LIFT

Low-Input Farming and Territories – Integrating knowledge for improving ecosystem based farming

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Drivers of adoption of ecological approaches

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About the LIFT research project

Ecological approaches to farming practices are gaining interest across Europe. As this interest grows there is a pressing need to assess the potential contributions these practices may make, the contexts in which they function and their attractiveness to farmers as potential adopters. In particular, ecological agriculture must be assessed against the aim of promoting the improved performance and sustainability of farms, rural environment, rural societies and economies, together.

The overall goal of LIFT is to identify the potential benefits of the adoption of ecological farming in the European Union (EU) and to understand how socio-economic and policy factors impact the adoption, performance and sustainability of ecological farming at various scales, from the level of the single farm to that of a territory.

To meet this goal, LIFT will assess the determinants of adoption of ecological approaches, and evaluate the performance and overall sustainability of these approaches in comparison to more conventional agriculture across a range of farm systems and geographic scales. LIFT will also develop new private arrangements and policy instruments that could improve the adoption and subsequent performance and sustainability of the rural nexus. For this, LIFT will suggest an innovative framework for multi-scale sustainability assessment aimed at identifying critical paths toward the adoption of ecological approaches to enhance public goods and ecosystem services delivery. This will be achieved through the integration of transdisciplinary scientific knowledge and stakeholder expertise to co-develop innovative decision-support tools.

The project will inform and support EU priorities relating to agriculture and the environment in order to promote the performance and sustainability of the combined rural system. At least 30 case studies will be performed in order to reflect the enormous variety in the socio-economic and bio-physical conditions for agriculture across the EU.

Project consortium

No.	Participant organisation name	Country
1	**INRAE - Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement**	**FR**
2	VetAgro Sup – Institut d'enseignement supérieur et de recherche en alimentation, santé animale, sciences agronomiques et de l'environnement	FR
3	SRUC – Scotland's Rural College	UK
4	Teagasc – Agriculture and Food Development Authority	IE
5	KU Leuven – Katholieke Universiteit Leuven	BE
6	SLU – Sveriges Lantbruksuniversitet	SE
7	UNIBO – Alma Mater Studiorum – Universita di Bologna	IT
8	BOKU – Universitaet fuer Bodenkultur Wien	AT
9	UBO – Rheinische Friedrich-Wilhelms – Universitat Bonn	DE
10	JRC – Joint Research Centre – European Commission	BE
11	IAE-AR – Institute of Agricultural Economics	RO
12	MTA KRTK – Magyar Tudományos Akadémia Közgazdaság – és Regionális Tudományi Kutatóközpont	HU
13	IRWiR PAN – Instytut Rozwoju Wsi i Rolnictwa Polskiej Akademii Nauk	PL
14	DEMETER – Hellinikos Georgikos Organismos – DIMITRA	GR
15	UNIKENT – University of Kent	UK
16	IT – INRAE Transfert S.A.	FR
17	ECOZEPT Deutschland	DE

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List of acronyms and abbreviations

AES: Agri-Environment Schemes

BIC: Bayesian Information Criterion

CAP: Common Agricultural Policy

DCE: Discrete Choice Experiment

EU: European Union

FADN: Farm Accountancy Data Network

GI: Geographical Indication

GMO: Genetically Modified Organism

HVE: “Haute Valeur Environnementale” (high environmental value)

HVM: Hierarchical Value Maps

LCA: Latent Class Analysis

LFA: Less Favoured Area

LPA: Latent Profile Analysis

MEC: Means End Chain

NUTS: Nomenclature of Territorial Units for Statistics

PDO: Protected Designation of Origin

PO: Producer Organisation

SEM: Structural Equation Model

UAA: Utilised Agricultural Area

Summary

This deliverable (D2.3) of the LIFT project presents the results of a series of investigations around uptake of ecological approaches across the value chain. We use primary and secondary data collected utilising a number of methods, built on conceptual frameworks developed within LIFT and elsewhere. This provides a range of empirical investigations for an overview of farming, supply chains and consumption drivers which may constrain or enable uptake of ecological approaches. Both exogenous and endogenous drivers were considered for these studies.

The report is presented as a set of summaries from academic paper outputs - to show the individual exercises across farmers, value chains and consumers – and to understand both the barriers and enablers for transition to more ecological approaches within European farming. A summary table is provided to show these investigations, as well as the approach used and the type of data collected.

Specifically the following sets of studies are presented:

1. Typologies of farm activity and farmer perceptions towards ecological practices. This allows us to partition a large scale farmer dataset (from the LIFT large-scale farmer survey) with multiple variables of interest [papers 1,2].
2. Examination of the exogenous and endogenous drivers behind ecological uptake, such as gender, the farm family life-cycle, neighbouring farms and supply chains. These papers take either a quantitative approach, through the application of behavioural models, or a qualitative approach to understand what drives this decision to adopt ecological practices [papers 3,4,5,6].
3. Examination of the value chain, collaboration and cooperation. These are explored through quantitative and qualitative routes to understand how value chains operate for ecological practices, compared to conventional practices, and how actors engage within specific value chains [papers 7,8,9,10,11].
4. Finally the role of consumption is explored, through market segmentation, labels or specific traits of food products that offer opportunities to promote ecological practices [papers 12,13,14].

Overall, we find much heterogeneity in both practice and attitudes towards production and consumption of ecological approaches. The investigations presented here provide illustrations of how these approaches and perceptions are driven by both personal, informal and formal institutional influences, such as the support from local market conditions or sharing of knowledge.

This leads to us understand the relationships between economic and non-economic goals, which are key to eventual uptake of ecological approaches. Incentives were considered to balance the conflicts between endogenous and exogenous drivers, such as labelling and support for social incentives, but also as a means to overcome perceived or real barriers through mechanisms which support further collaboration between farmers.

1 Introduction

Growing societal concern towards the environmental damage caused from current systems of food production are leading to a more explicit change in the ambition for agricultural policy (European Commission, 2020; Bhattacharyya *et al*., 2020, Schebesta and Candel, 2020). Mainstreaming more environmentally friendly farming methods is now explicit in agricultural policy strategies and this reflects a greater desire for transition towards sustainable food production. A number of documents herald an ambition to increase the uptake of ecological practices within farming in Europe. The European Union (EU)'s Farm to Fork Strategy promotes a vision for reversing biodiversity loss, reducing agrochemical use and limiting unsustainable protein imports (European Commission, 2020).

Ecological approaches[1] comprise solutions working with nature to support the wider ecosystem services from the farm, but also provide a way to support food production and economic needs (Robertson *et al*., 2014). Central to achieving these visions are the perspectives of farmers, farm communities, the supply chains and consumers, who may either accept or reject these new standards of practice within their own farming system.

Despite a growing proportion of the Common Agricultural Policy (CAP) budget dedicated towards support for environmental measures over the last two decades, the uptake of these ecological approaches has been slow across Europe, though with pockets of farmers operating to high ecological standards. Hence, an important aspect of European food and farming is the diversity of current practice, the confluence of decision-making and the multiple goals producers and consumers have towards production practices and the environment. European agriculture is also characterised by a range of income needs which may limit access to capital to invest in these approaches, but also the heterogeneous suite of biophysical and institutional constraints which limit the adoption and consumption of ecological produce.

The purpose of this deliverable is to present a variety of investigations within specific EU regional contexts aimed at understanding the heterogeneity in decision making towards ecological approaches. Specifically we investigate what is currently driving the adoption of ecological approaches and, furthermore, what are the barriers to further uptake. This latter question merits investigation as current policy strategies requires some knowledge of interventions to overcome the behavioural and institutional barriers towards more adoption of ecological approaches within European agriculture.

This deliverable is composed of a series of summaries of specific investigations, which link to a set of academic papers around this question. The deliverable is based on 14 separate academic papers, which focus on either a single case study, or provide a cross country comparison. The analysis covers both arable and livestock enterprises and represents examinations which cover the LIFT case study areas. In so doing it presents a mix of methods applied to understand drivers and is structured as follows: a brief overview of methods is provided, a summary table of the investigations are presented then a discrete set of results are reported in long abstract form. The discussion section draws out the main findings of these studies and we provide conclusions for policy and the research community going forward.

