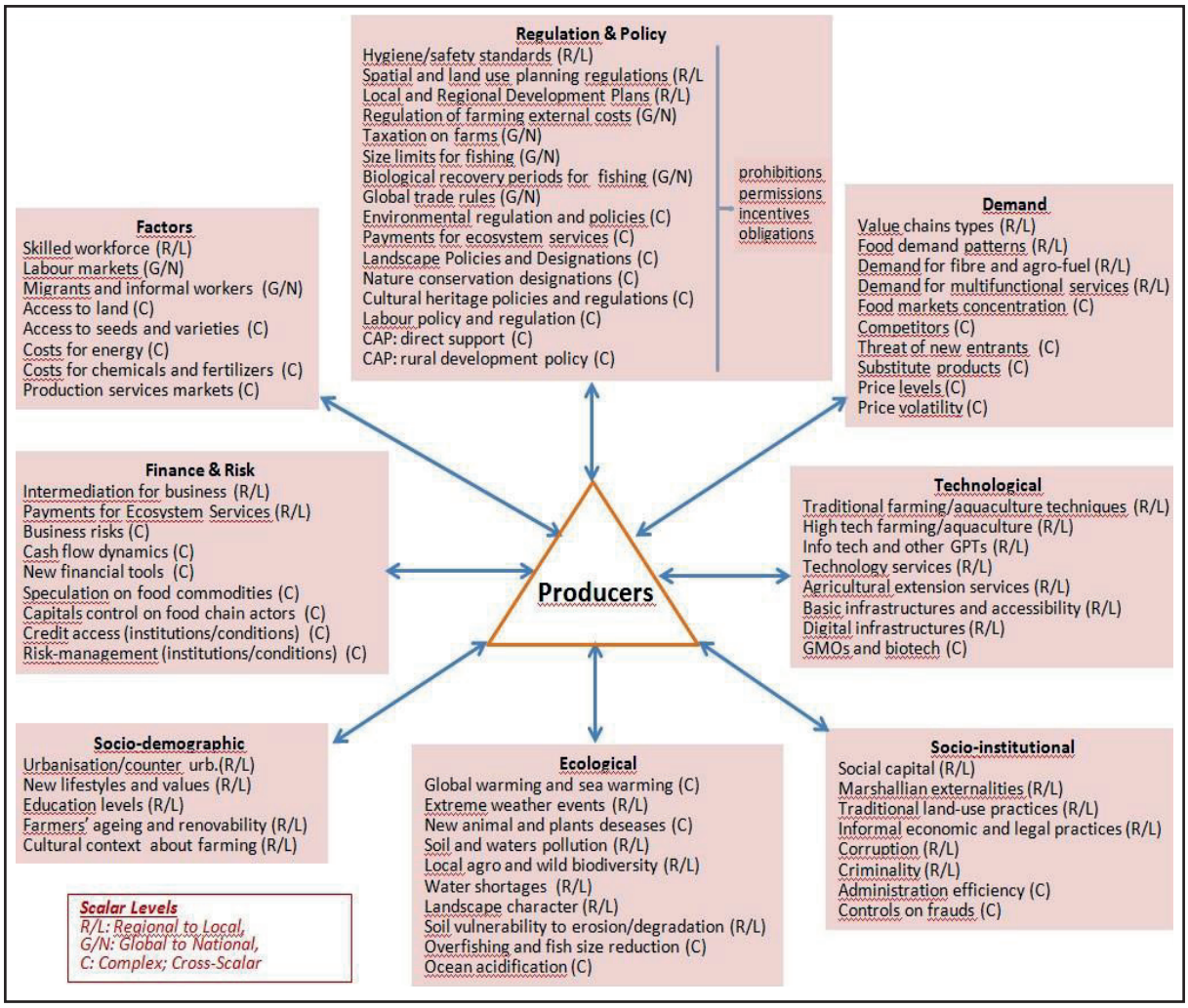

Figure 3. External conditions

External conditions are aggregated into eight groups, briefly described below, yet not pretending to be exhaustive.

The *Factors* box regards the conditions which the farm can manage, that is, acquire, trade, and use, the factors and assets used for its activities. Hence, this category describes the external conditions imposed on the factors used within the farm itself. In particular, the availability of those factors at the local/regional level is a key feature of the farms' business environment.

The *Demand* box represents the conditions influencing the demand for the goods and services the farm does (or could) produce or deliver. We refer first of all to the demand patterns for food, fibre and biofuel. We also consider the increasing demand for multifunctional and green services, that plays a fundamental role in farms' survival in many contexts, and that has been investigated by the literature on post-productionism (Wilson, 2008), and rural development (Ploeg et al., 2000). Demand conditions go beyond the mere neo-classical perspective, to encompass the differences between value chain typologies (Gereffi et al., 2005) and their effects on power relations and the distribution of value added. To better describe demand markets conditions in dynamic terms, three elements derived from Porters' analysis of the forces shaping competitive business environments are also

considered: competitors, the threat of new entrants, the threat of substitute products/services (Porter, 1979). Bargaining power by suppliers and customers are accounted for by the analysis of value chain types.

Regulation & Policy issues relate to various areas of concern, which sometimes overlap. Farmers have to comply with many regulations defined at different institutional levels and acting on several aspects of business management, such as labour, land use, trade rules and environmental impacts. However, agricultural policy also tremendously facilitates farmers' work given the huge financial help it provides. As far as the fishing sector is concerned, regulation is particularly relevant given the need for well-defined property rights in order to avoid over-fishing and to preserve the biological recovery circle. Furthermore, incentivising primary producers to contribute to ecosystem services provision (Guthman, 2007) is another field of intervention for regulations and policies.

Finance and risk markets play a decisive role in producers' sustainability. First, this role takes the form of credit provision. As argued by Benjamin et al. (2002) different credit markets' structures have significant effects on farms' investment decisions. Second, and at a broader level, the financialisation of the agro-food sector is observed and defined by Magnan (2015, p.1) as *"the process whereby finance capital and financial logics exercise increasing influence over food production and distribution".* In the same vein, Burch and Lawrence (2013) describe the increasing control by finance capital over the retail sector, and Clapp (2014) analyses its implications for food policy. Third, risk management is a key aspects of farming. Authors like Hardaker et al. (1997), Pennings and Leuthold (2000), Meuwissen et al. (2001) and Bergfjord (2007) analyse the risks associated with the primary sector and the related forms of insurance, risk-shifting or risk-sharing contracts.

Technology is a major issue to discuss in relation to changing business environment and farm development trajectories. Technological conditions refer here to the continuously evolving array of technological devices and methods available in that context. Available technology will then be adopted or not according to farms' sectors, sizes, skills, budgets and attitudes. Traditional technologies and skills should also be considered as relevant factors in themselves (when they are still applied) and as part of the farm context. Access to technology has a territorial dimension (availability in the area of technological services and products), yet is less relevant for web-based innovation. Innovation adoption should not be seen as a linear unidirectional process: farms adapt technologies to their characters and context. In doing so they create new knowledge and technology.

Socio-institutional factors account for social elements embedded in formal and informal institutions with a strong spatial dimension. Among the key features we can mention public administration efficiency, social capital (also in terms of networks and attitudes to cooperation) and - in some areas - the presence of corruption and criminality. Agglomeration, or "Marshallian", externalities describe the beneficial effects that spatial concentration of production brings to the firms in that location (for example in terms of knowledge spillover and of availability of specialised workers and suppliers). As mentioned with regard to the technological conditions, a co-evolutionary perspective grasps a key aspect of farms' interaction with their socio-institutional context: the capability they have to encourage the development of institutions capable to support their needs. The Window of Locational Opportunity approach (Scott & Storper, 1987) underlines how "*industries have the capability*

to generate or attract their own conditions of growth: new industries produce space through their own growth and development in places" (Borschma, 2007 p.43).

Socio-demographic trends' role is relevant yet often indirect, since demographic and lifestyles changes are relevant for the farms as long as they influence their market and regulatory context. For example, urbanisation or counter-urbanisation trends may influence land prices, whereas migrations have an impact on job availability and costs. On the other side of the chain, new social expectations on food (asked to be local, organic, fairly traded, etc.) and farms (expected to preserve agro and marine ecosystems, to protect the landscape, to provide green spaces and facilities for leisure time, etc.) influence the demand producers have to meet or can profit from, as seen in the "Demand" box.

The *ecological* context in which the farm operates, in relation to the various geographical scales, influences farms' strategies as it interferes with the eco-systemic and metabolic processes primary production relies upon. Fishery presents some specificities, as it is based on natural resources extraction (like hunting or mining) more than is the case with primary production. Yet similarities prevail over differences: for example, overfishing is a matter of excessive extraction, as well as, *mutatis mutandis*, intensive farming and overgrazing. The ecological context can also be read in terms of opportunities for the farm to develop new/green production methods and to deliver ecosystem services (Swinton et al., 2007), in a multifunctional perspective.

Strategies

Overall view

Producers select their strategies in specific multidimensional, multi-scale and evolving contexts. Yet, similar conditions do not necessarily lead to the choice of the same strategies for different producers. Understanding why similar contexts lead to different strategies requires in-depth case specific analysis.

Strategies range from the more farm- and farming-oriented, to others that involve off-farm (e.g. shift to part time farming) or extra-farming (e.g. leasing of buildings) activities. As suggested by the AHM, they can be aimed at improving farms' business, as well as at enhancing households' welfare. From another perspective strategies can be aimed at avoiding or limiting the effects of potentially harmful changes but also at profiting from new opportunities. Resistance to change and adaptive renewal (Darnhofer, 2010) are two poles, within which intermediate and cross-cutting strategies can be identified. The decision-making process often entails a choice between long term adaptive capacity to cope with stresses and shocks and short term profitability, as well as between adaptation and new development trajectories. Different strategies can certainly be alternative (as in the case of the choice between intensification and extensification). Yet in most of the cases they are not mutually exclusive. A producer may implement more than one action at the same time, as complementary aspects of a diversified development trajectory, Finally, most of the strategies can be implemented by a single farm, some others are collective (i.e. the creation of a territorial brand).

Several inventories of strategies have been suggested in the scientific literature, variously named (with slightly different meanings) as "adaptation", "survival", "adjustment" and "development" strategies (Marsden et al., 1989; Munton, 1990; Moran et al., 1993; Ilbery,

2001; Evans, 2009; Mills et al., 2013; Andrade 2015) and at various levels of aggregation. For the definition of this inventory, shown in Figure 4, we mainly referred to the mentioned authors. The base was given by the classifications made by Moran et al. (1993) (six development paths classified according to the resources use), and Munton (1990) (seven elements of change in farms' adjustment strategies), that were updated following the more recent literature and better detailed with regard to the less pro-active and more survival-aimed strategies thanks to Andrade (2015). Each box describes one strategy that is below articulated in its various forms and tools.

Strategies are indicatively grouped according to their similarities in the harvesting/organisation/use of resources and/or main aims, in order to give a reader-friendly landscape of the possible strategies. These grouping is merely indicative, aimed at readiness and rapid appraisal of the main strategies' typologies.

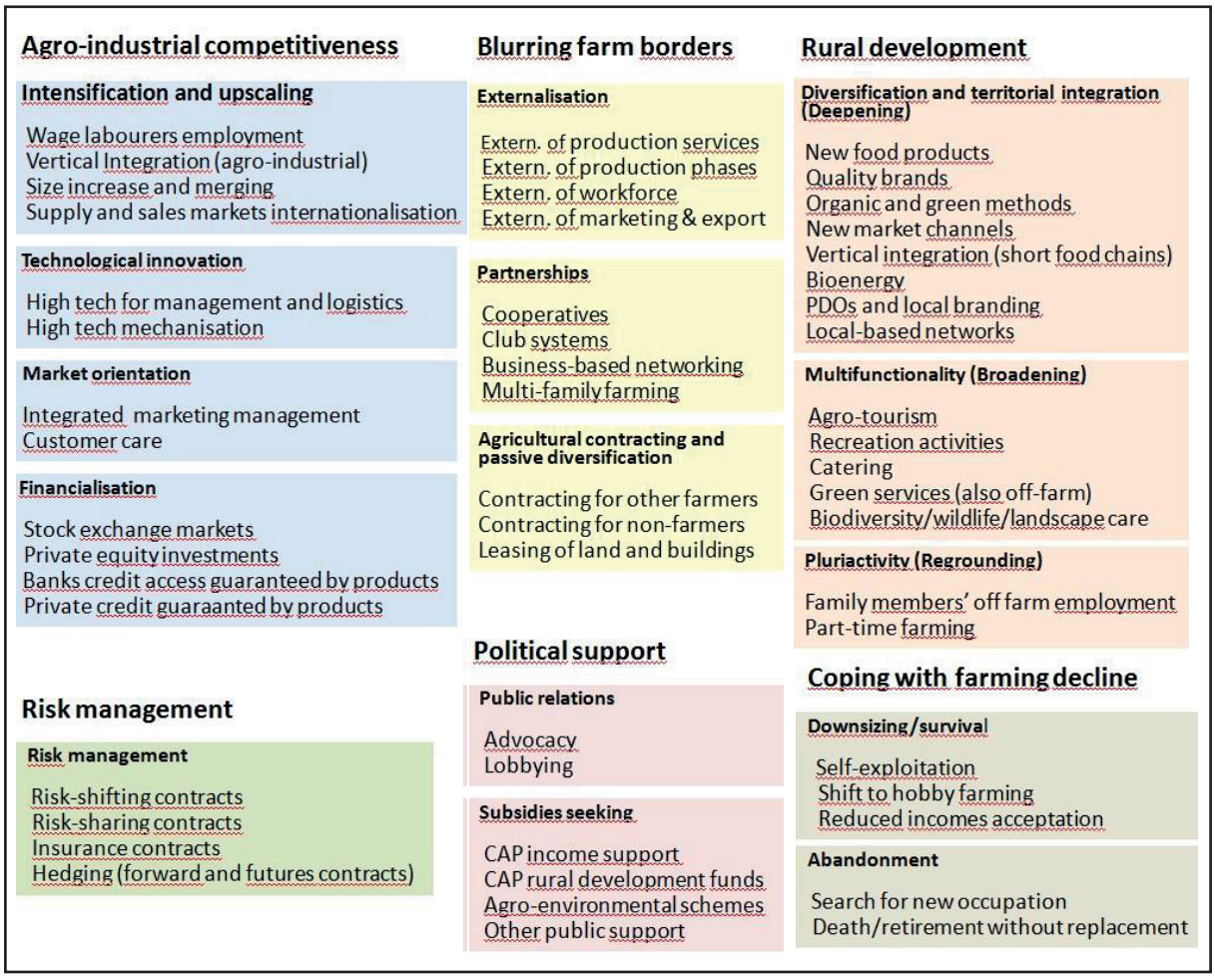

Figure 4. Farms' strategies groups

Description of strategies groups

Agro-industrial competitiveness

This first group of strategies is focused on three innovation levels: technology, marketing and finance, all elements which are relevant also in other types of strategy, but that are here considered in a classic industrial/market competition perspective. Some strategies aim at increasing competitiveness in the global agro-food markets, enlarging the business size in order to achieve a critical mass of budget and market shares and to profit from scale economies. Other strategies focus on market positioning and relations with customers. The so-called market orientation paradigm (Kohli & Jawaroski, 1990) expands the traditional scope of marketing activities to encompass the whole production process to be designed according to the activity of acquisition and use of information (marketing intelligence) about consumers' expectations. The last strategy type in this group is financialisation. In some sectors farms with certain requirements in terms of size, accountability and attractiveness, can harvest funds in the financial markets through asset management companies, private equity consortia or other financial instruments (Burch & Lawrence, 2013) with processes that also influence the core business of the firm, with financial ends potentially prevailing over the productive ones.