[1] Ecological practices are understood in LIFT as low-input practices and/or practices that are environmentally friendly. The originality of LIFT in this view is not to focus on a specific type of ecological approaches, but to cover the whole continuum of farming approaches, from the most conventional to the most ecological, including the widest range of ecological approaches. This comprises the existing nomenclatures such as organic farming, low-input farming, agroecological farming, etc. It also encompasses approaches that are not yet part of a nomenclature, but that can be identified with various criteria such as management practices, on-farm diversification etc. Thus, conventional practices mean non-ecological practices.

2 Methods and data used

2.1 Main methods used

***Latent Class Analysis (LCA*):** LCA is a statistical technique to cluster data based on a number of criteria. LCA classifies respondents (e.g. farmers) into discrete classes when the classification criterion is based on observations. LCA assumes that there is an underlying latent categorical variable that divides into discrete classes based on a series of measured items, in our case the responses to a set of statements. To identify the optimal number of classes or groups in the sample, classes are iteratively added to the model and a typology is performed for each iteration. LCA is based on a maximum likelihood estimation approach, so the optimal number of groups in the sample is that one that minimises the Bayesian Information Criterion (BIC) (Forster, 2000). The latent class model assigns each farmer's response into a latent class with an estimated probability – the latent class membership - which in turn produces expectations about how that observation will respond on each item. Specifically, we identify different characteristics from farmers' patterns of response as regards both current ecological practices and attitudes to ecological approaches, which will lead to the formation of subgroups in the population.

***Structural Equation Modelling (SEM)**:* SEM is used with observed and latent (unobserved) variables to test the conceptual behavioural model produced in LIFT Deliverable 2.1 (Hansson *et al.*, 2019) and assess the strength of the research hypotheses, namely the effect the behavioural determinants have on the intentions to adopt ecological practices and current/future adoption behaviour, as well as how current and future behaviour interacts. As each variable might influence behaviour and intentions both directly or indirectly the variance explained by the model is higher than when other methods, e.g., regression analysis, are used.

Means End Chain Laddering (MEC): Means-end chain (MEC) theory assumes a hierarchical relationship from perceived product attributes, to consequences of the attributes and finally to desired end-states or values which the consequences help achieving. This has been extended to the study of farmers' decision-making (Lagerkvist *et al.*, 2012; Hansson and Kokko, 2018). In relation to farmers' decision-making, MEC theory is useful as it allows for detailed understanding of which attributes farmers use to characterise a decision around a particular farming system, what consequences they perceive from those attributes and why those consequences are important to the farmers.

***Discrete Choice Experiment (DCE)**:* DCEs are a stated-preference valuation approach, wherein respondents are presented with a series of choices between a set of alternative scenarios and an opt-out scenario. The scenarios are described using the same attributes, but differ in their attribute levels. Typically, one of the scenarios presented is an opt-out choice whereby the respondent has the chance to not select either of the two alternative scenarios, thereby implying that the levels of the attributes in neither alternative appeal to them. The underlying assumption is that the respondent will choose the scenario that provides him or her with the highest utility level. Through repeatedly varying the scenarios presented to the same respondent, the preference parameters attached of each attribute can be estimated under the random utility framework.

2.2. Data used

The deliverable is based mostly on primary data collection. The main source of data used for a number of papers [1,2,3,12] is the LIFT large-scale farmer survey. This survey collected detailed data on over 1,600 farmers across LIFT partner countries with data based on 2018 activities. The main purpose of the survey was to gather in-depth information around ecological practices within European farming. Data collection was administered by partners in their home language with the aim of capturing a

sample of each country's farming systems. The questionnaire consisted of a number of sections which covered the characteristics of farming systems, the adoption of ecological practices, detailed motivations for their adoption administered as likert scales and economic costing data for a sub-set of observations (see Tzouramani et al., 2019). Other data collected for the analyses reported in this deliverable was mostly qualitative in nature. These emerged from bespoke investigations such as interviews [4,5,6,7,8,13], both free-form and semi-structured, workshops [5], or choice experiments [10,14] which gathered qualitative information around choices. Furthermore, some secondary data and literature were analysed [9,11]. Table 1 provides an overview of the 14 papers integrated in this deliverable.

Table 1: Overview of academic papers, implemented in the deliverable

Paper No.	Title of paper	LIFT partner(s)	Case study countries	Data used	Methodological approach	Short summary of main findings
1	Questioning the dichotomy: A Latent Profile Analysis of ecological management practices in Swedish agriculture	SLU	Sweden	LIFT large-scale farmer survey	Participatory Latent Profile Analysis	The findings reveal four farmer profiles with a varying degree of use of chemicals and ecological, alternative, or mixed management approaches. Using seemingly unrelated regression, we find that being certified according to the Swedish organic certification scheme 'KRAV', or the EU-organic label, does not have an impact on a farmer's profile, suggesting that the data does not support the organic/conventional dichotomy. Instead, farming income and geographic location are, to a greater degree, the key factors in determining farmer profiles of larger farmers compared with the smaller more diversified farmer profiles.
2	Finding the ecological farmer: a farmer typology to understand ecological perspectives within Europe	SRUC	Austria, Germany, Greece, England, France, Hungary, Ireland, Poland, Romania, Scotland, Sweden	LIFT large-scale farmer survey	Latent Class Analysis with Covariates	We identify four classes of farmer based on their perspectives, with two of these classes revealing a strong identity towards ecological approaches but differentiated by informal and formal institutions, such as social pressure and acceptance within the supply chain. A further group reveals evidence of a multifunctional identity, whereas a final group tends to show indifference towards ecological approaches which may align with previous identifiers as productivist farmers. As Governments are seeking to promote transition within the industry we argue for clear policy intent in payment regimes and regulations, as well as holistic

						approaches to institutional structures to target particular classes of farmers for real behavioural change.
3	Understanding the adoption of sustainable agricultural practices in Europe: farm and practice level insights	SRUC	Austria, Greece, England, France, Hungary, Ireland, Poland, Romania, Scotland, Sweden	LIFT large-scale farmer survey	Structural Equation Modelling	We find that farming objectives are more influential at the farm level than the practice category level. Those with stronger productivity objectives are much less likely to adopt sustainable practices overall, though this affects some practice categories more than others. We find that buyer supply chain relationships are important for adoption at both the farm and practice category level as are whether the farm is organic but also certified in other schemes. On the other hand agri-environment scheme participation has little to no influence on farm or practice category level adoption and we find a limited role for social norms and information networks.
4	The underlying values of Irish organic and conventional beef farmers	Teagasc, SLU	Ireland	Interviews	Means End Chain, Laddering and Hierarchical Value Maps	The results highlight the similarities in motivations between conventional and organic farmers, with similar consequences and values being identified in both cohorts. Of particular note is the prevalence of "profits" as a consequence for both groups. However what is of interest is the means by which farmers arrived at their different terminal values. A somewhat surprising result is the prevalence of the "traditional" attribute within the conventional cohort. This suggests that practices are likely to be strongly embedded and may be difficult to change. The findings are relevant for policy makers to develop differentiated communication depending on the type of values that guide farmers' decision-making.