Blurring farm borders

High tech and financialisation are not always the most appropriate or suitable solutions, and size increase can even be counter-effective: in some contexts producers opt for a more flexible or efficient organisation of resources by focusing on some activities and externalising others, or by establishing strategic partnerships and networks. These strategies represent different ways to blur farm borders to increase efficiency and effectiveness. The choice between internal implementation and externalisation of parts of the farm labour process is complex and rich with implications in terms of degree of specialisation, flexibility and resilience, relation between fix and variable costs and control on the processes. Due to asymmetric information (Hart, 1995), bounded rationality (Hobbs, 2003) and ex-ante or ex-post opportunistic behaviour (Williamson, 2000), efficient strategies are chosen as a function of associated transaction costs. If transactions were without costs, it would make little difference, at least in strictly economic terms, whether factors of production were purchased on the market or produced internally (Ventura & Milone, 2004), and the same could be argued with regard to production phases.

Rural development

These strategies, often implemented in synergy with each other, represent the wave of re-grounding of farming into the 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 for the consumers and the society as a whole. Through these strategies the products can be valorised and extra value added can be both produced (through the price premiums customers accept to pay) and retained by primary producers (when short chains reduce the intermediary steps and reduce or exclude the role of large retailers).

Risk management

The strategies to cope with production, business, productive, and environmental risks are mainly based on contracts and legal arrangements through which risks can be shared among partners, or partially or completely shifted to others. The more traditional solution is to rely upon insurance markets where risks are shifted through payment of a fee. Insurance contracts are still widely used to protect from the consequences of extreme weather events. Yet financial markets are gaining relevance, with hedging increasingly being used by producers to protect from price risks. Forward and futures contracts are well established tools in this arena. Production contracts represent an additional strategy to share risk with up-stream or downstream chain actors (Bogetoft & Olesen, 2004).

Political support

All outlined strategies aim, with different approaches and visions, at strengthening farms in a competitive market environment. Yet most of the farms are highly influenced by public support, as public support influences farms' capability to invest and to cope with risks (Kondouri et al., 2009; Sckokai & Moro, 2009), but also because it can be the dominant income source. In some cases this reliance assumes the importance of a true strategy; this is why a specific typology is identified here.

Coping with farming decline

A final set of strategies describes those situations in which a farm "merely" copes with the decline of its activity, finding solutions for the household's survival with or without a central role being played by the farm business.

Farm's performances and the whole canvas of CSP

In Figure 5 the whole sets of conditions and strategies are summarised, and performances added on the right hand side.

Performances, whose identification is rooted in the same literature analysed in relation to conditions and strategies, have been indicatively gathered into three groups.

The business-oriented ones (in light green) are investigated in the agricultural economic literature. They range from increased efficiency to improved quality, from diversification to financial stability. These performances are relevant as they are deemed to lead to the achievement of economic goals like higher profitability and increased business resilience.

The household welfare-oriented (in light gray) are mostly considered in the literature following the AHM or in the field of rural sociology. Again, a combination of actual wellbeing and resilience/adaptability through differentiation can be seen as the ultimate goal to which these performances may lead.

Finally the outward-oriented performances (in green) represent impacts on society and environment (for example: community involvement, local biodiversity preservation, animal welfare). They witness the nature of the farm as a socio-ecological system and reflect social expectations about farms and farming. They can be pursued by producers willing to meet those expectations per se, but also as a means of achieving other objectives: the business-oriented (when they become a marketing lever), and the household-oriented performances (when they contribute to improved family welfare).

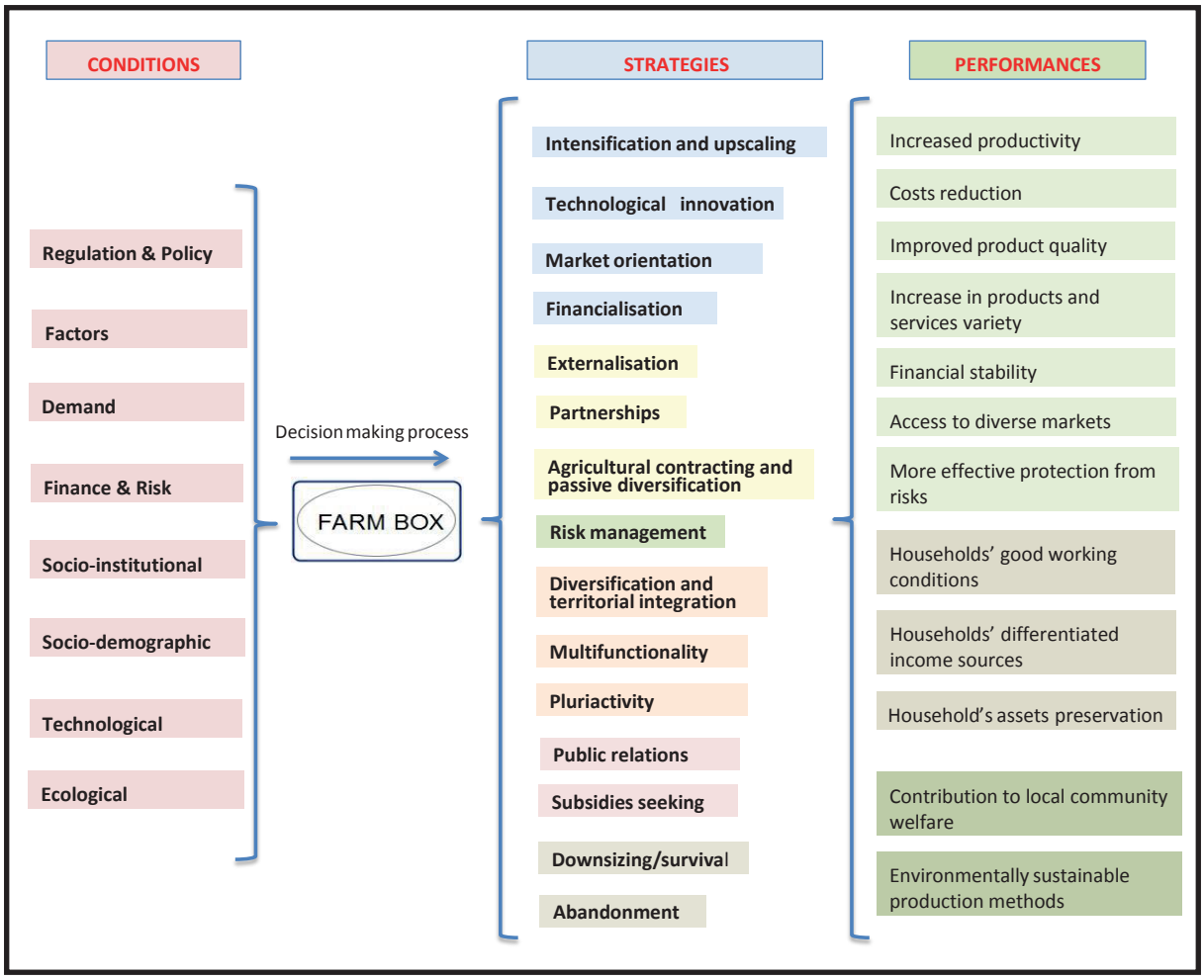

Figure 5. Conditions, strategies and performances

The performances connect farm's strategic choices with the sustainability concepts mentioned in the introduction. Sustainable finance can be pursued through actions that lead to the economic performances listed above (as well as by the outward-oriented ones as long as they contribute to economic and financial gains). In a broader view, agriculture and fisheries sustainability is strengthened by strategies leading to households' wellbeing and resilience, but also by the farm's capability to positively address the social and environmental concerns listed at the bottom of the list.

Conclusions

This paper presents a first outline of a Conditions-Strategies-Performance approach to the analysis of primary producers' strategic behaviour towards sustainability. Inventories of the three categories have been developed, with the aim of providing a base for subsequent specific investigations whose findings will deepen and integrate these lists. Similarly, reflections on the links between the three categories (for example: why under certain similar conditions different producers chose different strategies, or why similar strategies lead to diversified performance) can be further developed.

The work witnesses the wide range of internal characters, external conditions, strategies and performances that are being identified in the literature, and gives insights into the various ways in which this diversity can be typified and organised.

This framework can be applied to support more in-depth analyses of the conditions influencing farmers' strategies, and to identify areas of interventions for the creation of a more supportive environment for the development of successful and sustainable farms. In particular, analyses of market imperfections and policy requirements can be developed, with attention to their mutual interactions and their connections to other conditions. A comprehensive and systematic view on the conditions-strategies-performances can also help the researchers to understand and analyse the rationale of apparently inconsistent or incomprehensible strategies.

Acknowledgements
The work has been developed within the Project SUFISA - Sustainable finance for sustainable agriculture and fisheries (Horizon 2020. Grant agreement no 635577).

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Applied and planned risk management strategies of Austrian farmers

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Abstract: This article presents results on Austrian farmers' perceptions of risk management measures as well as currently applied and planned risk management strategies. A postal survey of Austrian farmers (N = 486) has been conducted to provide data for the analysis of differences with respect to farm types (cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed crop and livestock farms and forestry enterprises), farming methods (organic and conventional farms), employment situation (full-time and part-time farms), and geographic location (mountain farms and non-mountain farms). The results indicate that all subgroups of farmers expect the strategy of financial management to be most effective in coping with risks. Organic, part-time and mountain farmers are, on average, more confident in the strategy of off-farm diversification. In comparison with their part-time colleagues, full-time farmers regard farm expansion and insurance as well as cost and revenue management to be more effective. All subgroups of farmers plan to increasingly pursue risk management strategies of adaptive capacity building, cost and revenue management, financial management, and on-farm diversification.

Keywords: Family farming, risk perceptions, risk management, part-time and full-time farms, organic farming, mountain farming, Austrian agriculture

Introduction and research questions

Landscape, soil and climate conditions usually determine different pathways of agriculture, reflected by different farm types and production intensities. Hence, eight main agricultural production areas with typical patterns of land use and agricultural production are distinguished in Austria. (Wagner, 1990a and 1990b; see Figure 1). The alpine area represents 63% of the total Austrian territory of 84,000 km² and is dominated by forestry, grassland and pastures as well as extensive livestock and milk production. In total, there are 166,300 agricultural holdings in Austria of which 38% are classified as mountain farms (BMLFUW, 2015) producing under adverse natural conditions and receiving less-favoured area payments from the CAP (Groier, 2016). Mixed crop and livestock farms characterise the agriculture in the Northern Alpine foothills. Intensive forage and milk production dominates in the West whereas intensive livestock, vegetable and cash crop production prevails in the East of the country. The granite and gneiss highlands north of the river Danube experience continental climate and farmers usually specialise in potato, rye and poppy production. Intensive cash crop production with grains, vegetables, fruit and wine dominates in the Pannonien plains and hills in the North-Eastern part of Austria. Wine and fruit (i.e. apple production) prevails in the Southern Alpine foothills. The Klagenfurt basin – although located in the southern alpine area – experiences Atlantic climate and farmers mainly specialise in grain and fruit production (Wagner, 1990a and 1990b).

The agricultural pathways are also determined by the economic potential of the farms as well as by personal preferences of the farming families. Austrian agriculture is characterised by mainly small scale farms; the average utilised agricultural area (UAA) is 18 ha per farm. In Austria, 57% of the agricultural holdings cultivate below 20 ha and about 55% are run part-time i.e. the farming couple spends more than 50% of the working time in off-farm employment (BMLFUW, 2015).

Part-time farms usually extensify agricultural production to balance on-farm and off-farm work (Groier, 2016). In comparison with other European countries, organic agriculture as a certified farming method has been already promoted with public financial support in 1992. With the EC accession of Austria in 1995, the CAP subsidy schemes were applied to organic agriculture as well (Larcher, 2009). The number of organic farms increased from 880 in 1989 to 21,810 in 2013 representing 13% of all agricultural holdings in Austria (Groier, 2016).

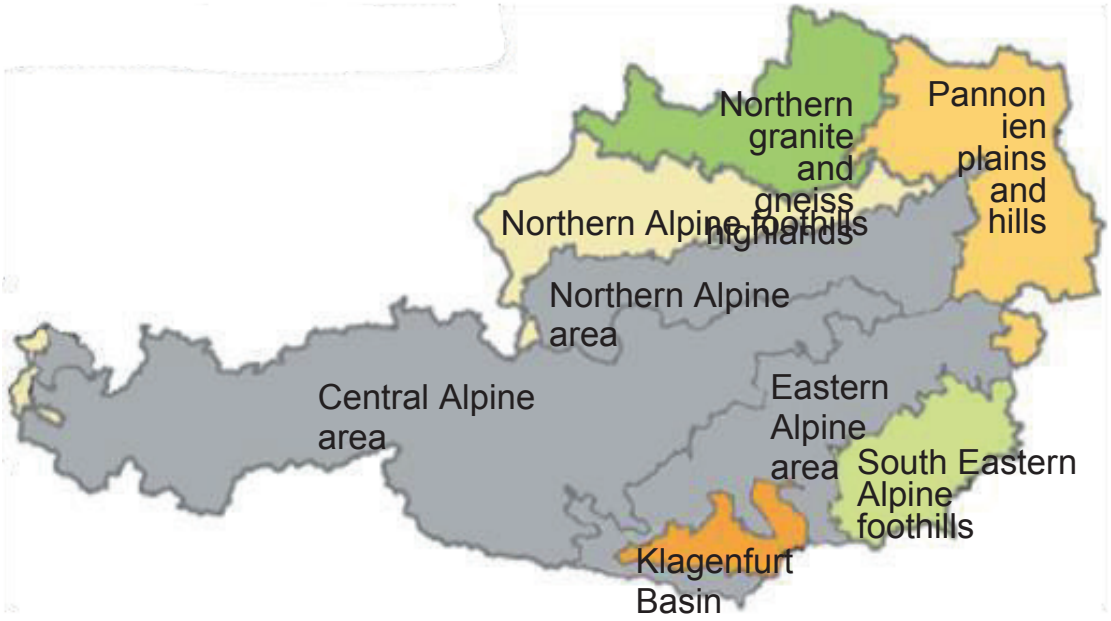

Figure 1. The main agricultural production areas of Austria *(Source: Statistik Austria 2016, modified)*

The risk environment of farmers is shown graphically in Figure 2. Farmers are both biological human beings facing health risks and social beings living with others in personal and institutional relations based on common values, rules and regulations. Social risks like personal conflicts, noncompliance, crime or disadvantages from governmental and international laws and regulations may occur. Farmers are also confronted with a broad range of professional risk sources. Depending on the analytical perspective, risk sources can be distinguished between those being unique to farming as an entrepreneurial activity and specific risk sources due to farm type, farming methods, farm location and other farm characteristics. In particular the specific risk exposure of the farm requires the development of an appropriate and concise risk management strategy, which is a fundamental entrepreneurial activity in agriculture. Considering the retrenchment of political and public risk management measures for agriculture, the awareness of risks and effective risk

management has become more important at the farm level, but also for farm extension services.