5	Ecological farming – rural realities, socio ecological arguments and comments. Cluj county case study	IAE-AR	Romania	Hybrid Forum Workshop/Interviews and Questionnaires	Descriptive and Qualitative Analysis	We find that in Cluj county, the share of area under ecological farming systems only increased from 1.8% in 2014 to 2.7% in 2018, the largest areas cultivated under an ecological system being those under pastures and fodder crops. We also find the use of ecological practices was not perceived as a form of socio-economic resilience for the farmers we interviewed. In this context, education was perceived by stakeholders as a need that can be covered by the creation of a comprehensive education system for ecological practice. The social capital needed to promote these methods is one of the core elements that could be achieved through the stringent membership of associations and organisations. The main behavioural factors which determine adoption were found to be those of a personal nature (e.g. educational improvement), of a social nature (e.g. for more organised cooperation) and cognitive (e.g. support for the acquisition of knowledge and information around ecological approaches).
6	A cross-country comparison of values in organic and conventional production as perceived by farmers, using the means-end chain approach	SLU, VetAgro Sup, Teagasc	Sweden, France and Ireland	Interviews	Means End Chain, Laddering and Hierarchical Value Maps	Personal values were found to be relatively more dominant than social values for both conventional and organic farming systems. Organic farmers display relatively more social terminal values than in the conventional case, such as “societal security”, as well as taking a holistic and societal health view which are valued in both Sweden and France. Economic rationales are more present in conventional farming. Finally, the analysis highlights that for Irish and Swedish farmers,

	and laddering interviews					organic production has a more complex decision structure than with conventional production, based on the number of points made along the decision ladder.
7	Switching to organic farming and to conservation agriculture in the Limagne plain (France). An analysis of the modes of access to resources mobilized during changes in practices	INRAE	France	Interviews	Individual trajectory analysis (social sequence analysis, quantified narrations)	The socio-economic networks analysis of farmers who have adopted practices recognized as ecological gives the opportunity to highlight the interactions involved in the agroecological transition at territorial level. In order to understand the dynamics of these interactions, we mobilize the analytical frameworks of social sequence analysis (identification of phases and typology of trajectories), relational chains (mode of access to resources) and quantified narrations (coding). In this paper, we report on a work of analysis of the modes of access to resources mobilized during the trajectory of 31 farmers investigated face to face - 22 in organic agriculture and 9 in conservation agriculture - involved in farmer groups and located in the Limagne plain of the Puy- de-Dôme region in France. The results show a significant mobilization of interpersonal relations prior to the adoption of practices, an isolation at the time of the implementation of conservation agriculture practices, contrary to organic farmers who emphasize the decisive role of formalized mechanisms such as farmer groups, support organisations and downstream actors.

8	Innovation system challenges to organic dairy expansion	Teagasc, NUI, SRUC	Ireland	Literature Review/ Farmer Interviews	Innovation Systems	For both organic and conventional systems, failures in terms of actors' interactions as well as hard institutional structures were identified. Clear differences emerged between the two systems that relate to more developed knowledge and physical infrastructure in the incumbent dairy sector. In addition, social and cultural (soft institutions) differences of the actors across the supply chain and capacity differences of dairy farmers emerged. This approach is particularly useful in the context of a comparative analysis of the relative failure or merits of the conventional and organic dairy sectors.
9	Agricultural cooperatives and farm sustainability - a literature review	INRAE	EU	Secondary Literature	Literature Review	This paper shows that cooperatives play a non-negligible role in farm economic sustainability and in the adoption of environmentally friendly practices, suggesting that both public policies and private initiatives in cooperatives may be complementary. As regards social sustainability, there are only a few studies which examine the effect of agricultural cooperatives. The trade-offs between economic and environmental sustainability in cooperatives should be investigated further.

10	How does horizontal collaboration influence the adoption of ecological farming practices: A choice experiment in France and Belgium	KU Leuven, VetAgro Sup, INRAE	Belgium, France	Discrete Choice Experiment	Econometric Analysis, Latent Class Analysis	Through this study we aimed to explore the potential of collaborative networks to influence farm management practices in Belgium and France. We see little evidence that the networks proposed here may increase adoption of ecological farm management practices. Though organic pest and fertilisation practices may form an exception. A secondary aim of this study was to assess farmer preferences for particular characteristics of collaborative networks. We find that farmers who responded have a weak but significantly positive preference for certain knowledge and labour sharing attributes within a collaborative network. However, they have a negative preference for attributes associated with machinery sharing. We see that there is a great deal of heterogeneity within our sample, and find two groups of respondents based on a distinct derived utility for proposed alternatives.
11	Organic leakage in the beef sector and its impacts on the value chain	NUI, Teagasc	Ireland	National Statistics Analysis	Bio-economic modelling, Value chain mapping	Within the literature there exists a lesser focus on the wider value chain and unbalanced development of various segments of production, which results in leakage from organic to conventional value chains. By mapping the progression of animals through the organic value chain, results show that the leakage of animals from the organic to the conventional beef sector in Ireland can be between 15 and 20%. Our study provides insights for stakeholders, especially for policy makers in design and for future improvements of policy. The results also have important implications for discussions on effective and efficient policy schemes on organic conversion internationally.

12	Can marketing channels influence the participation in organic label or in agri-environmental schemes	INRAE	Germany, France, Greece, Ireland, Poland, Romania and Sweden	LIFT large-scale farmer survey	Econometric analysis	We observe a diversity of marketing channels used by farmers with most farmers choosing a dominant marketing channel, namely from cooperative/producer organisation, processor, wholesaler, retailer, consumer, and other type of marketing channel. In the preliminary econometric analysis that focuses on organic certification and agri-environmental schemes (AES) participation, we show that only the cooperative marketing channel has a significant negative effect on the probability of being certified organic farming.
13	Adopting environmentally friendly farming practices and the role of quality labels and producer organisations: a qualitative analysis based on two European case studies	INRAE, DEMETER	France, Greece	Semi-structured interviews	Descriptive and Qualitative Analysis	Our study shows that economic actors of food supply chains in two case studies use European quality labels, a couple of national schemes, and a proliferation of private quality labels (in the case of Brittany's pig sector). Our interviews reveal that many quality labels, for which agricultural farming systems must comply, are not specifically aimed at improving environmental impacts. In the French pig sector, many quality labels do not include requirements for practices aiming at improving the environment, but instead focus on other practices that matter for society, namely improving animal welfare. However, advisory services provided by the producer organisations can play a key role in the adoption of environmentally friendly practices. They include research programmes and agronomic events. In Crete, producer organisations are able to offer technical assistance thanks to European support programmes.

14	Consumers' preferences for environmental credence attributes of vegetables and the trade-off with an overall Eco-Score. A choice experiment with Belgian food consumers	KU Leuven	Belgium	Discrete Choice Experiment	Econometric Analysis, Latent Class Analysis	The discrete choice experiment provided relevant insights into the functioning and interplay of consumers' preferences for various environment-related credence attributes of vegetable supplies. In particular, we observed a large market opportunity for an Eco-Score to induce a demand driven transition towards more environmentally friendly food choices. However, this transition might be hampered by the presence of organic and local claims. The results also suggest that, somewhat paradoxically, consumers who have a confident sustainable self-view reported less sustainable preferences while respondents with a confident unsustainable self-view reported more sustainable preferences. As this contradicts the general self-validation hypothesis, further theoretical substantiation is needed.

3 Empirical analysis

3.1 Paper 1: Questioning the dichotomy: A Latent Profile Analysis of ecological management practices in Swedish agriculture

Authors: Höglind, L., Hansson, H., Manevska-Tasevska, G.

SLU, Sweden

Organic farming practices have played an important role in European farming over the past decade. As consumption of certified organic products has increased (Eurostat, 2020), part of the agricultural sector has converted in response to the growing demand for this type of produce. Between 2007-2017, the farm area devoted to certified organic production increased by 70%, with 20% of the total farm area now under conversion, reflecting the potential growth in the coming years (European Union, 2019). Certified organic farming practices are encouraged and recognised under the European organic certification scheme (Council Regulation (EC) No 834/2007). However, while organic farming practices are expected to contribute to the provision of ecosystem services, such as biodiversity, enhanced animal welfare, carbon sequestration, and positive landscape features (Darnhofer *et al*., 2010; Power, 2010), only the certified organic farms themselves and the products they produce are accounted for in terms of ecological practices. Consequently, if a farm is not classified according to the organic production scheme, its products are considered conventional by default, irrespective of the farm's adoption of various ecological farming practices. This is problematic as it may lead to a significant underestimation of the actual application of ecological farming practices, as farms that partially adopt ecological management practices but are not certified due to size, costs, or other reasons, will not receive market premiums for the societal benefits from their production.