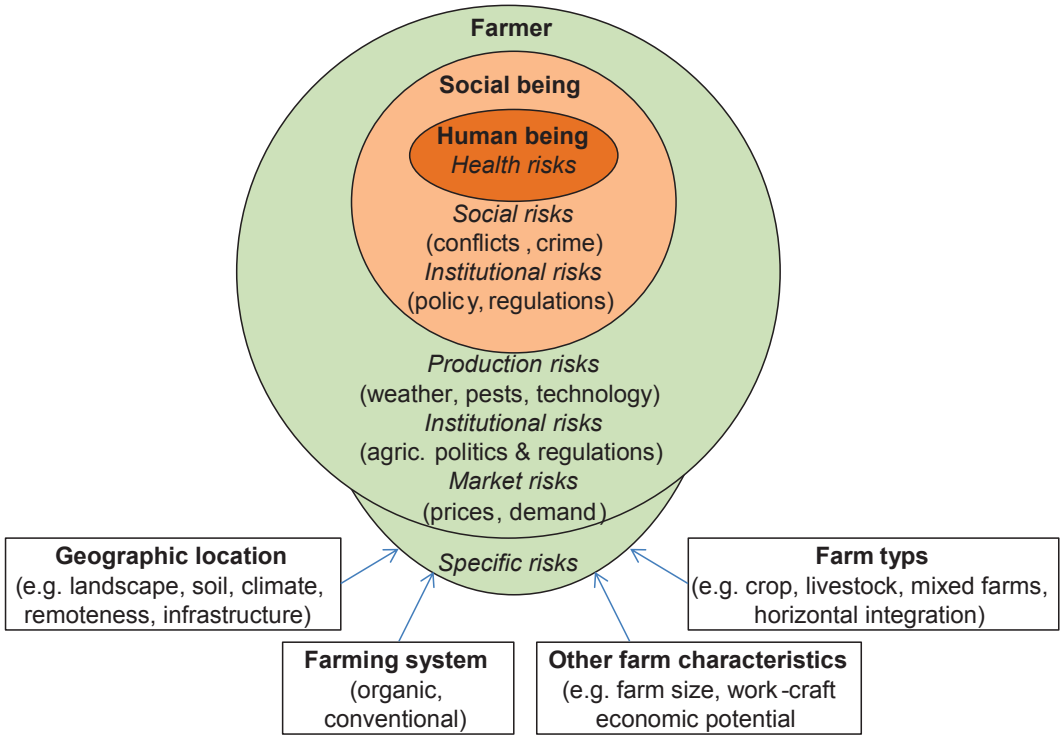

Figure 2. Illustration of farmer´s risk environment *(Source: own description)*

In general, risk management strategies can be classified into risk avoiding, risk reducing, risk transferring or risk retaining. Each strategy consists of a number of concrete risk management measures such as use of irrigation systems and storage facilities, diversifying income or buying insurance products. The combination of different measures in an appropriate and successful risk management strategy serves two main aspects: first, it has to meet the individual security needs and secondly, it has to synergise with the long-term orientation of the farming family. A literature review reveals a huge variety of empirical models including different variables explaining risk management in agriculture. According to their theoretical framework authors analysed farmers´ risk management strategies in dependency of either a single factor (e.g. farm size, Wauters et al., 2014) or they included variable sets addressing psychological and social factors as well as sociodemographic characteristics of the farmers and farm structure (e.g. Flaten et al., 2005; Lien et al., 2006; Meuwissen et al., 2001; van Duinen et al., 2015). In this paper we want to focus on risk management strategies according to different pathways of agriculture, represented by farm types, farming methods and farm geography. Regarding these relations Meuwissen et al. (2001) found that risk management strategies to reduce price risks were relatively less relevant to Dutch managers of dairy farms and insurances to those of mixed farms. Managing risks via diversification strategies was most important to pig farmers and, via stabilisation of income, to dairy farmers. Flaten et al. (2005) found that Norwegian organic farmers see flexibility in production and marketing as well as collecting information as important risk management measures. On the contrary, debt management, cooperative marketing and veterinary services were more important to conventional farmers. The

authors also show geographical differences: farmers located in favoured areas without regional policy priority paid more intention to flexibility and less importance to insurance than farmers in areas with regional policy priority (Flaten, et al., 2005). Significant differences in risk management between full-time and part-time farmers in Norway were reported by Lien et al. (2006). Part-time dairy farmers considered off-farm investment, off-farm work, surplus machinery capacity, storage and debt management as more important than their full-time colleagues. Full-time crop farmers put more importance on good liquidity, use of risk reducing technologies, cooperative marketing, use of economic consultancies, enterprise diversification and use of production contracts.

The aim of this article is to provide empirical results of Austrian farmer´s perceptions on already applied and planned risk management strategies by:

i) farm type (cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed crop and livestock farms and forestry enterprises);
ii) geographic location of the farm (mountain farms and non-mountain farms);
iii) farming method (organic and conventional farms); and
iv) employment situation (full-time and part-time farms).

The article is structured as follows. In the next section we describe the empirical methods used and the following section is dedicated to the results. After describing the sample we present and discuss the results with regard to the perceived efficiency of risk management measures and the perceptions of risk management strategies according to different pathways of agriculture. In the final section we draw some conclusions.

Material and methods

The data for the analysis presented in this article result from a postal survey of Austrian farmers, conducted between January and March 2015. A four pages questionnaire was sent to a stratified sample of 2000 farmers. The strata refer to the Austrian farm type classification of the IACS[1]: cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed crop and livestock farms, and forestry enterprises. The questionnaire contained sections on i) general attitudes towards farming, entrepreneurship and risk; ii) experiences and perceptions of risk sources; iii) perceptions of risk management measures, currently applied and planned risk management measures; and finally iv) socio-demographic and farm characteristics.

Methodologically the survey followed the psychometric paradigm (Slovic, 2007) focusing on the perceptions of individuals measured by socio-economic scaling. Accepting the limitations of survey techniques in the social sciences in principle (e.g. strategic-responses, social-desirability), the strength of this approach is to embrace perceptions as the result of complex mental processes, considering specific contexts. Its weakness is the limited comparability of contextualised results. By the end of March 2015, a total number of 502

[1] IACS refers to Integrated Administration and Control System (German: INVEKOS) based on Council Regulation (EEC) No 73/2009 and Commission Regulation (EC) No. 1122/2009. It differentiates seven farm types: cash crop farms, permanent crop farms, forage-growing farms, intensive livestock farms, mixed farms crop and livestock, forestry enterprises and horticultural enterprises. The horticultural enterprises were excluded from the study because of the small number in the database.

questionnaires was returned. After excluding 16 incomplete questionnaires, a sample of 486 questionnaires was available (response rate 25%). The data were manually recorded in a SPSS data sheet and analysed by using IBM SPSS 21. This article provides results for section iii) i.e. perceptions of risk management measures, currently applied and planned risk management measures.

Thirty-eight different risk management measures based on international literature (e.g. Patrick et al., 1985; Martin, 1996; Meuwissen et al., 2001; Flaten et al., 2005; Schaper et al., 2010) were listed and farmers were asked to assess each of them with regard to the perceived effectiveness in controlling risk on a Likert type scale with 1 = very ineffective, 2 = rather ineffective, 3 = partly (in)effective, 4 = rather effective, 5 = very effective. Additionally, farmers should indicate which risk management measures they have already been implementing on their farms and which ones they plan to continue with or to implement in the following five years. We present a descriptive analysis of the data and an explorative factor analysis (principal component method including varimax rotation) to summarise information on farmers' perceptions of risk management measures in a smaller number of related risk management strategies (factors). Kaiser-Meyer-Olkin measure (KMO) of sampling adequacy of 0.893 suggests a good quality of the data set for factor analysis. In order to determine the appropriate number of factors latent root criterion with eigenvalue above 1.2 and visual scree plot test were used. Factor solutions with 6, 7 and 8 factors were tested. Finally, we decided on the 8 factor solution, because this set was best shaped, most feasible and easiest to interpret. A total variance explanation of 53% is seen as satisfactory for an empirical social science study.

In further analysis, all risk management measures with a rotated factor loading of ≥0.4 were subsumed under the respective factor (see Table 1). In order to develop an indicator for the perceived effectiveness in controlling risk of the management strategies represented by one of the eight factors, the scores of the risk management measures belonging to each factor were averaged. Similarly, the level of risk management strategies currently applied and the level of planned risk management were defined as quotients of the number of applied (planned) risk management measures of a factor divided by the total number of management measures belonging to this factor. On the basis of this data, we explored the differences among groups, defined by farm type, farming method, employment situation and farm geography. As the data are not normally distributed, nonparametric tests were employed. The Mann-Whitney test was used for pair-wise comparison of organic and conventional farmers, full-time and part-time farmers, and mountain and non-mountain farmers. The Kruskal-Wallis test was employed for analysing differences by farm types, followed by a series of pair-wise comparisons using the Mann-Whitney test with Bonferoni correction.

Results and discussion

In this section we present and discuss the results of the statistical analysis. First we describe the sample according to different pathways of agriculture represented by farm type, farming method, employment situation and geographic location. We then consider the perceived efficiency of risk management measures and the results of factor analysis. According to different pathways of agriculture we present the perceptions of risk management strategies in the following section and finally the levels of applied and planned risk management.

Sample description

This sample contains 25 permanent crop farms (5.1%), 54 forestry enterprises (11.1%), 236 forage growing farms (48.6%), 47 mixed farms (9.7%), 105 cash crop farms (21.6%) and 19 intensive livestock farms (3.9%). There is no response bias in respect to the farm types in the IACS data base according to a Chi Square test ($p \leq 0.05$). In contrast, the sample contains a higher percentage of full-time farmers (51.3%; IACS: 37.2%), organic farmers (22.3%, IACS: 16.5%) and mountain farms (49.1%; IACS: 41.2%).

Perceptions of risk management measures and strategies

In total 38 risk management measures were presented to the farmers asking them to evaluate the effectiveness in managing risks. Table 1 presents the average scores of the evaluation and the standard deviations of each risk management measure (see columns 2 and 3). On average, the highest scores on effectiveness were given to financial risk strategies i.e. keeping debt low (4.06), obtaining liquidity (4.03), and producing at lowest possible costs (3.83). Farmers, on average, also gave relatively high scores to risk management strategies related to the established portfolio of extension services and agricultural education i.e. using legal advice services (3.83), information services (3.73), agricultural consultant services (3.63), financial advice services (3.56), training in agricultural production and marketing (3.64), and training in farm management (3.57). Production risk management strategies are perceived by farmers to be rather effective and include: preventive plant protection and animal health care (3.80), production of valuable quality products (3.75), adopting production technology to climate change (3.53), flexibility in respect to market changes (3.55), and participation in the Austrian agri-environmental programme (3.63). Management strategies perceived by farmers as partly effective and partly ineffective in coping with risks have a strategic long-term management focus i.e. agricultural specialisation is the one with the highest average score in that group (3.37), followed by off-farm employment of the farm mangers spouse (3.30), avoiding employment of off-farm workers (3.26), production diversification (3.17), off-farm work of the farm manager (3.09), production expansion (2.99), investing in on-farm businesses (2.96), extensifying production (2.82), and reducing farm investments (3.03). Other risk management measures are perceived as indifferent and include: buying insurance (3.27), increasing productivity (3.24), investing in and use of advanced production technology (3.17; 3.31), cooperative marketing (3.13), maintaining storage capacities (3.09), and long-term customer contracts (3.04). Contrary to the literature (e.g. Meuwissen et al., 2001; Flaten et al., 2005; Schaper et al., 2012), buying insurance products is not that important for farmers in Austria according to the results. This might be explained by the high level of insurance already held by the farmers (Larcher et al. 2016). Hedging by commodity futures contracts, options and futures received the second lowest average scores (2.60), probably due to little knowledge about this risk management tool among the Austrian farmers and due to small average farm sizes. This result is confirmed by the findings of the studies cited above. The risk management strategy with the lowest average score is investing in non-agricultural businesses (2.55), suggesting that using capital other than for farming is not favoured by many farmers.

The explorative factor analysis reduced 38 risk management measures to bundles of eight distinct factors, each representing a risk management strategy. The grouping of a risk management measure to a factor is determined by a rotated factor loading of ≥0.4 (see

Table 1). The interpretation of the factors is due to the subsumed risk management measures: factor 1 is named “adaptive capacity building and technology”. It has high loadings with risk management measures reflecting active adaptation processes of farmers to a changing natural environment as well as to changing market conditions and subsidy schemes. Adaptation activities of the farmers also include personal development of the farmers; training in agricultural production and marketing as well as training in farm management are high loading measures of this factor. The high loadings of using legal advice services and agricultural consultant services can be interpreted as using specific expert support in the adaptation process.

Factor 2 is very similar to factor 1; both have high loadings to risk management measures in respect of technology, training and advice, and both are strongly connected with agricultural production. This suggests unity, but both factors displayed stability in the six, seven and eight factors solution. Therefore, we assume two separate factors with the farmer´s orientation on expansion of the farming business being the main difference. While the adaptation process described by factor 1 does not give evidence for a specific long-term farm development perspective, the adaptation process of factor 2 is directed towards expansion of the farming business. Consequently, factor 2 is interpreted as “adaptation towards expansion and insurance”. Participation in the Austrian agri-environmental programme might seem to contradict this interpretation, but this subsidy scheme containing 22 different measures is compatible with almost all strategies of farm development. This argument is supported by the fact that the participation in the Austrian agri-environmental program is also high loading on factor 7 “agricultural extensification” (see below). In respect to agricultural expansion, it might facilitate the achievement by providing additional financial resources.

Factor 3 “cost and revenue management” has high loadings with measures of transferring price risks like long-term customer contracts and hedging by future commodity contracts, options and futures as well as with measures of reducing price risks or sharing costs (cooperative purchase of inputs and marketing; maintaining storage capacities).

The coherence of high loading risk management measures in factor 4 addressing financial issues like keeping debt low, obtaining liquidity and maintaining equity capital justifies the term “financial management”. Measures of keeping input expenses low like avoiding the employment of off-farm workers and producing at lowest possible costs are also included in this factor. This strategy can be seen as part of a rather conservative farm management style.