In this study, we departed from the synthesis of ecological practices by Rega et al. (2018) (LIFT deliverable D1.1) and propose a procedure for classifying farms into an ecological farming typology based on information about management practices applied at the farms. Consequently, the aim of this study was to develop an approach for constructing a typology of the current uptake of ecological practices on a variety of farms to understand the type of ecological practices applied in a sample. We used data from the LIFT large-scale farmer survey to demonstrate the applicability of the approach and further explored how current organic farming certification practices relate to the typology revealed from the applied ecological practices, along with other characteristics of the farms.

Using a participatory approach that combined data analysis (latent profile analysis) with stakeholder participation, we identified four farmer profiles. These can be summarised in the following bullet points:

- Profile 1: Low chemical input and low alternative or conservation farming.
- Profile 2: High chemical input farming with diversified crop and soil management.
- Profile 3: Low input farming with alternative soil and crop management.
- Profile 4: High chemical input with ecological farming with mixed grassland management.

Profile 1 was the largest profile. Our discussions with stakeholders confirmed Profile 1 as representative of practices used by "an ordinary Swedish livestock farmer". However, the smaller profiles (3 – 4)

were seen as somewhat less representative of farm types that are generally recognisable to stakeholders. Nevertheless, a conservation management approach is dependent upon the use of more chemicals, such as glyphosate, which corresponds well to Profile 2, where farmers relied more on chemical input than farmers in Profile 1. In our view, the three smaller groups represent varying degrees of use of alternative and/or conservation approaches but may be more reliant upon the use of chemicals (Profiles 2 and 4). Furthermore, it is interesting to note that whether a farm is certified according to the Swedish KRAV certification or the EU-organic label does not determine profile belonging. Hence, certified organic farms do not differ enough from non-certified farms to form their own latent profile in the data. This means that farms in Profile 1 with more conventional approaches could be certified organic, as could farms in Profile 3, which are characterised by low-input, conservation, and alternative approaches, suggesting that even though a farm is not certified organic, the farmer may use ecological practices. The strict division into certified organic or conventional is therefore not supported in our results, implying that the dichotomy may indeed be too narrow.

Our examination of heterogeneity in ecological management practices provides insight that can be applied in policy making. Widening the view of the conventional spectra and including levels of ecological management practices could incentivise farmers that are willing to adopt ecological practices, but to a lesser, or higher extent than what is required by the current certification schemes.

3.2 Paper 2: Finding the ecological farmer: a farmer typology to understand ecological perspectives within Europe

Authors: Barnes, A.P., Thompson, B., Toma, L.

SRUC, UK

A number of authors have shown how farms can be classified across a discrete trajectory from conventional to a state of agroecology through the addition of successive sets of wider practices (Duru *et al*., 2015; Trabelsi *et al*., 2016). The link between these types and attitudes has also been found to be significant in determining participation within agri-environmental or organic schemes (Sulemana and James, 2014; Cullen *et al*., 2020). Overall, the nature of the transition to ecological practice adoption is driven by overcoming constraints both from within the farm, but also outside in terms of social acceptance and how farmer perceptions meet or conflict with internal belief systems (Toma *et al*., 2018). This paper aims to provide a classification of dominant farmer types with a view to informing future policies that promote ecological practices within farming. We develop this typology based on individual perspectives towards ecological practices and further estimate these on main descriptors available in farm databases to allow mapping of these identities at a wider scale. We do this using the LIFT large-scale farmer survey from across a number of selected European countries, namely Austria, Germany, Greece, England, France, Hungary, Ireland, Poland, Romania, Scotland and Sweden. This gave a total of 1,256 observations. Moreover, this reflects different environmental and institutional conditions, and apply a one-stage latent class analysis to both define our classes and explain the effects of farm characteristics on shaping membership of these classes. This is illustrated in Figure 2.1.

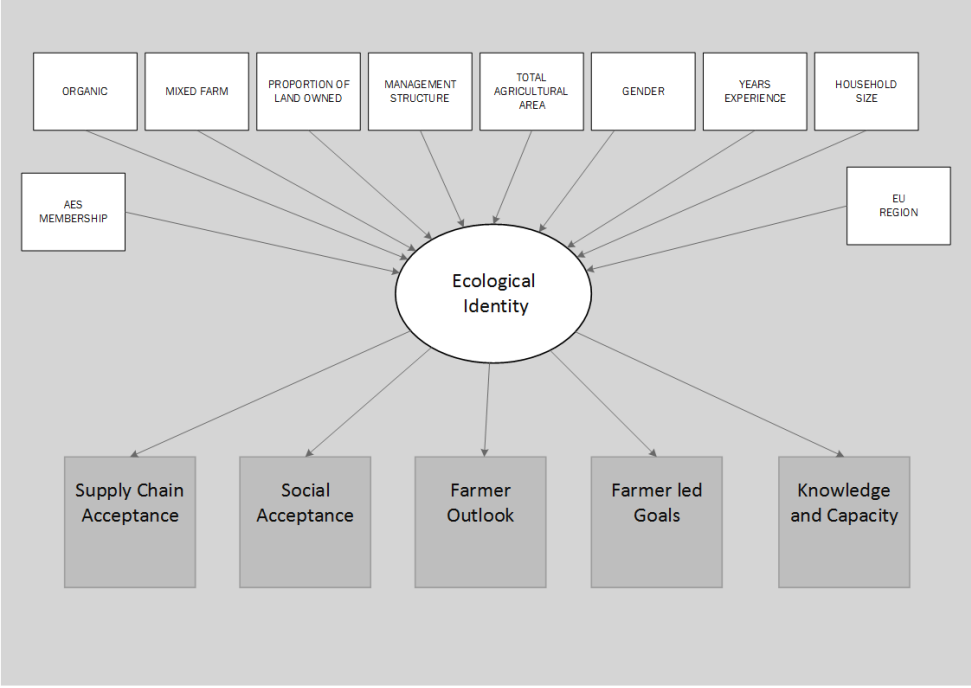

Figure 2.1. Path diagram of latent class model of ecological types with covariates

We find four main types operating with the data, based on both minimisation of the BIC and maximising entropy values. *Class 1 Enabled Ecologists* - characterised by high probabilities that they will strongly agree with the farmer outlook statements, indicating their self perception as positive and ecologically aware farmers. Members of this class will also be likely to have high levels of agreement with goals of adopting farming methods that promote social and environmental benefits, as well as enabling monitoring of their farm performance. In addition, they have the highest probability of agreement with statements around supply chains. This tends to infer members of this class have a good working relationship with their buyers and are enabled when adopting ecological practices. *Class 2 Constrained Ecologists* - this group have limited probabilities of agreement with farmer outlooks towards the environment but tend to disagree with statements on access to knowledge networks and supply chain support for their methods. In particular, they are more likely to identify a lack of supply chain support to adopt ecological practices. *Class 3 Balanced Ecologists* - tend to identify a more multifunctional stance, where productivity and ecological goals are similarly balanced within their values and goals. *Class 4 Unengaged* - mostly characterised by low probabilities towards agreement or disagreement with the statements.

Our findings emphasise the importance of respecting heterogeneity within current EU farming and, thus, supporting targeted interventions within these populations to encourage and support transition. Whilst we find most farmers perceive themselves to be part of the farming community there are few other similarities between our four farmer types. For two of these types there is an ecological outlook, but these are conditioned by formal and informal institutions which either constrain or enable this identity. The enabled ecologists seem to be supported in the supply chain, feel they belong in the farming community and have strong environmental outlooks.

The typology approach emerges as a useful tool to baseline and monitor progress towards a policy goal. That identities may be malleable, and positive ecological identities allowed to emerge if enabled, is also encouraging for shifting policy goals towards more ecological approaches. Across Europe we find pockets of multiple identities operating. Perhaps of interest to the present dialogue on Farm to Fork are lessons learned between the enabled and the constrained ecologists. The main motivator for perceiving to be constrained are issues within the supply chain, something which the CAP has failed to show much ambition towards addressing in the past. Within the EU Farm to Fork strategy there is an aspiration towards changing supply chains which may enable more ecological identities to emerge.

3.3 Paper 3: Understanding the adoption of sustainable agricultural practices in Europe: farm and practice level insights

Authors: Thompson, B., Toma, L. Barnes, A.P.