Table 1. Perceived effectiveness of risk management measures and membership to the extracted factors according to the factor loadings

	Perceived effectiveness		Extracted factors[b)]							
	Average Score[a)]	SD	F1	F2	F3	F4	F5	F6	F7	F8
Flexibility in respect to market changes	3.55	0.95	**0.67**	0.22	0.20	0.06	0.04	0.08	-0.08	0.10
Adapting production technology to climate change	3.53	0.96	**0.73**	0.14	0.15	0.09	0.00	-0.02	-0.03	0.02
Participating in regional development projects	3.10	1.01	**0.66**	0.06	0.21	-0.03	0.13	0,18	0,17	0,00

Training in agricultural production and marketing	3.64	0.91	**0.72**	0.26	0.21	0.07	0.08	0.08	-0.08	0.01
Preventive plant protection / animal health care	3.80	0.90	**0.55**	0.34	0.04	0.22	-0.20	0.09	-0.02	-0.12
Using production technologies such as GPS	3.31	1.07	**0.46**	0.33	0.31	0.08	0.02	0.19	-0.16	-0.08
Using legal advice services	3.83	0.95	**0.48**	0.35	0.14	0.22	0.05	0.18	-0.04	-0.03
Training in farm management	3.57	1.00	**0.63**	**0.42**	0.17	0.05	0.08	0.08	-0.12	0.07
Using agricultural consultant services	3.63	0.92	**0.42**	**0.54**	0.01	0.11	0.09	0.11	0.09	0.09
Buying insurance	3.27	1.02	0.15	**0.54**	0.17	0.17	0.10	0.01	0.01	0.13
Production expansion	2.99	1.11	0.20	**0.45**	0.39	-0.03	0.08	0.10	-0.34	-0.10
Using information services	3.73	1.01	0.24	**0.58**	0.15	0.18	0.03	0.10	0.01	-0.07
Investing in advanced production technology	3.17	1.00	0.28	**0.58**	0.32	0.05	0.02	0.06	-0.22	-0.04
Using financial advice services	3.56	1.06	0.23	**0.65**	0.13	0.12	0.13	0.09	0.05	-0.04
Participation in Austrian agri-environmental programme	3.63	1.21	0.12	**0.48**	0.04	-0.14	-0.18	-0.06	**0.48**	0.20
Cooperative purchase of farm inputs	3.45	1.04	0.31	-0.07	**0.50**	0.24	0.02	0.05	0.09	-0.02
Maintaining storage capacities	3.09	1.04	0.19	0.21	**0.50**	0.25	-0.16	-0.10	0.03	0.12
Cooperative marketing of my products	3.13	1.12	0.32	-0.02	**0.58**	0.16	0.15	0.20	0.11	0.10
Increasing productivity	3.24	1.09	0.07	0.39	**0.51**	0.15	-0.01	0.11	-0.26	-0.04
Long-term customer contracts	3.04	1.01	0.15	0.23	**0.59**	0.03	-0.06	0.11	0.07	-0.06
Hedging by futures contracts, options and futures	2.60	0.92	0.11	0.25	**0.62**	-0.08	0.03	0.01	-0.07	0.06
Avoiding the employment of off-farm workers	3.26	1.14	-0.13	-0.15	0.14	**0.46**	0.07	-0.05	0.24	-0.10
Maintaining equity capital	3.79	0.93	0.24	0.22	0.22	**0.53**	0.03	0.06	-0.09	0.20
Keeping debt low	4.06	1.06	0.11	0.15	0.06	**0.76**	0.05	0.07	0.11	0.04
Obtaining liquidity	4.03	0.93	0.26	0.20	-0.02	**0.73**	0.07	-0.02	-0.05	0.08
Producing at lowest possible cost	3.83	1.02	0.02	0.29	0.10	**0.42**	0.13	0.03	-0.14	-0.17
Investing in non-agricultural enterprises	2.55	1.08	0.15	-0.08	0.33	0.08	**0.55**	0.16	-0.08	0.16
Off-farm employment the farm manager	3.09	1.29	-0.01	0.06	-0.07	0.04	**0.76**	-0.03	0.12	0.01
Off-farm employment the farm managers' mate	3.30	1.25	0.04	0.25	-0.05	0.13	**0.69**	-0.06	0.14	-0.09
Voluntary work in agricultural professional associations	2.94	1.05	0.18	0.10	0.06	0.00	-0.05	**0.84**	0.08	0.04
Voluntary work in agricultural cooperatives	2.69	1.01	0.15	0.14	0.14	0.05	0.04	**0.84**	-0.03	0.08
Production extensification	2.82	1.01	0.05	0.02	0.03	-0.05	0.14	0.01	**0.69**	-0.07
Reducing farm investments	3.03	0.97	-0.15	-0.08	-0.03	0.23	0.12	0.10	**0.59**	-0.09
Production specialisation	3.37	1.06	0.19	0.02	0.23	0.16	-0.02	-0.01	0.17	**-0.75**
Production diversification	3.17	1.10	0.17	0.05	0.26	0.19	-0.08	0.10	-0.01	**0.68**
Investing in on-farm businesses	2.96	1.31	0.35	-0.07	0.29	0.07	0.33	0.10	0.15	**0.41**
Production of high-priced quality products	3.75	1.03	0.34	0.32	0.29	0.15	0.06	-0.03	0.06	0.21
Compensating financial straits with forestry income	3.02	1.08	0.28	0.31	-0.15	0.06	0.31	-0.02	0.04	-0.11

a) Average scores measured on a Likert type scale with 1 = very ineffective, 2 = rather ineffective, 3 = partly (in)effective, 4 = rather effective, 5 = very effective.

b) The extracted factors are: F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and nsurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification; membership to a factor with loadings ≥|0.4| (bold).

Source: Survey of Austrian farmers 2015, N = 486; own calculations

The interpretation of factor 5 as "off-farm diversification" is obvious. The risk management measures off-farm employment of the farm manager and of his/her spouse are high loading as well as investing in non-agricultural enterprises. Off-farm diversification can be a strategy for stabilising small farms by non-farming income and therefore should be typical for part-time farms. But it may also come along with production extensification when handing over the farm to a successor, already employed in a non-agricultural sector.

Factor 6 represents “farm community service” and includes two risk management measures in respect to honorary functions in the context of agricultural organisations. In Austria, honorary functions in agricultural professional organisations as well as in cooperative processing and marketing of agricultural products (e.g. dairy) have a long tradition. Holding such a function provides the possibility of networking and influencing the economic and political environment of agriculture actively. Farmers with honorary functions may be able to gain relevant information earlier than farmers not involved. Therefore, the engagement in agricultural organisations can serve as a risk management strategy of farmers.

Factor 7 represents “agricultural extensification” and is high loading on reducing farm investments, participation in the Austrian agri-environmental programme, and on production extensification. It represents a long-term strategy of the farm and is supposed to be correlated with organic farming and with farming in mountainous areas.

Factor 8 represents “on-farm diversification” and has a high positive factor loading with production diversification and a high negative one with its opposite production specialisation. The risk management measure investing in on-farm businesses (e.g. tourism or direct marketing) is also included in the factor with a positive factor loading. On-farm diversification like agricultural extensification represents a long-term strategy of the farm, compatible with organic and conventional farming as well as with mountain and non-mountain farming. It is supposed to be less suited to part-time farms and to large scale intensive and specialised production.

Perceptions of risk management strategies according to different pathways of agriculture

Farmer’s perceptions of management strategies represented by the eight factors were analysed by using non-parametric Mann-Whitney and Kruskal-Wallis tests. In respect to farm types, significant differences indicated by the Kruskal-Wallis test (F1, F2, F3, F6, F7) could not be confirmed by the pair-wise Mann-Whitney tests. Consequently, the results on average scores by farm types presented in Table 2 only provide some qualitative information.

The other results in Table 2 show that the highest scores are given to the financial management strategy by most subgroups; the lowest scores are given to farm community service. The perceptions are significantly different between organic and conventional farmers for the strategies of agricultural extensification as well as off-farm and on-farm diversification. Organic farmers assess those as significantly more effective than their conventionally producing colleagues. Off-farm diversification is also perceived to be more effective by part-time farmers and mountain farmers. Contrary to their part-time colleagues, full-time farmers, on average, give higher scores to adaptation towards expansion and insurance as well as to cost and revenue management. Non-mountain farmers regard the risk management strategies of adaptive capacity building and technology as well as cost and revenue management to be more effective, while mountain farmers score the effectiveness of agricultural extensification and off-farm diversification higher.

Table 2. Perceptions of risk management strategies according to farming method, employment situation and geographic location of the farm

	Average Scores [a] in perceived effectiveness of risk management strategies							
	F1[b]	F2	F3	F4	F5	F6	F7	F8
Farm type								
Permanent crop farms	3.82	3.55	3.21	3.73	2.66	2.70	3.01	3.28
Forestry enterprises	3.39	3.23	3.03	3.94	3.20	2.62	3.32	3.16
Forage-growing farms	3.47	3.40	3.02	3.79	2.95	2.82	3.21	3.12
Mixed farms	3.52	3.46	3.17	3.72	2.75	2.78	2.98	3.23
Cash crop farms	3.72	3.63	3.24	3.78	3.07	2.97	3.25	3.21
Intensive livestock farms	3.77	3.60	3.50	3.92	2.98	2.66	2.52	3.36
Farming method								
Organic farm	3.63	3.56	3.14	3.83	3.19*	2.82	3.47***	3.30(*)
Conventional farm	3.54	3.43	3.12	3.83	2.93	2.80	3.08	3.15
Employment situation								
Full-time farm	3.57	3.52(*)	3.19*	3.84	2.66	2.79	3.11	3.21
Part-time farm	3.53	3.39	3.05	3.77	3.31***	2.85	3.21	3.14
Farm geography								
Mountain farm	3.50	3.45	3.02	3.83	3.05*	2.75	3.31***	3.15
Non-mountain farm	3.59(*)	3.46	3.21**	3.76	2.88	2.87	3.06	3.19

a) Average scores measured on a Likert type scale with 1 = very ineffective, 2 = rather ineffective, 3 = partly (in)effective, 4 = rather effective, 5 = very effective.

b) F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and insurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification.

Non-parametric Mann-Whitney test, pair-wise significant differences at *** p≤0.001; ** p≤0.01; * p≤0.05; (*) p≤0.1.

Source: Survey of Austrian farmers 2015, N = 486; own calculations

Levels of farm risk management according to different pathways of agriculture

Differences in the level of already applied and planned risk management of the subgroups of Austrian farmers were analysed by using non-parametric Mann-Whitney and Kruskal-Wallis tests. According to the number of risk management strategies, the differences are highest between full-time and part-time farms (see Table 3). Full-time farms have levels of using adaptive capacity building and technology, adaptation towards expansion and insurance, and cost and revenue management of 58%, 64%, and 43%, respectively. In contrast, part-time farmers use these risk management strategies in a significantly lower level such as 47%, 54%, and 31%, respectively. Full-time farmers use seven of eight risk management strategies to a higher extent than part-time farmers, even those they do not perceive to be more effective than their part-time colleagues. This result may suggest that a higher dependency on farming as source of income leads to a higher awareness of risk and a more proactive risk management. The fact that only 52% of the part-time farmers indicate use of the strategy off-farm diversification is remarkable, because this strategy constitutes part-time farming. An explanation could be that off-farm diversification is more seen as a mode of farming in general rather than as a specific strategy of managing risk. The level of financial management is significantly higher in conventional farms while a higher level of use of off-farm diversification and agricultural extensification is observed in organic farms.

Table 3. Level of currently applied farm risk management according to farming method, employment situation and geographic location of the farm

	Average level[a)] of currently applied risk management strategies							
	F1[b)]	F2	F3	F4	F5	F6	F7	F8
Farm type								
Permanent crop farms	63%	62%	40%	63%	15%	27%	54%	28%
Forestry enterprises	44%	53%	29%	72%	39%	23%	62%	30%
Forage-growing farms	51%	58%	36%	70%	36%	33%	58%	30%
Mixed farms	50%	58%	40%	70%	34%	29%	47%	42%
Cash crop farms	57%	62%	37%	68%	44%	35%	55%	39%
Intensive livestock farms	64%	71%	61%	71%	21%	45%	31%	23%
Farming method								
Organic farm	56%	61%	38%	66%	44%**	29%	61%*	37%
Conventional farm	51%	59%	37%	72%*	34%	33%	53%	32%
Employment situation								
Full-time farm	58%***	64%***	43%***	72%	21%	40%***	56%	35%
Part-time farm	47%	54%	31%	68%	52%***	26%	54%	30%
Farm geography								
Mountain farm	49%	58%	36%	70%	35%	29%	61%***	32%
Non-mountain farm	56%**	60%	40%(*)	70%	35%	37%(*)	51%	33%

a) Average level is defined as average percentage of planned risks management measures in the total number of risks management measures of a factor.

b) F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and insurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification.

Non-parametric Mann-Whitney test, pair-wise significant differences at *** p≤0.001; ** p≤0.01; * p≤0.05; (*) p≤0.1.

Source: Survey of Austrian farmers 2015, N = 486; own calculations

While agricultural extensification can be regarded as a main characteristic of organic farming, the relatively high level of off-farm diversification is surprising. With respect to the farm geography, results show that extensification is more important for mountain-farmers than for non-mountain farmers, which is due to the natural circumstances of agricultural production of the two farm groups. In contrast, the level of using adaptive capacity building, cost and revenue management, and farm community service is lower in mountain farms. The subgroups by farm type analysed by the Kruskal-Wallis test indicated significant differences between F1, F3, F5, F7, and F8, but the pair-wise Mann-Whitney tests could not identify which farm types differ from each other.

Table 4 displays the results of the farmer`s future plans for risk management. In comparison with the currently applied risk management the average level of strategies planned for the future of all subgroups of farmers is constant or increasing for the risk management strategies of adaptive capacity building and technology, cost and revenue management, financial management, and on-farm diversification. On average, all farmers concur in planning to reduce farm community service. In contrast, the level of the risk management strategies of adaptation towards expansion and insurance, off-farm diversification and agricultural extensification vary among the subgroups.

Table 4. Planned level of farm risk management according to farming method, employment situation and geographic location of the farm

	Average level[a] of risk management strategies planned for the future							
	F1[b]	F2	F3	F4	F5	F6	F7	F8
Farm type								
Permanent crop farms	63%	53%	45%	63%	26%	35%	59%	33%
Forestry enterprises	55%	52%	33%	70%	36%	26%	62%	30%
Forage-growing farms	58%	59%	40%	73%	38%	31%	54%	31%
Mixed farms	63%	62%	50%	75%	35%	23%	52%	38%
Cash crop farms	70%	66%	45%	72%	42%	33%	55%	42%
Intensive livestock farms	68%	67%	61%	73%	19%	39%	29%**	23%
Farming method								
Organic farm	67%*	65%(*)	43%	73%	41%	27%	64%***	38%
Conventional farm	59%	58%	42%	73%	36%	32%	50%	32%
Employment situation								
Full-time farm	65%*	63%*	48%***	73%	25%	37%**	53%	36%
Part-time farm	58%	58%	37%	72%	50%***	25%	55%	31%
Farm geography								
Mountain farm	56%	59%	38%	74%	36%	27%	59%***	33%
Non-mountain farm	67%***	62%	47%***	71%	36%	34%	50%	35%

a) Average level is defined as average percentage of planned risks management measures in the total number of risks management measures of a factor.

b) F1 = adaptive capacity building and technology, F2 = adaptation towards expansion and insurance, F3 = cost and revenue management, F4 = financial management, F5 = off-farm diversification, F6 = farm community service, F7 = agricultural extensification, F8 = on-farm diversification.

Non-parametric Mann-Whitney test, pair-wise significant differences at *** p≤0.001; ** p≤0.01; * p≤0.05; (*) p≤0.1.

Source: Survey of Austrian farmers 2015, N = 486; own calculations

Organic farmers plan to raise the level of using the strategies of adaptive capacity building and technology and of adaptation towards expansion and insurance to a higher extent than conventional farmers, which could be interpreted as a consequence of increasing risk awareness in organic agriculture. Part-time farmers plan to pay slightly more attention to the risk management strategy of adaptive expansion and insurance as well as to agricultural extensification, which seems to be contradictory. An explanation might be that part-time farmers are more heterogeneous and one group with expanding plans opposes another planning further extensification. Mountain farmers as well as non-mountain farmers plan to use the strategy of adaptation towards expansion and insurance and off-farm diversification more often than currently applied, but they also plan to reduce the strategy of agricultural extensification. In respect to farm type, the Kruskal-Wallis test indicates significant differences between F1, F2, F3, F5, F7, and F8. Using the pair-wise Mann Whitney tests, a significant difference could be found between intensive livestock farms and the other farm types. Livestock farmers plan a significantly lower level of agricultural extensification than farmers of other farm types.