SRUC, UK

Understanding the factors associated with the adoption of more sustainable farming practices is an active research area with primary studies and reviews investigating a range of practices and models of adoption. Much of the literature is focused on only a limited set of factors for example behavioural factors (Dessart *et al*., 2019) or a narrow range of ecological practice types (Pierpaoli *et al*., 2013). Our research for LIFT deliverable D2.1 (Hansson *et al*., 2019), led us to understand the wide range of factors that may influence the adoption of ecological farming practices including individual behavioural, social, formal institutional (such as the policy and supply chain environment) as well as farm structural factors such as the location and conditions on the farm. We therefore include variables in our behavioural model that represent these distinct aspects to understand which are associated with the adoption of more sustainable farming practices. We applied data from the LIFT large-scale farmer survey for Austria, Greece, England, France, Hungary, Ireland, Poland, Romania, Scotland and Sweden. For the crop sector model this gave us 554 observations and 597 observations for the livestock sector model. We also found that much research focused on the adoption of narrow range of sustainable practice types. Whereas we are interested in assessing how sustainable a farm's practices are. We therefore model the adoption of sustainable practices using a measure of intensity which allows us to understand the drivers of overall sustainable practice intensity.

Figure 3.1 outlines the model we used. It includes reflective latent variables for environmental attitudes, environmental objectives and productivity objectives which represent the personal and attitudinal aspects. Social influences are represented by a reflective indicator for subjective norms. Formal institutional influences are represented by a reflective latent variable for value chain information sharing and individual variables for environmental policy engagement (agri-environmental schemes organic and other certifications). Lastly farm structural factors are represented by single variables that indicate whether the farm is in an area subject to local constraints (e.g. less favoured area-LFA/Water Directive) and whether it is specialist crop or specialist livestock for each model respectively. Two different dependent variables are used according to whether the farm had crop land or livestock. For farms with crop land, we looked at their adoption of pest, weed, fertilisation, crop rotation and soil management practices. For farms with livestock, we looked at their adoption of grassland management, feed management, manure and slurry management and disease management.

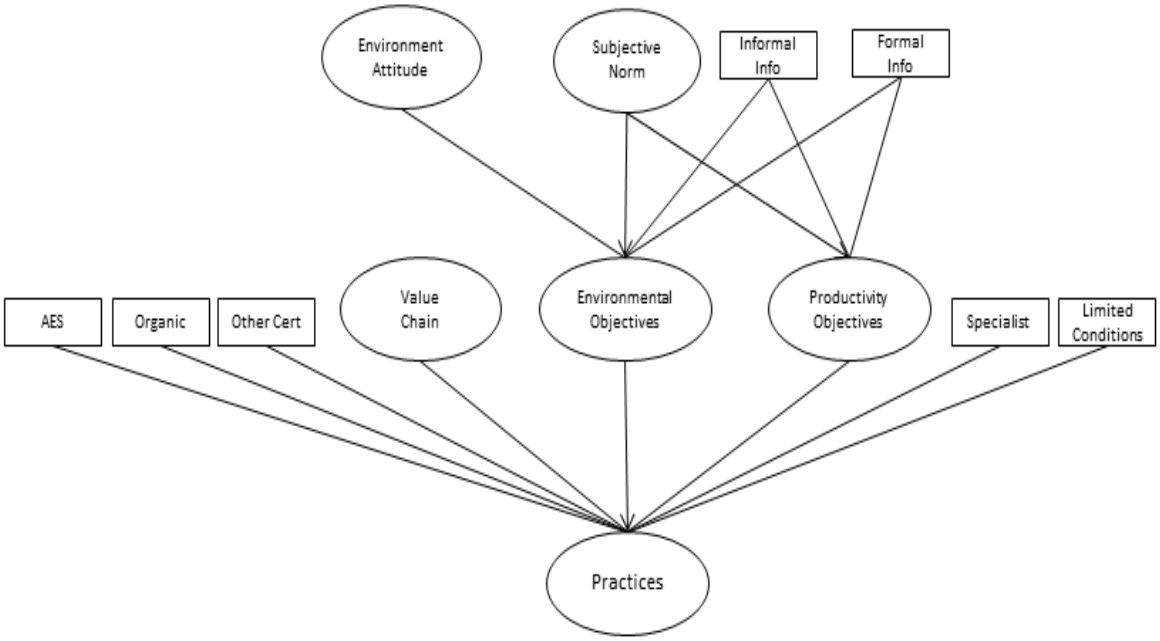

Figure 3.1. Practice adoption structural model

To summarise the results, we report the total effects of each variable on the adoption of more sustainable practices. We found that productivity objectives were negatively associated with the adoption of more sustainable practices in both the crop practices and the livestock practices model. Environmental attitudes and objectives were positively associated with adoption of crop practices but not livestock practices. Value chain influences have a positive association with the adoption of more sustainable practices in both the crop practice and livestock practice model, as does being an organic farm. We also saw a weak relationship between other types of certification and the adoption of sustainable livestock practices, though no significant effect was detected between participation in agri-environment scheme and practice adoption in either model. Specialist livestock but not specialist crop farms were more likely to take up more sustainable practices. In terms of social influences we found no significant relationship between social norms and objectives or practice adoption. Use of formal information sources was negatively associated with adoption of sustainable crop practices while there was no significant effect detected for information sources. On the other hand use of informal information sources was negatively associated with adoption of sustainable livestock practices while there was no significant effect detected for formal information sources.

Our findings indicate the importance of both personal and formal institutional influences on the adoption of more sustainable practices. While environmental orientation is important for adoption of sustainable practices, a productivity orientation driven by maximising profit and minimising financial risk is negatively associated with the adoption of sustainable practices. The support of the supply chain will be important to encourage business orientated farms to adopt more sustainable approaches by making their adoption financially rewarding.

3.4 Paper 4: The underlying values of Irish organic and conventional beef farmers [2]

Authors: Hyland, J.[1], Henchion, M.[1], Kilcline, K.[1], Hansson, H.[2], Leduc, G.[2], Clavin, D.[1], Jin, Y.[1], Leavy, E.[1], Lynch, R.[1], Ryan, M.[1]

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The organic sector in Ireland accounts for one of the lowest land uses in Europe. While the EU Farm to Fork strategy has ambitions for 25% of land to be devoted to organic production, the Irish government's current target is to achieve 7.5% of the utilised agricultural area (UAA); despite the small share, it is a multiple of the reality on the ground currently. So a key question is how can Irish conventional farmers be motivated to change to organic farming? Organic production is supported by consumers, through the purchase of organic products, for a range of reasons including health, the environment, food safety and taste. It is known that these benefits are also important motivations for some farmers in converting to organic production (Padel, 2001; Läpple, 2013).

Previous research has indicated that the attitudes of organic and conventional farmers are different (Läpple, 2013) - in general, organic farmers are seen to have more pro-environmental attitudes than conventional, with differences in attitudes to risk also reported. However it is also known that there are many similarities between organic and conventional farmers (Sullivan *et al.*, 1996), with conventional farmers placing significant importance on many of the same benefits, and valuing their current production systems for these same reasons, and both organic and conventional farmers being concerned with the economic risks associated with farming (McCann *et al.*, 1997). So are organic and conventional farmers actually different and how can we use this knowledge to increase adoption of organic farming practices? This work seeks to (i) identify and compare the values (the basis for fundamental decision-making amongst farmers) of organic and conventional farmers in Ireland, (ii) to understand their cognitive structures to determine differences and similarities among different groups and (iii) to investigate their decision-making process towards farming. Through mapping the cognitive structures we can identify the links between values, consequences and the attributes of the farming technique used.

In seeking to compare decision-making and underlying values of organic and conventional beef farmers, this study employs Means-end chain (MEC) theory, which assumes a hierarchical relationship between the attributes of specific products or decisions, the consequences of these attributes and ultimately the desired values which the consequences help in achieving (Reynolds and Gutman, 1988). While MEC theory originates in the field of marketing and consumer studies, it has previously been utilised to study farmers' decision-making (Lagerkvist et al., 2012; Hansson and Lagerkvist, 2015). It allows for the characterisation of farmers' decisions to adopt given practices in terms of the attributes they use to describe their choices, allowing us to understand the end-point in terms of individual farmers' values to which those attributes lead, providing a greater appreciation of the importance of these attributes to farmers. This study specifically aims to compare the values of organic and

[2] This study was undertaken as a collaboration between the LIFT and BovINE H2020 projects.

conventional beef farmers. An underlying principle of MEC is that individuals live by certain values that direct behaviours, allowing us to examine differences and similarities in relation to the underlying values of organic and conventional farmers.

As a way to uncover individuals' underlying values, the attractiveness of MEC lies in the freedom it gives to respondents to select and verbalise their own constructs for evaluating their farm management decisions. The model denotes that decision-making consists of a hierarchical structure: linking the attributes (A) of an item with particular consequences (C) to satisfy personal values (V). Hence, decisions are taken on the basis of particular attributes that can help to achieve a personal value. In the context of this study MEC is used to characterise farmers' decision to adopt ecological practices in terms of what attributes they use to describe their choices, understand the consequences of those attributes, and why this is important to farmers.

A range of organic and conventional farmers were selected across Ireland through engagement with industry stakeholders. The MECs of individual farmers are derived using a laddering interview technique (Reynolds and Gutman, 1988; Olson, 1988). Organic and conventional farmers were interviewed for approximately 30 minutes to elicit the link between the attributes (A), consequences (C) and farmers' personal values (instrumental or terminal) (V). Interviews commence with the interviewer asking the farmer what aspects of the production system were most important in their decision to be a conventional or organic farmer. They are then probed as to "why is this important to you?" When a farmer can no longer articulate why an aspect is important, the process stops and the interviewer continues with the next item until they have asked about all attributes mentioned. This process is called laddering and this point in the interview is taken to represent the desired end-stage of a ladder.

The interview technique can build on either 'hard' or 'soft' laddering. This study used the soft laddering technique where respondents are not forced to follow ladders in a specific way. A set of ''why is that important to you?'' questions prompt the respondents to 'climb' their cognitive hierarchy until arriving at a point where the question can no longer be further answered. Such an end-point is taken as the value underlying a particular behaviour.

Individual MECs are summarised across groups of respondents into a set of Hierarchical Value Maps (HVMs) (Reynolds and Gutman, 1988). All interviews were recorded and transcribed and ladders consequently identified from the transcribed material. LadderUX is the software used to generate a visualisation of the laddering exercise.

From analysing the 18 interviews with Irish organic farmers, 79 ladders were attained. A total of 78 MEC elements (attributes, consequences, values) were identified with each respondent providing an average of 4.4 ladders with 4.3 elements. Table 4.1 outlines the definition of some of the more commonly mentioned MEC elements. The attribute element which attained the most responses was 'environmental' (13) while the consequence element that received most attention was 'profits' (20). With regards to values, 'to care for the environment' (11), and 'to earn a living' (11), represented high response rates for moral and competence instrumental values respectively. The terminal value 'life quality' was mentioned nine times.

The HVM analysis identified 983 links between elements (461 direct links and 522 indirect links). The HVM suggested that organic farmers perceive the environmental attribute of their farming practices to link strongly to benefiting biodiversity, which is turn preserves soil quality, leading to increasing profits through less inputs use, thereby allowing them to earn a living and ensure a good quality of life. Some of the stronger links identified in the HVM include: sustainable approach and environmental impact; profits and less inputs; and environmental and benefits to biodiversity.

Table 4.1 List of master codes for the most prevalent MEC elements

Master code	Definition
Environmental	Related to or derived from nature and /or the surroundings
Life quality	Farmer can refer to his/her health, mental health, standards of living, life/work balance
Profits	Generates monetary benefits
To care for the environment	Farmer expresses concern for nature, the environment
To earn a living	Expresses necessity to earn an income or make a living
Traditional	Part of tradition, long-established
Satisfaction	Being content, feeling fulfilled, provides pleasure

Results from interviews with 13 conventional farmers yielded 145 ladders. A total of 99 MEC elements were identified from the interviews; an average of 11.2 ladders per participant. 'Profits' (33) not only represented the most prevalent consequence element but it was also the most widely mentioned element overall. The attribute element that was most widely presented was 'traditional' (13). The values that prevailed most were the terminal values 'life quality' (32) and 'satisfaction' (12).

The HVM analysis identified 774 links between elements (362 direct links and 412 indirect links). The HVM illuminated how many of the attributes identified by the respondents lead, directly or indirectly, to the consequence ''profits''. In one such example, the HVM shows how conventional farmers perceive their farming practices are suited to their context which is low in intensity, this in turn generates profits because of less costs and inputs. This enables farmers to earn a living and have a good quality of life that ultimately leads to satisfaction. Some of the stronger links identified include in the HVM: profit and less costs; self-care and being flexible; and developing the business and quality of life.

The results highlight the similarities in motivations between conventional and organic farmers, with similar consequences and values being identified in both cohorts. Of particular note is the prevalence of "profits" as a consequence for both groups. However what is of interest is the means by which farmers arrived at the different terminal values. A somewhat surprising result is the prevalence of the "traditional" as an attribute within the conventional cohort. This suggests that practices are likely to be strongly embedded and may difficult to change. The findings are relevant for policy makers to develop differentiated communication depending on the type of values that guide farmers' decision-making.

3.5 Paper 5: Ecological farming – rural realities, socio ecological arguments and comments. Cluj county case study [3]

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The present study had two goals. The first goal was to create a picture of the state and evolution of ecological agriculture in EU member states, and, in particular, Romania and in Cluj county, over a 5-year period using locally available, as well as EUROSTAT, data. The second goal was to analyse the behavioural factors that influence farmers' decisions to adopt environmentally sustainable practices in general, and in Cluj county in particular. For this we applied the Hybrid Forum Method. The hybrid forum concept is a democratic and dynamic way to think and act together when many actors and controversial issues are involved. The method was applied in Cluj area: the first part was animated by the presence of ten stakeholders (5 men and 5 women) who were selected to provide a representative of each link in the ecological farming system. The second part was represented by a debate with the participation of 43 stakeholders involved in ecological farming – studies, promotion, production, marketing and consumption. The self-administered questionnaire was used as a sociological tool, built on the perception of the trends of ecological agriculture in Cluj county. This investigation tool consisted of a set of written questions, in a logical order, which were answered by the respondents in written form, without the intervention of the researchers. 4 stakeholders from Cluj county completed this type of questionnaire.

We find that in Cluj county, the share of area under ecological farming system in total cultivated area increased from 1.8% in 2014 to 2.7% in 2018, the largest areas cultivated under an ecological system being those under pastures and fodder crops. The discussions in the hybrid forum focused on the need for education in the process of building pro-ecological behaviours and, at the same time, on the creation of a high-performance associative model for the users of sustainable farming practices. Stakeholders considered that these are primary needs for the implementation and development of ecological farming. Furthermore, in our analysis of the Hybrid Forum, we identified an acute social need for educational capital, the need for a broad, homogenous educational process that would be the basis for promoting an ecological behaviour. Cultural capital was also perceived as an essential element within farmers' associations. Farmers' organisations were perceived as a necessary institutional construct for entering the market.

The two concepts, i.e. cultural capital and organisational capital, appeared as a necessity. This leads to the idea that the way of relating to ecological farming, in sociological terms, is consistent yet dysfunctional, i.e. farmers' awareness of sociological problems is noticeable, as is their knowledge of the necessary elements for the circumvention of negative aspects, yet this is less vital than the economic needs of farming businesses. Personal characteristics, mainly those related to educational capital were relevant in adopting ecological behaviours and in developing a pro-environmental attitude. Stakeholders perceived the way in which knowledge is accumulated, leading to a higher level of specialisation within ecological farming. Moreover, the inter-generational accumulation of educational capital, identified by the farmers' opinions, was seen as a key in supporting promotion of these methods.