Conclusions

This article presents empirical results on famer's perceptions, applied and planned risk management measures in Austrian agriculture. Results show a coherent picture of the different agriculture pathways represented by farm types, farming methods, employment situation and geographic location and the risk management strategies of the farmers. The

long-time farm orientation of the farmers matches quite well with the applied and planned risk management strategies. A factor analysis resulted in plausible groups of risk management strategies, revealing financial management to be regarded as the most effective followed by adaptive capacity building and technology. Both indicate that farmers appreciate flexibility and innovation, either in production or with respect to farm assets and liquidity. These results support farm modelling studies that reveal plasticity of farm management, i.e. flexibility to changing environmental conditions, to increase resilience compared to more rigid management behaviour (Rodriguez et al., 2011). The empirical results on farmers' perceptions should support administration, policy makers and extension services in developing risk management policies and extension service products given increasing volatility on agricultural markets and climate change risks in the years to come. But it is crucial that farmers are convinced of the effectiveness of a risk management strategy in order to implement it on the farm. Lack of knowledge about risk management measures, e.g. hedging by future contracts, options and futures leads to a low level of application as shown e.g. by Schaper et al. (2012). Policies and extension initiatives to enhance farmers' management capacities, skills, and awareness appear useful according to farmer perceptions. Employing multivariate models, more in depth research of our rich data set will follow to improve our understanding on risk management in agriculture.

Acknowledgements
We want to thank the Jubiläums Fund of the Austrian National Bank for financing the project (OENB funds project no. 15748) and the Austrian Federal Ministry of Agriculture Forestry, Environment and Water Management for its support. We are grateful to Christine Heumesser for co-developing the questionnaire and Christina Roder for her support in data management.

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Revealing strategic conversations around future visions of agriculture to improve the debate on transformation pathways towards sustainable farming systems

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Abstract: To address sustainability of agro-food systems, different innovation models are proposed which carry underlying pathways for change. Making explicit the divergences between these visions for the future could give more visibility to alternative visions, which otherwise could be dismissed by visions of the dominant regime. The generation and discussion of future visions for agro-food systems can open up or close down options for radical change. Therefore, we aim to analyse the cross-relations between the representations of pathways for change carried by actors and their strategies for change. We follow future-oriented debates, consisting both of a corpus of future representations, and of a community of actors associated to their discussion. We focus on one case study: the future-oriented debate on agriculture and water quality in the Seine river watershed in France (between 2000 and 2016). We organise the materials from documentary sources and interviews through a narrative of the links between the future-oriented debate and strategies. Our results highlight three types of strategies: (i) opening the map of options for change; (ii) promoting radical change for agro-food systems; and (iii) using the future-oriented debate to build an intervention strategy. We identify a gap in this debate: very few explicit transition pathways exist, while it may improve their credibility. We show that some alternative visions integrate performance criteria of the dominant narrative to strengthen their credibility. We conclude by suggesting that another strategy could be to embed future visions in a consistent alternative narrative, revealing the social dimension of water management by agriculture.

Keywords: Future-oriented debate, strategic conversation, transition pathways, future studies, expectations, agro-food systems, water quality, Seine river watershed

Introduction

European farming systems are currently urged by society to reduce their environmental impacts, while the mere economic viability of their activity is endangered. Change in farming systems seems necessary, to identify and adopt innovative models able to perform jointly on the three dimensions of sustainability. There are different proposals for such models, on very different scales: from one innovative practice (such as combined crops), to low-input production systems (such as organic farming), to territorial innovative organisations or to the complete redesign of whole food systems. Those proposals carry underlying pathways for change which are more or less explicit. Innovation research has identified two different general patterns of innovation: system optimisation and system innovation which differ in the

nature and extent of change (Barbier & Elzen, 2012). The first trajectory of change relies on an optimisation of existing systems, putting a strong emphasis on the role of technological progress to achieve it. The second one aims at redesigning the entire systems, tackling not only technical dimensions but also organisational, economic and social ones. In the field of sustainable agriculture, these two patterns can be recognised in diverging visions of agricultural innovation, identified for instance by Levidow et al. (2013) as the Life sciences vision vs. the Agroecology vision, which are embedded in competing socio-technical paradigms. In broad terms, the Life sciences vision relies on more efficient inputs, while the Agro-ecology vision aims at reducing the dependence on external inputs. Those two pathways for change imply diverging strategies regarding research and development, knowledge and actors' networks mobilisation… and different societal consequences. Many dimensions that contrast these different strategies remain implicit, particularly more hidden dimensions of a narrative. For instance, some pathways for change actually reinforce the neoliberal productivist narrative highlighted by Levidow (2015) as the underlying basis for the dominant food regime, while others contest it. Levidow (2015) concludes that making these divergences explicit could clarify the different trajectories promoted for agro-food transitions.

Indeed, actors use the generation and diffusion of expectations for the future in order to pursue their own interests (Berkhout, 2006). Therefore, it is likely that alternative visions, aiming at transitions towards more sustainable systems, will be dismissed by visions produced by the dominant regime actors (Garnet, 2015). If the transition management literature has highlighted the role expectations and visions could play in order to align innovative actors around a shared objective (Smith et al., 2005), the strategic context in which those visions operate (what are the competing existing visions?) should be considered to design them in a more performative way. We therefore propose to follow the processes of generation and discussion of visions of the future for agro-food systems, as they contribute to framing problems and solutions, potentially opening up or closing down options for radical change. Our research aim is to analyse the cross-relations between the representations of future pathways for change carried by actors of the agro-food system and the strategies for change of these actors. We consider that debates on the future of agro-food systems can be analysed as a strategic conversation (Van der Heijden, 1996), from which collective action can emerge. To identify the links between these conversations on future and strategy building, in the light of sustainability objectives, we follow the future-oriented debates, which consist both of a corpus of representations of the future of agro-food systems, and of a community of actors associated with their discussion (Treyer, 2009).

Methodology

A case study approach: following the future-oriented debate on agriculture and water quality in the Seine river watershed

Multiple visions on the future of agro-food systems exist, as well as arenas where they are discussed on very different scales, from a local group of farmers to a small rural territory or national, EU or global level. The way sustainability issues are addressed also varies greatly according to the visions and actors. For the purpose of analysis, we have chosen to reduce the scope of investigation to one case study, consisting of one territory and one sustainability issue. We focus on agro-food systems of the Seine river watershed territory in the north of France, and on the issue of water quality related to agricultural practices. The Seine river watershed, covering 75 000 km^2, is an interesting territory because its main agricultural

systems (cereal, oil and industrial crops) have been following for decades a trajectory of high intensification and specialisation, creating a typical example of a lock-in situation, making it difficult to imagine alternative pathways. The choice to focus on water quality lies in the existence of a regulating water authority for the watershed, the Seine Normandy water agency (AESN), which deals, on the financial and technical levels, with every issue regarding water and aquatic environments' quality, including agricultural impacts. The water agency's programmes are voted by a basin committee, a deliberating body gathering all the stakeholders of the river basin (State representatives, local municipalities, industries, farmers, consumers, NGOs…). This organisation (water agency - basin committee) offers an entry point as a collective, building a strategy for addressing the impact of agriculture on water quality, and providing an arena for debates. It is obviously only a convenient starting point, as many other actors and levels deal with the issue of agricultural impacts on water quality.

To analyse the generation and discussion of future representations of the Seine river watershed's agro-food systems and link them with strategies for change, we study the future-oriented debate on water quality issues linked with agricultural practices; in the Seine river watershed specifically but also in the wider framework of debates and strategies regarding agriculture and water at the French and EU level, as they have great influence on the Seine watershed level. We adopt a retrospective analysis in order to follow changes of the future-oriented debate in a broad timeframe.

When studying the future-oriented debate on agriculture and water quality, we consider that production or discussion of visions for the future is a strategic intervention in this debate (Treyer, 2009). We do not focus only on explicit future representations, such as scenarios resulting from foresight studies. We also pay attention to more implicit visions of the future, as they contribute to framing agendas and solutions. Those implicit visions are embedded in different types of discourses or plans addressing the change of agro-food systems (e.g. a general trust in high technology for solving environmental problems). For instance, a public policy programme contains a form of expectation for the future, as it defines objectives, institutional settings to meet these objectives, and means to achieve them, which are characteristic features of future visions according to Berkhout (2006). This generation of a future vision contributes to making explicit a strategy for change. We follow those processes of "making explicit" strategies for change, in different settings and at different levels: (i) public policy programmes regarding agriculture and water quality; (ii) strategic studies and evaluations, as they express a framing of the problem to solve and - most of the time - propose different solutions through recommendations; and (iii) explicit foresight exercises, as they explore different possible future changes.

Materials

We follow an iterative analysis between documentary sources (documents making explicit strategies for change as per the three types outlined above) and interviews with stakeholders involved in the future-oriented debate on agriculture and water quality. This paper presents the results of the analysis of twelve interviews with stakeholders from the water agency, research institutes, NGOs, administration and agricultural development institutes.

The paper focuses on the most salient period and actors that stand out from the analysis of these interviews. We chose to focus on the most recent period, for which the memory of interviewees is obviously better. We also focus on a specific set of actors, due to our entry

point via the Seine river agency organisation. Widening of the time frame and actors analysed will be addressed in further stages of the research work. The first interviews led to a focus on:

- a specific period of time: 2000 – 2016. We choose as a starting point the beginning of the year 2000, as the Water Framework directive explicitly sets targets and deadlines for water policies at the European level. At the Seine watershed level, at the same time, future representations change the debate on agriculture and water quality, showing that business-as-usual in agriculture is not compatible with water quality objectives.

- a limited number of actors, mainly: (i) the Seine water agency; (ii) a scientific programme on the watershed (PIREN Seine); (iii) the French National Agronomic Research Institute (INRA); and (iv) the national administration, addressed through the public policies' changes in the period.

We first present an intermediate result that has been produced to organise the material: a narrative of the co-evolution of (i) the future-oriented debate on water quality and agriculture in the Seine river watershed; and (ii) strategies to address this issue in terms of objectives and means. This form of narrative is useful to present a first stage of the results, as it allows capturing of the systemic dimension and the complexity of interactions of the processes studied (Ricoeur, 1983). Secondly, we present the results coming from the analysis of this narrative.

An intermediate result: a narrative to follow the links between the future-oriented debate and strategies regarding agriculture and water quality in the Seine river watershed

When our story begins, in 2000, the problems caused by diffuse agricultural pollution on water quality exist in the French political agenda, thanks to alarms that have been rung since the 1980s, mostly by scientific works (Hénin, 1980). Policy instruments already exist to address this issue, such as the Nitrates Directive, enacted in 1991 and implemented from 1998. The Seine river agency, even though it recognises non-point source agricultural pollution as a major issue, lacks the skills and policy instruments to tackle it efficiently, as its intervention has until then been centred on urban water treatment with technical approaches based on equipment (Narcy, 2004).

2000-2007: building the evidence of the need to change agricultural practices to reach water quality objectives in the Seine river watershed

In 2000, the water policy undergoes an important change, coming from the EU level, with the adoption of the Water Framework Directive (WFD). It makes explicit a strategy for change, setting objectives for water quality ("good status" for all European waters) and clear deadlines to reach them (through three management cycles ending in 2015, 2021 and 2027). This results-based approach reveals the needed changes to meet the objectives. The WFD thus introduces "future-oriented" thinking in water management.

In the Seine river watershed, also at the beginning of the 2000s, evidence is gathered on the future deadlocks for water quality of the current agricultural systems. A research programme, called the PIREN Seine (*Programme Interdisciplinaire de Rercherche sur l'Environnement* on the Seine river), which has been working on water quality in the basin since the end of the 1980s, plays a key role in building this evidence. The issue of agriculture and water

quality gradually enters the programme's work, as pollution from urban water decreases, making clear that the next big challenge for reaching water quality lies in diffuse agricultural pollution. Thanks to sophisticated models elaborated in the programme, some researchers show that the continuation of current agricultural trends, even with the adoption of good agricultural practices, is not compatible with water quality objectives (Thieu et al., 2010). If this work provides sound evidence for the water agency to argue in favour of a deep change to agricultural practices, the means and policy tools to promote those changes are still lacking.

2007: a turning point: ambitious objectives and deadlines for agro-environmental policies are set at the national level, opening options of change for agriculture

In 2007 the French government organises a conference on environmental issues (called "Grenelle de l'Environnement"), which includes a working group on agriculture. Several measures are taken after the conference, among them three ambitious policy objectives regarding agriculture: (i) reducing the use of pesticides by 50% by 2018 (with a "if possible" condition added after pressure from the agricultural sector); (ii) developing organic farming, to reach 6% of the agricultural area on the national scale in 2012, then 20% in 2020; and (iii) protecting 500 water catchments threatened by diffuse agricultural production in 2012.

Even though we know today that those objectives have not been reached, they represent an important moment when explicit visions for the future of agriculture were stated. Regarding organic farming, it gives it legitimacy as a solution considered by national authorities, undermining its opponents' attempts to dismiss it as a credible alternative. The pesticide reduction objective (labelled under the "Ecophyto" policy) also introduces a vision of a future agriculture using far less pesticides. Even though those two policies are not directly linked with territorialised water quality objectives, they can both contribute to reaching them. By contrast, the water catchment policy protection for drinking water is less explicit: it targets a number of areas under protection, but only sets objectives at the catchment level in a means-based approach (e.g. indicators such as the area rate under agro-environmental schemes).

2008-2016: looking for strategic objectives and tools: defining levels of change and levers of action to reach the policy objectives

We can follow some contributions to the future-oriented debate or strategic moves that have been taken by some actors after the setting of the Grenelle objectives. Regarding the pesticides reduction policy (Ecophyto), the French Agriculture and Environment Ministries had asked INRA, simultaneously with the Grenelle, to launch a study on the feasibility of pesticides reduction (called Ecophyto R&D (Butault et al., 2010)). This was useful to address counter arguments on the impossibility of this vision for change. The study results contributed to specifying the pathways of change compatible with different levels of reduction objectives. Simulation scenarios were realised, showing two thresholds of change: (i) an option leading to a decrease of 30% in pesticides use, through significant changes in terms of agricultural practices but with moderate changes in terms of production systems, and maintaining equivalent economic results; (ii) an option leading to a 50% decrease that would entail a deep redesign of production systems and associated food chains.

At the Seine river watershed level (as well as at the national scale), a lot of efforts were focused on the water catchment policy, as the pressure from the State to reach the administrative objectives, labelled in number of catchments to engage, was strong. But concerning the implementation on the ground, the level of changes required and the

assessment of their efficiency on water quality were vague. A lot of action plans established at the catchment scale were mainly paper plans, lacking ambition, with no long-term guarantee of success. To address this unsatisfactory situation, the Seine river agency searched for means of action to secure significant and long-term changes to production systems. It launched in 2009 an evaluation of its policy for long-term land use control on water catchments areas (Epices, AScA, 2011). This study proposed two scenarios for the implementation of the Seine river agency's strategy. The first strategy consists of working with the dominant agricultural actors, while the second option consists of finding new alliances at a territorial level, for instance with municipalities (responsible for drinking water protection). The Seine river agency also launched reflexions on other levers of action. Notably, they launched an experimental programme of measures to bring financial support to economic projects based on low-input production systems.

In parallel, on the Seine river watershed, the PIREN Seine researchers were pursuing their work on agriculture, by producing an image of radical change for the agriculture of the watershed, consistent with water quality objectives. In this image, the entire agricultural systems of the basin are organic, with a significant role of livestock for fertility reasons (while livestock systems are currently marginal), and a shift to a diet with reduced meat consumption (Billen et al., 2012). The building of this image has been backed by an important research programme on the performance of organic farming regarding water quality. This work draws a radical image for change, which has led to numerous debates in the water authority bodies or in agricultural organisations. Even if it does not give a systemic image of what the agriculture of the basin would be under these assumptions, it represents a step further in the future-oriented debate.

In 2011, a special Seine basin committee on agriculture was organised, highlighting a moment of policy debate on agriculture issues on the watershed scale. Different dynamics of the future-oriented debate converged, leading to, among other interventions: (i) the radical image produced by the PIREN Seine program; (ii) the evaluation of the long-term land use control on water catchment areas; (iii) the results of the Ecophyto R&D study. Despite this convergence of arguments in favour of a radical change, the effects of this basin committee are difficult to identify while this committee encompasses different groups of interests, reflecting society at large. According to interviewees, this meeting can be considered as a further step in an accumulative process on the definition of objectives and means regarding agriculture and water quality in the watershed.

More recently, we can identify another moment of convergence of different studies, more directly aimed at providing an opinion on the direction the future of agriculture should take. In April 2014, the scientific committee of the Seine basin committee published a position paper on the issue of agricultural transitions for restoring water quality (Conseil scientifique du Comité de basin Seine Normandie, 2014). It relies on several studies, such as the PIREN Seine work and the evaluation on water catchment outlined above, but also on more recent works by INRA, on success stories of water catchment restoration (Benoit Merle, 2013), and on levers for crop diversification (Meynard et al., 2013). This position paper calls for a breaking scenario at the scale of the entire basin. It presents the involvement of food sectors as a strategic lever to reach large-scale results. Following this position paper, the Seine river agency launched a strategic study to see how it could encourage low-input production systems through support to the structuration of economic sectors, which represents a further step in the dynamics of the future-oriented debate and its strategic outcomes. In parallel, the

PIREN Seine keeps working on a new foresight project, aiming at introducing food chains and territorial issues in the scenario building, and at designing a transition pathway towards a socio-economic image compatible with water quality, as it was a blind spot of the previous scenarios.

Results: highlighting the strategies emerging from the dynamics of a strategic conversation on agriculture and water quality in the Seine river watershed

The narrative outlined above, organising the most salient elements from the interviews analysed, shows the future-oriented debate cannot be restricted to water quality issues but should also consider interventions on agro-environmental issues. The forms of interventions in this future-oriented debate identified are mostly: scenarios and modelling exercises on the Seine watershed, scientific works on input reduction or water catchment protection (some of them using simulation scenarios), strategic studies or evaluations.

Through the analysis of the narrative we identify different dynamics around agro-environmental issues (including water quality issues) that contribute to a strategic conversation on the means to change agro-food systems to decrease their negative environmental impacts. We organise them around four dynamics: (i) the setting of public policy objectives regarding agriculture and environment; (ii) the research works of INRA addressing the feasibility and consequences of those objectives, (iii) the PIREN Seine works trying to define images for the agro-food systems of the Seine watershed compatible with water quality; and (iv) the building of an intervention strategy on agriculture by the Seine river agency. Figure 1 represents these dynamics and where contributions to the future-oriented debate on agro-food systems take place. We can identify three types of intervention strategies in the future-oriented debates through the analysis of these dynamics and their links.

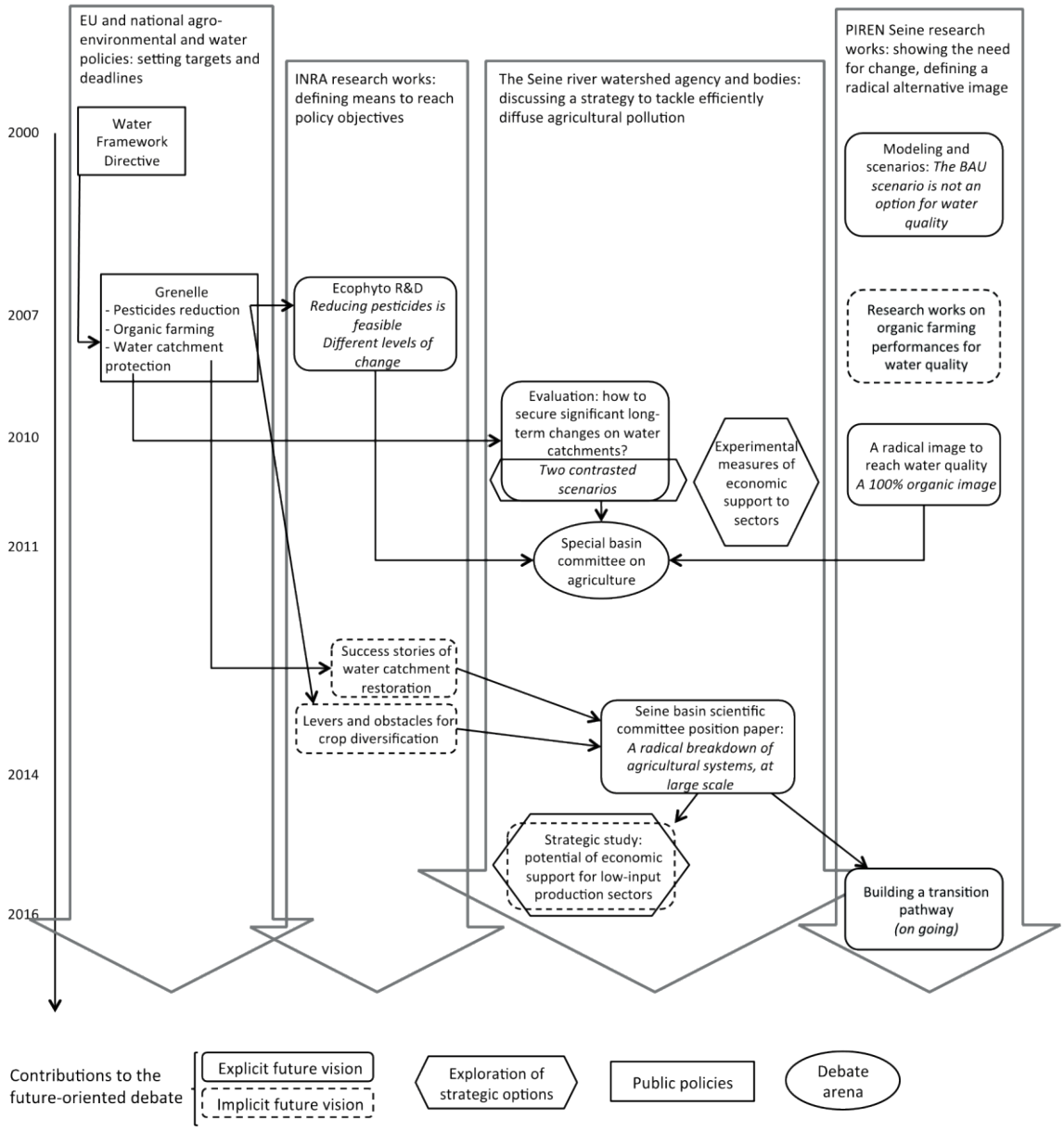

Figure 1. Links between the dynamics of agro-environmental public policies, the future-oriented debate on agriculture and environment, and the intervention strategy on agriculture and water quality in the Seine river watershed *(BAU = Business As Usual)*

Different types of intervention strategies in the future-oriented debate on agriculture and environment

Opening the map of possibilities: showing the feasibility of alternatives to the intensification trends, defining levers of action

The works from INRA represent this strategy, which are closely linked with public policies. Indeed, the works presented in Figure 1 were commissioned by state authorities to contribute to policy design and implementation. Based on sound academic evidence those works contribute to strengthen a line of argumentation defending alternative options to the business-as-usual scenario (pursuit of intensification and specialisation trends), therefore widening the scope of options for the future. Indeed, Ecophyto R&D (Butault et al., 2010)

shows that a significant pesticides reduction (30%) is possible without dramatic production and economic losses, which is a powerful counter argument to claims of the impossibility of changing practices. The research on crop diversification represents another step, by studying in depth the conditions for developing an important technical level for pesticides reduction. It shows the importance of working on technical levels (producing references for diversification crops for instance) but also on other levels, notably the structuration of food chains. The work on success stories of water catchment restoration also identifies conditions for success on various dimensions.

Those research works do not frontally oppose the dominant agricultural systems, but the way they make explicit the needed changes if environmental objectives are to be reached questions them (redesign of production systems for a 50% pesticides reduction, reorganisation of the food chains for crop diversification, local conditions on water catchments).

Promoting radical change for the agro-food systems of the Seine river watershed

In the Seine river watershed, we can identify intervention strategies in the future-oriented debate more directly aimed at contesting the current dominant trends of agro-food systems, as illustrated by the PIREN work's dynamics. Trying to figure out an adequacy between agro-food systems and water quality, they first demonstrated that a business-as-usual scenario on practices was not consistent with quality objectives. They therefore launched several works to define a "water-friendly" image, which resulted in the 100% organic image of the basin (Billen et al., 2012). If their work was first aimed at showing the environmental efficiency of such an image (through modelling), they also progressively enriched the dimensions covered by the image, notably by adding insights about the food supply. This widening of the scope aims at improving the desirability and credibility of the image. Next steps for the PIREN work includes a new foresight exercise relying on qualitative scenario building, which will add more socio-economic elements on the food chain, and will design a transition pathway towards a future image, to strengthen arguments on its feasibility.

The intervention of the scientific committee of the Seine basin committee also aims at reinforcing arguments in favour of a radical change. For this, it does not build a new image, but relies on the one built by the PIREN, and on different works on changes of agro-food systems. This type of intervention strategy, synthesising different future representations rather than producing new ones, had been identified by Treyer (2009) and Labbouz (2014).

Using the future-oriented debate to build an intervention policy

We here focus on the way the Seine river agency takes part in the strategic conversation. The narrative shows how the agency has integrated different results from interventions in the future-oriented debate (the PIREN Seine argument on the deadlocks of the BAU scenario, its radical image, the Ecophyto R&D results…) to strengthen a line of argumentation in favour of significant changes of agro-food systems. It has also produced its own contributions to the debate, in order to identify strategic levers for its intervention policy on agricultural issues. Those explorations of strategic options contribute to the future-oriented debate as they explore potential changes for agro-food systems (through the development of low-input sectors) or for water catchment protection measures (through land use control measures). Those interventions can be interpreted as a means to widen the scope of the debate on agricultural impacts on water, which tends to be focused on very technical issues, framing the search of solutions mostly on an optimisation of practices.

Introducing measures on the structuration of economic sectors or on landscape management helps avoid this framing. It also contributes to working with actors other than the usual ones; municipalities, water companies and marginal agricultural sectors are allies to mobilise for actions towards water quality.

A gap in the future-oriented debate? Very few explicit possible transition pathways
The visions for the future of agro-food systems we have identified take different forms. Some are explicit future images (the BAU and 100% organic scenarios of the PIREN Seine) or at least explicit directions for the future (the call for systemic radical change of the scientific committee of the Seine basin). Others are more implicit, but still carry a vision for the change of agro-food systems, identifying different levels of change and conditions to achieve them (the study on crop diversification is typical in this respect). However, we do not identify explicit consistent transition pathways, combining different levers of action to reach a specific image. Obviously, building this kind of transition pathway is not an easy task, but opponents of radical changes strategically use this absence to contest their feasibility. This has led the PIREN Seine to include the building of such a pathway in the next step of its work. However, it would be naive to consider it would be enough to address criticisms, as the strategic conversation on agriculture and environment takes place in a wider and contradictory debate.

Replacing the strategic conversation in the wider debate on the future of agriculture: how to deal with the dominant paradigm?
Indeed, the narrative presented above does not mention a crucial dimension of the future-oriented debate: the future visions of actors from the agricultural sector. This is due to our entry of analysis by the water quality issue and the actors involved in its management. However, the performative effect of the visions produced in the future-oriented debate on agriculture and environment can only be understood by linking them to other debates, encompassing a whole range of issues on the future of agro-food systems and actors addressing them, from the agricultural sector but also others (e.g. the health sector).

The scope of this paper was not to provide a large overview of the future-oriented debates on agriculture. However, some links between the debate on water quality and other debates stand out of the interviews and deserve a specific analysis as they are also markers of strategic choices. First of all, the issue of food security is omnipresent in any discussion on the future of agriculture. For instance, Ecophyto R&D assesses the impact of pesticide reduction in view of its consequences on production volumes. The PIREN Seine works integrate this issue when it shows that the 100% organic image allows the food supply of the basin (if coupled with a decrease in the share of animal products in the human diet). But it lacks the consequences of the scenario on EU and global markets, which is the level of playing of the Seine basin agriculture. Besides, when asked to identify significant foresight exercises (as markers of future-oriented debates), the interviewees fail to identify some on the water quality issue, but quote exercises of the food security debate. Indeed, the overarching objective of feeding the world in 2050, omnipresent in this debate, is used to hinder any target of input reduction in the name of production. Some actors declare referring to exercises proposing counter-arguments (such as the Agrimonde exercise (Paillard et al., (2010)). The arguments around production are often coupled with concerns on economic aspects. Ecophyto R&D also assesses pesticides reduction in view of farms' economic results; the capacity of the 100% organic image of the basin to maintain a significant amount of cereal exportation is put forward. The

reflexions of the Seine river agency on financial support to economic sectors supporting low input production systems follow the same line. The issue of competitiveness is therefore integrated as a concern in the generation of visions on agro-environmental issues.

This importance of production and competitiveness is not surprising, as they are defining features of the dominant neoliberal productivist narrative (Levidow, 2015). The power of actors supporting this discourse leads any designer of a future vision to position it with respect to this narrative, either reinforcing or contesting it. We can highlight different ways of handling this positioning in the future visions analysed in this paper. Most of those visions contribute to proposing an innovation pathway rather than an optimisation one, this latter being at the core of the productivist paradigm. The different visions presented above show the need to redesign systems, and widens the scope of change compared to a technically focused lens. By showing that solutions can lie in reorganisation of the food chains or territorial projects, they undermine the predominance of technological innovations as the only solutions for the future. They do assume the potential decrease of production caused by changes in practices, but some of them argue that this decrease is consistent with the maintenance of good economic results or cereal exports for national competitiveness. Thereby, they adopt some performance criteria of the dominant paradigm, giving them more credibility in the policy debate where those criteria dominate. The positioning towards the dominant productivist narrative mixes contestation and integration of some of its features.

Discussion and conclusion

The analysis of generation and discussion of future visions produced around agriculture and water quality reveals some strategies of actors involved in the debate around this issue. Some strategic consequences in terms of policy intervention measures have been identified for the Seine river agency. The choice of this paper has been to study rather precisely the content of the future visions produced to see what options for change they carried, however it has led to focus on a limited number of actors. Further work should be pursued to widen the scope of analysis towards other actors, notably the agricultural sector. Applying the same approach to the study of strategic conversations around the neoliberal productivist narrative or alternative narratives would allow us to have a more complete view of how the generation of expectations plays a role in the dynamics of sociotechnical regimes. Our identification of different dynamics in the intervention strategies is close to the notion of “multiple streams” used by Elzen et al. (2011) to study the effects of normative contestations in transitions in progress.

Our analysis is focused on debates and strategies taking place at a collective level, and does not analyse how an individual farmer designs their strategy regarding external conditions. It rather addresses the level which frames what shape of individual actions emerge and evolve. We can refer to the concept of single, double and triple-loop learning, used for instance by Pahl-Wostl (2009) to argue in favour of this level of analysis: a radical change of actions require a change in the frames (i.e. goals, problem framing and assumptions on how goals can be achieved) and the structural context that influence those actions. Future visions can contribute to changing the frames of reference (for instance visions that give a new credibility to organic farming as a credible option for the future). It is likely to influence how a farmer designs their strategy, even though further work is needed to study this process. We have also shown how performance is a crucial feature of the future-oriented debate, as alternative visions position themselves regarding performance criteria of the dominant regime, but can also propose new performance criteria (such as health, good living conditions for farmers,

lively rural territories…). We believe that analysing performance at this level where it is built can help analyse how an individual farmer considers the performance of their own systems.