[3] *Published as: Florian V., Rosu E. (2020). Ecological farming – rural realities, socio ecological arguments and comments. Cluj county case study.* Agricultural Economics and Rural Development, New Series: Year XVII pp. 101-112 (1)

Another factor was identified as by the farmers as institutional. Specifically the imbalance in power between smaller farmers and those of supermarkets which create a constriction for adoption of ecological approaches. This also helped to identify a strong and significant perception of the material and financial benefits of ecological farming, through the high price paid for these goods within the region. Furthermore, farmers were aware of the physical barriers to producing ecological products, such as the land fragmentation and proximity to plots on which conventional farming is practiced.

In summary the small area dedicated to ecological practice reflects the perception that the use of ecological approaches does not represent a form of socio-economic resilience for the farmers, whilst, at the same time, being a rational option to progress, from conventional to ecological farming. Education is perceived by stakeholders as a need that can be covered by the creation of a comprehensive education system which includes ecological awareness. Social capital was also identified as one of the core elements needed to support more uptake - through the stringent need of membership in associations or organisations and offering essential links in the marketing of ecological products. Finally, behavioural and physical barriers exist around the availability of easily available knowledge and information around these production systems.

3.6 Paper 6: A cross-country comparison of values in organic and conventional production as perceived by farmers, using the means-end chain approach and laddering interviews

Authors: Leduc, G.[1], Hansson, H.[1], Engström, E.[1], Billaudet, L.[2], Jeanneaux, P.[2], Ryan, M.[3], Lynch, R.[3], Kilcline, K.[3], Leavy, E.[3], Henchion, M.[3]

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Personal values act as driving forces for individuals to behave in a certain way or to choose particular actions. In this paper, we identify and compare the types of values, economic or otherwise, that motivate farmers to choose a specific farming system, namely either organic or conventional. To this end, we analyse and compare the 'attribute-consequence-value' representation of the choice of production approach among organic and conventional farmers in Sweden, France and Ireland, using a means-end chain approach and laddering interviews. Seventy-eight laddering interviews were collected to explore how farmers characterise their choice, what consequences they perceive from these characteristics and what values they associate to these consequences. The revealed values were classified along Rokeach's typological framework to distinguish between instrumental and terminal types of values.

Our findings show that motives and values of organic and conventional farms present several similarities and differences. First, results indicate that both economic and non-economic types of motives drive conventional and organic farmers' decisions to conduct a specific farming system. For example, concerning instrumental types of values, economic motives were given by organic farmers such as "maintaining the business", "earning a living", as well as more social motives such as "morality", "care for others", "prove the value of organic farming". Social motives are also driving conventional farming such as "preserving traditions", "morality", "responsibility", "supporting family" and economic motives including "earning a living", "being autonomous" and "taking up a challenge".

In regards to terminal values, personal values are relatively more dominant than social values for both farming systems, as depicted by the Hierarchical Value Maps (HVM) derived from these interviews. HVMs of organic farmers display relatively more social terminal values than in the conventional case. Both organic and conventional farmers value "life quality", "security", "pride" and "joy" and both types of farmers also value the terminal social value of "social recognition" but organic farmers value a more numerous amount of other social terminal values such as "societal security", which is valued in all studied countries, as well as "holistic view" and "societal health" which are valued in both Sweden and France. The central concepts identified in the conventional case, such as "earning a living", "profits" and "ensuring production" show that economic rationales direct and centre the other types of motives within this type of farming system. In contrast, for organic farmers, the identified central concepts of "sustainability", "environmental impact" and "benefit biodiversity" underline that organic farmers' decision-making is interconnected to environmental types of rationales. This does not apply to the Irish organic case where rationales are interlinked to "profits" and "less inputs". Finally, the ladders and HVMs obtained from the analysis highlight that farmers with organic production have a more complex decision structure than farmers with conventional production, except in France. Organic farmers derived lengthier ladders in Sweden and Ireland, meaning that farmers tended to answer a higher

number of rationales from the same starting point. The organic ladders also had a more complex forked structure.

The identified motives and values in this analysis can be of use for farmers' advisers and policy makers to segment and target communication by promoting or market the potential perceived benefits, which are here both environmental and economic, both socially oriented and self-centred. Furthermore, the cross-country comparison of this analysis can also be exploited in order to adapt these motives in the French, Irish and Swedish case.

3.7 Paper 7: Switching to organic farming and to conservation agriculture in the Limagne plain (France). An analysis of the modes of access to resources mobilized during changes in practices

Authors: Polge, E., Pagès, H.

INRAE, France

Supporting farmers in the implementation of ecological practices is necessarily a collective undertaking. Whether it concerns their crop choices, their technical choices, the definition of their objectives and market opportunities, the socio-economic context in which the farmers operate determines their strategy and sometimes leaves them with only a limited degree of autonomy and independence. Assessing how farmers change their practices towards more ecology therefore requires understanding to what extent farmers' interactions with other actors - cooperatives, support organisations, suppliers, buyers, but also colleagues, customers, friends or family - influence their decision-making and impact their degree of autonomy. Based on interviews with 31 farmers in the Limagne plain within the Puy-de-Dôme NUTS3 region in France we conduct an individual trajectory analysis of these farmers on the role of supporting socio-economic networks to enable a switch in practices.

Through the analysis of all the interview, we were able to identify 5 typical phases associated with the farmers' trajectories. The identified phases were generally associated with an access to one or several key resources. (See Table 7.1)

Table 7.1. List of phases identified

Name of the phase	Description	Associated Resource(s)
Disruption	The farmer is in dead-end, he/she is experiencing a fracture with his/her way of producing. An event or the gradual evolution of the context pushes him/her to lead the change.	No associated objective resource
Recognition	The farmer takes his/her "first steps" towards the envisaged production system. This is a phase of discovery and information gathering.	Technical overviews, technical references, administrative information, identification keys
Preparation	The farmer has decided to launch the change. This is a planning phase. He/she seeks to gather the missing resources to implement the change.	Initial skills/knowledge, opportunities for change
Implementation	The farmer is in the operational implementation of the change. He/she tries to adopt his/her new practices.	Technical skills
Consolidation	The farmer adopted his/her practices. He/she now seeks to improve or develop them through individual or collective experimentation.	Technical references and skills

We identify five sequences based on typical trajectories. Namely i) accumulation: the farmers multiple the factors that drive them to question their way of producing, generally surrounded by peers who have already changed their practices; ii) sudden reaction: the farmers experience a significant even that drives a change in practice; iii) without disruption: the farmers experience no fracture period and have changed practices because of opportunity; iv) one foot already in: the farmers had changed practices several years ago, but a breakthrough event occurred which remains in line with past developments on the farm, usually associated with mixed farming systems; v) conservation agriculture: the

typical trajectory of farmers who have implemented conservation agriculture practices. The discovery of these principles plays a triggering role in launching the change, followed by continuous learning and implementation of changes.

Overall, the farmers trajectories followed certain identified trends. There was a clear presence of downstream actors for organic farming and generally much more surrounded by formal mechanisms than farmers operating conservation agriculture. For organic farmers, our results emphasise the importance of local organic farming associations. For conservation agricultural farmers our results underline the high degree of autonomy and clear absence of downstream actors. For both types of farmers the role of peers is crucial in diffusion of new practices. It is therefore important to encourage these informal interactions, which can be promoted through the formation of inclusive farmer's groups.

3.8 Paper 8: Innovation system challenges to organic dairy expansion

Authors: Kilcline, K.[1], O'Donoghue, C.[2], Ryan, M.[1], Jin, Y.[1], Gillanders, M.[3], Clavin, D.[1], Leavy, E.[1]

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[3] SRUC, UK

There is a growing awareness of the key role agriculture production systems must play to meet the global grand challenge of feeding a growing world population while minimising environmental impacts. In particular the EU's Green Deal for Europe looks to enshrining the principles of sustainability within the next EU programme, a key pillar of which will be the "Farm to Fork Strategy" for agriculture and an emphasis on input reduction and promotion of organic farming practices.