Finally, we have shown how proposals for change in agricultural systems to reach water quality objectives deal with the dominant neoliberal productivist narrative. This process is obviously not one-sided, as the rise of environmental concerns in public opinion leads the dominant food regime to adapt, moving towards a “corporate environmental food regime” (Levidow, 2015). Debates on expectations for the future do contribute to redefining strategies and performance criteria. A strategic move for water actors in the Seine river watershed could be to base their images for change in consistent narratives proposing alternatives to the dominant one on a more general level, revealing the social dimension of water management by agriculture.

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Effects on territories of ending milk quotas. Exploratory findings from two contrasting French case studies: the Niort Plain and the Chartreuse Massif

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Abstract: In France, the ending of milk quotas marks a breach in the mode of milk supply management and dairy farmers' conditions. Regulation administered by public authorities gave way to private regulation by dairy companies. In this context, farmers and actors of territorial development are concerned about the future of dairy farming at local scale. This paper explores the effects of ending milk quotas at the local level by comparing two contrasting case studies: upland and lowland areas. It is based on the same conceptual framework of socioeconomic metabolism, which addresses the biophysical exchange relationships between societies and their natural environments. We sought a better understanding of the effects of ending milk quotas, through looking at milk flows and uses of local resources, and the system of actors activating and regulating these flows, and their strategies. Our research is based on interviews and presentations of our characterisation of milk production designed to prompt discussions between farmers and local actors. We show that the ending of milk quotas, and the ensuing high price volatility, means increased disparities between farmers. It generates (i) in the upland area, rivalry and tensions at the local level, and (ii) in the lowland area, difficulties in sustaining cow milk production in an area that is turning towards crop production. Lastly we discuss, among other topics, the multidimensional and growing requirements and systems boundaries that farmers are facing.

Keywords: End of milk quotas, production structures, downstream operators, relationships between dairy production and territory

Introduction: the ending of quotas challenges territories

Milk quotas were set up in 1984 and stopped in April 2015, ending 30 years of regulation of milk supply by the public authorities in favour of private regulation through formalised contracts between producers and industrial operators. The quota system helped sustain production over the whole country (Perrot et al., 2015). Although the number of dairy farms has declined in every region, volumes delivered have held quite steady (Chatellier, 2015[1]). The exit from quotas was not abrupt but begun in 2008 with the deregulation of the CAP and more liberalised markets, leading to the milk price crisis of 2009, and the passage from quotas to contract from 2012. There are several outcomes (Perrot et al., 2015):

- greater importance of processors, who have also experienced deep restructuring (concentration, internationalisation, system re-engineering (Ricard, 2013));
- more volatile prices of both milk and inputs, and pressure on producers' management decisions - major changes in the relationship between dairy production and territory,

[1] *The number of farms delivering milk dropped from 384 950 with an average delivery of 65.8 tons of milk/farm (25.3 million tons in total) in 1983, to 67 380 in 2013 with an average delivery of 345.4 tons (23.3 million tons in total).*

with deep restructuring (Roguet et al., 2015) and widening disparities between production areas.

Local areas are at the heart of these changes in production systems. However, outside the areas where there has been a collective organisation, e.g. around a recognised high value-added PDO (Protected Designation of Origin) product, the patterns of change in territories are steered by downstream players, which are not necessarily concerned about their impacts or the wealth created locally. Territorial players, who are faced with economic and environmental development issues, are concerned about the effects of ending milk quotas on production, and are seeking to recover some control over the system. In lowland areas, one issue is the competition with cash crops which have benefited from better economic conditions in recent years and without the constraints of animal husbandry (Fillonneau, 2012), while upland areas are penalised by their topography and climate and lack competitiveness in the world market unless they can produce a product with high added value (Dervillé et al., 2012).

Here we explore the effects on territories of ending milk quotas. We therefore characterised and examined the reconfigurations undergone by the dairy industry (focusing on the production and processing steps) and how they interact with territories. In the conceptual framework of socioeconomic metabolism we compare two contrasting cases: one located in a lowland and the other in an upland area. The aim was to better capture the reconfigurations at stake with the ending of milk quotas in order to prompt reflection with territorial players, and to re-think the links between dairy industries and territories.

Materials and Methods

The conceptual framework of socioeconomic metabolism

In a systemic and sustainable thinking, addressing the interactions between industries (with vertical flows) and territories (with horizontal flows) raises the question of the socio-ecological system at play (Fischer-Kowalski & Haberl, 2007; McGinnis & Orstrom, 2014), which depends on flows of materials and energy for its reproduction and maintenance. The socioeconomic metabolism concept[2] has gained interest in this research field (Erb, 2012). It aims to study the biophysical basis of human society, and is developed in flow analysis and accounting (Pauliuk & Hertwich, 2015). The material and energy flows result from political, economic, social and technical choices, and couldn't be analysed without taking them into account. Buclet (2015) proposes then to study the biophysical exchanges between societies and their natural environment by linking material and energy flows to socioeconomic organisations (actors' systems and created wealth -in a large meaning-) in which they are embedded. Understanding the forms of territorialisation of the dairy industry in this conceptual framework questions:

- the forms of dependence of the territories, for their dairy production, on exogenous resources and operators, or on other territories;
- the forms in which the dairy production is anchored to the territory;
- the environmental and socioeconomic footprints of the production on the territories (impact, services provided or wealth created).

[2] *For a review see the special issue of the Journal of Industrial Ecology, 2015: Frontiers in Socioeconomic Metabolism Research.*

Here we focus on characterising the forms of dependence of territories on external resources and operators for their milk production.

The case studies and their comparison

Two contrasting cases were used for this study: an upland area, the Chartreuse Massif (CM), and a lowland region, the Niort Plain (NP). Besides compiling statistics on each area, we also (i) carried out semi-directive interviews with dairy farmers, downstream and upstream operators, and other actors in the territory[3]; and (ii) delivered presentations, locally, of our characterisations of dairy production and forms of interaction between industry and territory, to prompt reflection and exchanges among producers and with local actors. The material was collected between November 2014 and July 2015, and interviewees were asked about past, current and presumed changes linked to the end of quotas and its expressions since 2008.

The first step was to use the common conceptual framework for each territory to analyse and characterise the territorial contexts, the structuring of the dairy industry and the forms of its interaction with the territory before the formal end of quotas in April 2015. We analysed milk flows, from their source (use of local resources and flows of feeds purchased for dairy production) to their processing stage (milk flows between farms based in the area studied, and the associated dairies[4], some of which could be located outside the area), and the system of actors mobilising and regulating these flows (characterisation of the: operators, management systems -in particular since 2008- and modes of coordination, forms of interaction with the territory and the added value it gains). The second step consisted of a cross-analysis of the past effects from 2008 and discussed future changes on the territories due to the ending of milk quotas, with special focus on changes in the forms of dependence on external resources and operators.

Results

Structuring of the dairy industry in the two study areas before 2015

Territorial context: a dairy industry in decline in the Chartreuse Massif, and rivalled by field crops in the Niort Plain.

The CM is an upland area located in the Northern Alps, astride the Departments of Isère and Savoie. It comprises a Natural Regional Park over 60 communes and covers 91,300 ha. Farming is one of its main activities, along with forestry. The NP, located in the South of the Department of Deux-Sèvres in the Poitou-Charentes Region, comprises 38 communes and covers 42,000 ha. It corresponds to an area of transition between broad crop plains and bocage hosting diversity of production systems (field crops and mixed crop–livestock).

[3] In the CM, besides the use of published data, a survey was conducted on 20 farms and 9 dairies collecting and/or processing milk, together with other actors in the territory or upstream. The metabolism of 11 of the farms was reconstituted. In the NP, the work was conducted as part of training for graduate agronomists. The aim was to meet dairy goat and cattle farmers, upstream actors (animal feed cooperative), downstream actors (dairy), agricultural advisors and territorial actors.

[4] We ignored the few farms that processed 100% of their milk on-farm as the end of quotas was less of an issue for them.

Livestock is mostly dairy herds (cows and goats). The main characteristics of the farms with dairy cows (DCs) are given in Table 1.

Table1. Characterisation of farms with dairy cows in the two study areas

	CM		NP	
	2000	**2010**	**2000**	**2010**
Number of farms	165	103	139	88
% (of all farms in the area)	16%	15%	16%	14%
UAA[5]/farm (ha)	47	69	126	153
Number of DCs per farm	25	34	43	59
MFA/UAA	93%	96%	30%	34%
PG/UAA	84%	87%	8%	6%
Average volume delivered/farm	For CM in 2014: 219 000 L		For NP (CLS) in 2014: 572 500 L	

Sources: Agreste farm census 2000 and 2010, statistical analysis from SSP / Irstea UR DTM, and survey data.

In 2010, the CM dairy farms were smaller (34 DC/farm) than the French average (45 DC/farm), but NP farms were larger (59 DC/farm). This was reflected in the volumes delivered and the average UAA per farm, which were more than twice as high in NP than in CM. Only 34% of the areas in NP were used for animal forage supply, due to the presence of cash crops in the dominant mixed crop–livestock systems. We note an expansion of farms between 2000 and 2010, at the expense of the grasslands which were reduced to the non-arable areas. The upshot is that the DCs hardly left their stables, except for some cases near their buildings. Conversely, in CM, the specialised dairy systems are grass-based, although some farms grow crops for on-farm feed. Farms with DCs make up only 14–15% of all farms in each area, and their numbers are in constant decline. In CM we observe a switch to suckling systems, and in NP a trend towards specialisation in cash crops.

Dependence of dairy production on external operators

Chartreuse Massif: a fragmented dairy industry

Using the data obtained from the interviews, we counted 61 farms in CM, delivering 13 million litres (ML) of milk. Eight dairies receive this milk. Only one dairy is located in the CM study area: the Entremonts cooperative (Figure 1). Two-thirds of the volume produced leaves the area. Except for the dairy Sainte-Colombe that receives 30% of its milk from CM, this milk makes up no more than 5–6% of the total volume for the other dairies. These dairies differ in various ways:

(i) in their status - from small-sized directly-managed cooperatives to large cooperative groups with international reach or private enterprise belonging to large groups;

(ii) the added value - one third of the milk production is processed locally via the Entremonts cooperative which uses the “Marque Parc” (a brand linked to Natural

[5] *The descriptive variables of the utilised agricultural area (UAA) are: proportion of the main forage area (MFA), itself broken down into permanent grassland (PG), maize forage and silage, and temporary grassland or meadow; proportion of cereal crops; proportion of industrial crops; proportion of fresh vegetables and proportion of permanent crops.*

Regional Parks) for its cheeses, requiring the farms to meet Savoie protected geographical indication (PGI) specifications. The remaining two thirds are not identified as coming from CM, and either enter the standard long processing chain (Sodiaal and Domessin) or are used for PGI Saint-Marcellin or PGI and PDO Savoie cheese. The wealth created then benefits in part the CM producers, but does not benefit the area in any other way;

(iii) their potential for development according to (i) the proportion of the volume processed; less or greater than that collected, which forces some dairies to find other outlets for their surplus (only the Yenne cooperative and Domessin process more than they collect), and (ii) the level of use of processing plants, in particular when some are at saturation point, as for the Entremonts cooperative;

(iv) their systems for managing volumes and prices[6]. Professional management has been set up to replace the hitherto administrative management of the milk volumes produced for PDO and PGI Savoie (price A and B system with coefficients of regulation, both annually and monthly) from 2012. The other dairies have set up their own systems, after some negotiation with farmers[7]. To illustrate, in 2014, average yearly milk prices were in the range €375–515/1000 L. Thus, not only did the mode of governance of dairy production slip from the hands of the territorial actors in CM (except for the Miribel cooperative), but these varied systems also generate marked differentials between 'neighbouring' farms in prices paid and volumes allotted.

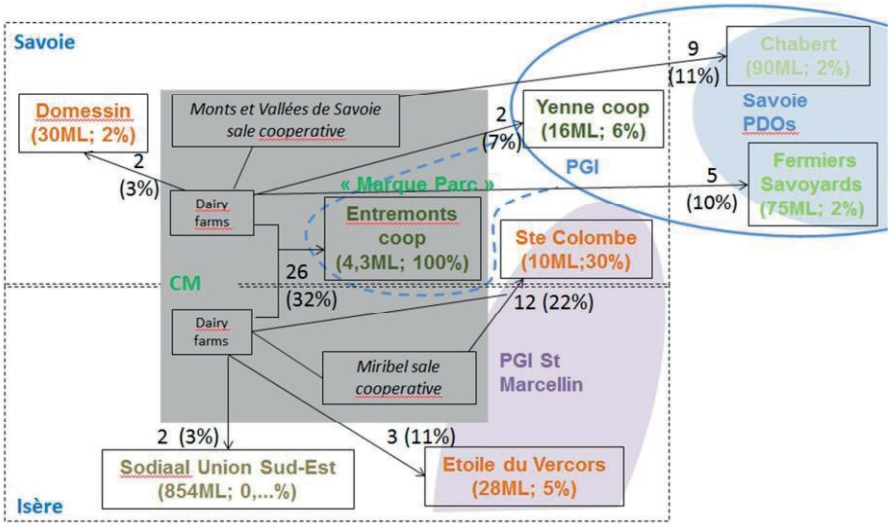

Figure 1. Distribution of dairy production in the Chartreuse Massif in early 2015

[6] *In place of the quotas, there is a regulatory obligation for processors and producers to sign 5-year contracts. These must state, among other things, the rules for: allocating reference volumes, adjusting reference volumes and allotting volumes released by cessation of business; milk price fixing (base price, quality price, specific premiums); dealing with noncompliance with contractual individual volumes; and terminating contracts. The introduction of annual references can be indicative (i.e. volume A and the rest B, but excess paid at the same price), or discriminating (i.e. excess paid at release price), or else constraining (i.e. single price A for a set volume, excess penalised or refused). The quality-certified sectors are authorised to regulate and supervise product supply, and thereby volumes of milk. It is possible to negotiate the clauses of the contract collectively via producers' organisation. The cooperatives are recognised as such.*

[7] *For example, the Domessin dairy has set a single price for a reference volume, and surplus production is penalised. Producers that had federated have more weight in the negotiations—one example is the Miribel sales cooperative which manages to negotiate a premium from Sainte-Colombe for PGI Saint-Marcellin.*

(Key: milk sale coop; ***directly-managed coop; Indirectly-managed coop; SICA; cooperative group; private enterprise (belonging to a group)***
On arrows: number of CM farms delivering to that dairy (% of total vol. of milk from CM)
In 'dairy' boxes: total volume collected by the dairy; proportion of milk from CM)
Niort Plain: a concentrated dairy industry

In the NP, we find around 60 farms delivering 37 ML of milk[8] to two operators, in a cooperative system with regional scope. These two operators are specialised in producing PDO Charentes Poitou butter, and diversified goat cheeses. Since 2004 the Sèvre dairy cooperative (CLS) has grouped the Sèvre et Belle cooperative and the Echiré cooperative renowned for its production of a high-end 'Echiré' butter. This product enjoys additional status within the PDO, through its own specifications, and a 'GM-free' guarantee (entailing an additional cost estimated at €7-15/1000 L according to the dairy farmers). It is sold to prestige customers. This cooperative is faced with a decline in the number of producers, putting the structure's future at stake. The milk is collected from 72 dairy farms at more than 602 ML/farm, which in 2015 equated to 43.4 ML of milk. The expansion of structures (there were 96 farms at 490 ML/farm in 2011) was not sufficient to prevent a fall in collection volume of nearly 4 ML since 2011, i.e. 7% of the production. Over this period, base price paid to producers peaked in 2014 at €320/1000 L but was €302/1000 L in 2012 then fell to €283/1000 L in 2015[9]. The current price situation is unfavourable in view of the constraints of quality specifications, in particular for milk intended for Echiré butter. Terra Lacta, formerly Glac, was renamed in 2013 after its four basic cooperatives merged. The group collected 870 ML of cow's milk, and made numerous dairy products (PDO butter, UHT milk and cream, powdered milk ingredients). Only the Sèvre et Belle dairy is actually located in the PN study area, but the others are adjoining. Historically, this feature offered the area the advantage of having decision making centres nearby, and thus not needing to rely on 'outside' operators.

Dependence on external resources: a dairy industry reliant on external animal feed supplies in both study areas

In neither study area are the farms self-sufficient for animal feed. In CM, this dependence is linked to the difficulty of growing maize and cereals in upland conditions and/or to land shortage. In NP, the farms could theoretically be self-sufficient on animal feed in terms of available land and possible crops, but the farmers prefer to grow high-yield cash crops rather than animal feed for their own herds. In practice, the specifications for PDO butter is based on a feed ration with at least 50% maize, which requires protein supplementation. Soymeal came from South America or even India, while alfalfa is either produced on-farm or imported from the Champagne Ardennes Region or Spain. In some cases, this is the heaviest cost of production for the dairy activity, depending on the production levels targeted. Figure 2 gives an illustration mapping the flows of one of the farms surveyed. In this case, milk production is 610000 L/year, at 7800 L/DC. The area under maize forage (30 ha) makes up 80% of forage

[8] These figures were obtained by extrapolation from the number of farms counted in 2010 and the evolution trend (let 62 in 2015), and from the average delivery for the CLS in 2015 (let 600 ML/farm for 62 farms, i.e. 37 ML).

[9] Compare these figures against average base prices over the Poitou-Charentes area: €361 in 2014 and €298 in 2015. Like in many cooperatives, the pricing policy in the CLS is a subject of local controversy, particularly as profits had reached €50/1000 L in the past, and there was formerly a premium of €18/1000 L for Echiré butter. The cooperative chose to invest in a new plant. Also, butter-making leaves a by-product, skimmed milk, whose value is difficult to increase, thus reducing earnings. The CLS joined forces with another cooperative to try and make better use of this by-product.

supply, the rest coming from meadows (30 ha). The purchase of concentrates is the main production cost, at 305 kg/1000 L[10]. Feed self-sufficiency is not a priority for farmers as it does not generate any extra economic profits. Most crops are intended for sale (140 ha including maize and wheat, but also rapeseed and peas).

In CM, we reconstituted the metabolism of 11 farms. Five deliver their milk to the Entremonts cooperative, with an average delivery of 165800 L/farm, i.e. 5100 L/DC at 300 kg of purchased feed/1000 L. These systems are all based on upland grass, depending on energy and protein supplementation. For the farms delivering their milk to outside operators, the average is 311150 L/farm, 6500 L/DC and 245 kg of purchased feed /1000 L. These systems are located on lower ground where crops can be grown and a greater animal feed self-sufficiency achieved.

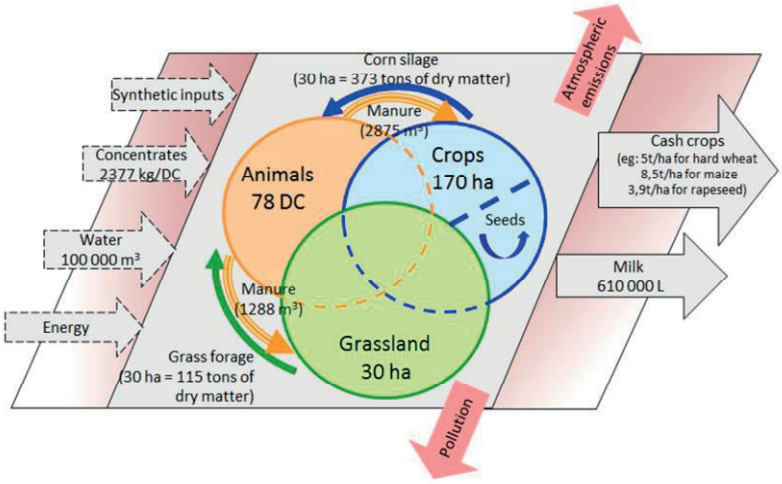

Figure 2. Flows for dairy production in a farm surveyed in the Niort Plain

Effects on territories of ending milk quotas

Stronger forms of dependence on external operators?

With the liberalisation of markets from 2008, restructuring has accelerated among the downstream operators to form groups that carry more weight on the markets, and to cut costs by economies of scale and scope.

In NP, Terra-Lacta and the group Bongrain (renamed Savencia in 2015) joined forces in 2013, and the territory's 'independence' from external operators is becoming very relative. In CM all private dairies were bought by bigger group (Etoile du Vercors by Lactalis, Domessin by Intermarché, Ste Colombe by the Italian group Granarolo).

[10] The average over 113 farms in the Department was in 2013: 250 kg/1000 L for an average production of 7900 L/DC (data from the Chamber of Agriculture of Deux-Sèvres, cow's milk records).

In addition, agreements between dairies on the collection and sale of milk for logistics and cost reasons are multiplying, especially in CM[11] where the collection areas overlap. Farmers no longer know what happens to their milk, which is collected by one dairy, delivered to another and paid for by a third one to which they are affiliated. This is a symptom of a widening disconnection between downstream operators and territorial actors. This trend may lead to a stronger dependence of territories on fewer, larger operators, whose decision centres are ever further away, for whom the territories are no more than logistic variables in a flow optimisation designed to reduce costs. This effect could spiral through a less dense array of farms increasing collection costs, and jeopardising collection by private operators. In CM, the Danone group had vanished from among the processors in 2015, since it has no more than two farms in CM. The attachment of dairies to producers and a production area seems dependent on their status (cooperative -with obligation of collection- or private), the presence of specific products with certified origin, and the volume that the area supplied[12].

Moreover less dairy farms and further dairies can also lead to a loss of a 'dairy atmosphere', which in turn demotivates the remaining producers. In NP, some farmers have the feeling of lost identity and not belonging anymore to the territory, as they find themselves stranded alone in their locality surrounded by cereal crops. This effect becomes particularly acute in both study areas as it is no longer only small structures that are quitting dairy production but also large farms, some with heavy capital investments such as milking robots.

Another local effect of ending milk quotas are greater differences in the price paid to milk producers, and its stability, prompting producers to change dairies. Several such cases were found in the CM survey. This has generated local tensions, especially when dairy farmers who moved were in a producers' organisation (e.g. milk sale coop) which was thereby weakened in its negotiations with processors.

Stronger forms of dependence on external resources?

The producers who have managed to maintain their activity after the 2009 crisis employed different individual strategies. Some have opted for expansion, but it is grounded in greater dependence on inputs from outside, in particular animal feed. Others have sought greater self-sufficiency, which in CM have taken the form of adding value by developing processing and direct sales, diversifying sources of income (e.g. by developing a meat activity), or making more gainful use of locally available resources so as to reduce dependence on external resources and operators. Others have sought to improve the profitability of their dairy activity. At an individual level, this involved re-thinking inputs and how to reduce them, or re-thinking milk quality to make better use of resources. Collective dynamics are also observed. In both study areas there is local reflection on setting up soymeal production activities, in tandem with feed supply cooperatives, with collective investment commitments. In NP, the GM-free

[11] For example in 2014, the costs of collecting milk in CM ranged from 15 to 60 €/1000 L according to the operators, considering that some dairies: move to collection every 72 hours, while some cannot because the quality specifications require collection every 24 hours; collect densely farmed localities where the fall in the number of farms concentrates volumes over a limited number of neighbouring points, while some still collect farms scattered over hilly uplands.

[12] The producers in CM supplied the Saint-Colombe cheese-making plant with practically all their milk for PGI Saint Marcellin, for which it was difficult to find other producers in the certification area. This was less true for other dairies, for which CM was just one among many other areas.

constraint for CLS has made feed supply increasingly difficult. Today, less than 10% of available soymeal is GM-free, causing strong pressure on prices. For alfalfa, mechanisation and labour costs are high. There is new reflection on setting up collective drying plants, revolving around biogas units for animal waste, or setting up 'short' alfalfa chains between cereal and dairy farmers, with outsourcing of fieldwork. But these dynamics are constrained by territorial contexts. Scope for expansion is narrow in CM. In NP, water supply issues and the allied environmental pressure directly affect the self-sufficiency of some dairy farms where the yields required to meet the dairy herd's needs are not reached (e.g. limited access to domestic water catchment areas, or extra costs for irrigation). For alfalfa, development is slowed down by issues concerning investment in biogas plants and convincing cereal farmers of the usefulness of this approach.

Discussion: strengths and weaknesses of the approach…

There is abundant work on the reconfiguration of the dairy industry (Ricard, 2013) or on territories viewed as dairy production areas (Napoleone et al., 2015), but very few studies on the socioecological interactions between dairy industry and territory, in terms of both material flows and systems of actors. A large proportion of the work done on interactions between the agrifood industry and territory addresses either localised agrifood systems (Muchnik et al., 2008) or production under origin-certified labels (Paus & Reviron, 2010). For standard food-chain activities, only a few studies have investigated the organisational structure of the industry as a critical factor in achieving a (re)-territorialisation of agricultural production. The approach presented in part here aims to offer a way to analyse these interactions between industry and territory, without being restricted to quality-certified production or short circuits. Approaches using socioeconomic metabolism mostly analyse the biophysical basis of agricultural systems and their energy and material throughput (Grešlová et al., 2015). By examining both flows and systems of actors, our approach details also the forms of socioeconomic interactions by considering the interplay of the actors that steer and regulate the flows.

… for addressing the multidimensional and growing requirements and systems boundaries faced by farmers

Our approach shows the multidimensional and growing requirements and systems boundaries that farmers are facing. A milk producer is integrated into the scope, for example, of: its locality with its agronomic, environmental, climatic constraints and opportunities, and its administrative, regulatory and management rules; a milk sale cooperative; a processing collector; a certification of origin, etc. These different scopes involve different issues and actors, and are not governed by the same rules and systems for action and decision-making. This has to be fully understood before any changes can be attempted, e.g. changes in socioeconomic metabolism for more sustainable development (Buclet, 2015).

… for examining interactions between dairy industry and territory

This approach enables us to find the role and place of territorial resources and actors in the dynamics of dairy value chains, particularly in their governance. We have focused on the forms of dependence and self-sufficiency of territories for their production (Van der Ploeg, 2008). However, this was a first exploratory approach, which now requires further detailed work on (i) the ways in which production is anchored in the territory and its contribution to territorial development; this anchoring is both socioeconomic and ecological (Baritaux et al., 2016), and (ii) the socioeconomic and environmental footprints of these operating modes

(Buclet, 2015), for instance by transforming material flows in C, P or N imprint (Billen et al., 2012) as environment markers. The strength of such an approach is that material flows account for environment or socio-economic issues as they are analysed in regards to distant and local resources. A further aim is to understand the current situation in regards to its historical background so as to envision possible future perspectives (Napoleone et al., 2015). This would allow looking further into the drawing up and assessment of different scenarios. Our approach also raises a number of questions and paradoxes for sustainable development. In CM, most of the milk collected in the area is sent for processing elsewhere, yet a cheese-making unit in CM is making non-area-specific products using inputs from outside the area, even though its name, 'Le Chartrousin', would suggest territorial roots. This approach aims to generate exchanges and reflexivity among territorial actors concerning the future of local dairy production.

... for prompting exchanges and reflexivity of territorial actors

This was tried out in both study areas. It revealed the low level of reflection by farmers on their production costs, and their dependence on external resources and operators. In NP, the actors, including the farmers, estimated that only 10–15% of farmers knew their production costs precisely. The question also arose of how to stem the tide of withdrawal from dairy activities, and maintain production, with problems of transmission of farm ownership (given the capital needed to take on ever-larger farms), organisation and workloads.

In CM we presented the work to dairy farmers and other CM actors, including elected government representatives. The followed exchanges revealed the awareness of the territory's actors of the fragmentation of the dairy industry, and provided several outcomes concerning: (i) individual and collective strategies to be implemented to strengthen the self-sufficiency of farms, favour pooling (of equipment and labour) and thus reduce production costs and lighten workloads; and (ii) a joint project for dairy farmers in CM around "milk from Chartreuse" to develop and communicate to enhance the activity's image, and even raise or guarantee milk prices.

In NP, discussions on the farms themselves revolved around problems of water quality and quantitative management, procurement of plant proteins, and differences in milk quality in geographically neighbouring farms. The sharing of experience was found useful to gain a better understanding of farmers' disparities and solutions and help find the right trade-off between quantity and quality. As regards the CLS, discussions revolved around how to improve the communication and marketing of the CLS's territorial specificities such as the quality specifications and the 'GM-free' status[13], the traditional manufacturing processes, and the large number of jobs created by the company[14], in order to increase earnings, better remunerate farmers, and more generally ensure a stable future for the dairy industry in NP through greater market control. However, all the exchanges in NP stressed the importance of

[13] Many dairy farmers wish their efforts (obligation to spread straw in stalls and use GM-free soymeal) were better appreciated by consumers and that the milk was correspondingly higher priced (especially as the coop endures competition from pasteurised products based on milk produced with GM concentrates).

[14] The dairy today has more salaried staff than farmers. Its marketing fails to leverage the 'hand-made' processes, even though they represent a heavy wage cost. This annoys some dairy farmers, who do not understand how the dairy works.

dairy farmers in the territory, and ensuring their future and their continued contribution to various local services.

Conclusion

The ending of milk quotas, and the ensuing high price volatility mean very different or variable milk prices for the dairy farmers in any given area. These increased disparities between farmers plus the price volatility generate: (i) in the upland area, rivalry and tensions at local level; we noted changes of dairy companies for dairy producers; and (ii) in the lowland area, difficulties sustaining cow milk production where crop production had become more remunerative in recent years and required less work in a traditionally mixed cropping-livestock farming area, and so could cause farmers to stop dairy production. Effects are also seen within dairies over strategic decisions to be made, which impact on producers' earnings from milk production. Faced by the dynamics of the dairy industry, in a freer market, and a sharper competition, some territories 'endure' while others seek to build up self-sufficiency or leverage comparative advantages. Territories can aim for economies of scale (specialisation and development for high volumes), economies of scope (complementarity among different activities) or differentiation.

The CM, which had tended to 'endure' the changes in the dairy industry, has moved to get more closely involved in the future of dairy production. Being unable to make economies of scale, it looked more towards a strategy of scope and territorial differentiation that remains to be defined jointly with producers and processors. The NP looked at both economies of scale, as it presents the highest average volumes per farm, and differentiation, with high-end butter. Nevertheless, earnings from milk did not follow suit, milk quality has not always been up to par, and dairy farming is still under competition from field crops. So what is the right strategy to adopt: quality, quantity, or stronger complementarity with crop systems?

With the ending of quotas, according to the characteristics of individual farms, dairy area, and operators involved, the local producers and processors do not share the same opportunities for development and the actors in the territories do not have the same possibilities for reterritorialising the dairy industry. How can these conflicting interests be reconciled? The future of our two study areas, like that of many others, remains to be written, and will depend on how the territories embrace the question of the future of dairy production, and whether they let the industry take its market-led course or seek to make it a strong driver of territorial development -both socioeconomically and environmentally.

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