Despite strong policy support, the organic sector in the EU is still quite small. Ireland, for example, has a particularly low uptake or organic farming at just over 2% of the agricultural area. This is despite the fact that in comparison with other European countries Irish agricultural systems are quite extensive and for the predominant ruminant production system they are grass based. Given that organic dairy production is characterised by high-roughage diets and pasture based systems the profile of Irish conventional dairy systems would seem to readily facilitate conversion to organic production with less changes than more intensive confinement type system (Läpple *et al*., 2013). Moreover, the Irish organic sector receives strong government support for conversion through the organic farm scheme. Despite the opportunities for growth there has been little research evidence on the factors inhibiting organic dairy adoption at farm level and innovation across the sector more generally.

An innovation system is described by the OECD (2013) as a 'system' of actors (that can include individuals, organisations, policy makers and the market) that play a part in generating new products, processes, or forms of organisation into being. The innovation system approach is based on the concept that innovation is the outcome of a collaborative, non-linear process of interaction between these actors, ranging from individual interactions to networks of actors (Spielman and Birner, 2008) and this interaction is conditioned by the sectors infrastructures and institutions, which combined determine the success of the innovation system (Klein Woolthuis *et al*., 2005). This study applies the Klein Woolthuis *et al*. (2005) structural analysis approach with the focus on identifying and describing 'systemic problems' namely those structural elements which hinder innovation processes and system functioning in the organic dairy sector.

In total, data were gathered from 20 dairy stakeholders. This information was complemented by a review of published research, grey literature and unpublished national reports. During the interviews, stakeholders were asked to describe their (or their organisation's) role and experiences in the conventional or organic dairy sectors, using an egocentric network mapping exercise. To facilitate the drawing of interviewees' egocentric social networks, an inter-active social networking tool 'Net-Map' (Schiffer, 2007) was used.

The classification of the interviewees (presented in table 8.1) is according to the four domains of the dairy sector innovation system presented in figure 8.1, namely: research, enterprise, influencing, and

intermediary. Grouping actors by their domains provides a representation of interviewees as indicated by their main role and area/domain of contribution.

Table 8.1: Categorisation of interviewees by actor domain

Research	Enterprise	Influencing	Intermediary
Public Research (2) 3rd Level institute (1)	Farmers (4) Industry processors (3) Input suppliers (1)	Government (1) Certification bodies (2) Representative groups (1) Agriculture media (1) Innovation support (1)	Extension (2) Education (1)

The outputs from the actor interviews and the literature review were collated to develop a sectoral map for both conventional and organic sectors. The results of the sectoral mapping exercise are presented in Figure 8.1, showing the disaggregated structure of the current dairy sector innovation system. The stakeholder mapping identifies the key sectoral stakeholders/actors and the behavioural drivers to which they contribute in influencing farmers' production system decisions.

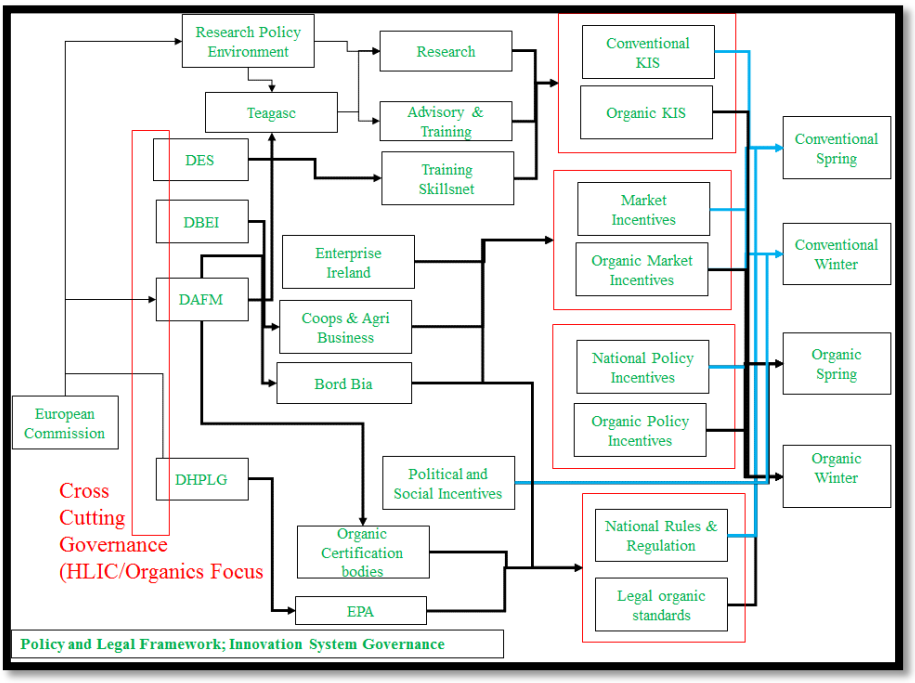

Figure 8.1. Organic and Conventional Dairy Innovation System

This paper applies a comprehensive innovation systems analytical framework, to assess and compare the relative performance (failures and merits) of the organic and conventional dairy innovation systems. For both systems, failures in terms of actors' interactions as well as hard institutional structures were identified. Clear differences emerged between the two systems that relate to more developed

knowledge and physical infrastructure in the incumbent dairy sector, along with social and cultural (soft institutions) differences of the actors across the supply chain and capacity differences of dairy farmers. This approach is particularly useful in the context of a comparative analysis of the relative failure/merits of the conventional and organic dairy sectors.

To address these 'systemic problems' and deliver on the very clear demand for organic products respondents felt the sector needs an agreed vision for innovation in the form of a coherent government sectoral strategic plan. This requires sufficient funding support and the input of key sectoral actors to co-design a range of coherent policies to promote sectoral innovation and organic dairy farming adoption.

3.9 Paper 9: Agricultural cooperatives and farm sustainability: a literature review [4]

Authors: Candemir, A., Duvaleix, S., Latruffe, L.

INRAE, France

The supply of agricultural goods that are more sustainable is expected to increase in response to increasing consumer sensibilities and governments' initiatives in the future (Saitone and Sexton, 2017). In this context, farmers are expected to produce in a sustainable way, reconciling all dimensions of sustainability; namely, economic, environmental and social. Assessments of farm sustainability, as well as of the underlying factors, are numerous in the empirical literature (Dessart *et al*., 2019). However, the role of supply chain organisation has been under-investigated so far, in particular as regards environmental and social sustainability.

The objective of this article was to assess the role of agricultural cooperatives in food supply chains in farm sustainability. Our literature review, both theoretical and empirical, shows that economists from different backgrounds study this issue. One part of the literature is mostly theoretical, and considers the behaviour of farmers in a cooperative. This approach provides analytical insights into the impacts of market power, farmers' heterogeneity, adoption costs and the availability of quality-related information when farmers are members of a cooperative. In contrast, the other part of the literature is purely empirical and generally investigates the role of agricultural cooperatives, by introducing in the econometric analyses one driver that represents the relationship of the farmers with their cooperative. To our knowledge, there has been no academic attempt to link these two strands of literature.

Regarding the different historical backgrounds of cooperatives and technical characteristics of agricultural sectors, one can argue that more contextual works, both at the sector and country level, are needed to fill the gap between theoretical and empirical studies. One reason is that there are more empirical studies relating to developing countries. Indeed, newly-founded and rural development-oriented cooperatives in these countries provide generally positive evidence about quality in cooperatives. Cooperatives often provide various economic advantages to farmers by decreasing the information gap and market uncertainties. The incentives for farmers to engage in cooperatives may be linked to access to markets at the international level. By acquiring different labels (e.g. organic, fair trade) and cooperative brands, farmers may benefit from export-oriented high quality production. The major mechanism is linked to the cooperatives' impacts for coping with market imperfections in favour of farmers. In high-income countries by contrast, these effects are not so strong. Cooperatives may have cost-driven objectives to dominate markets. For example in the EU, cereal, sugar and pig meat cooperatives are oriented more towards market power via cost reduction than value creation (Höhler and Kühl, 2014).

In addition, the theoretical literature investigates deeply the possible problems arising from farmers' heterogeneity and from the different economic objectives within the cooperative. Analytical results from these studies fit better with cooperatives in high-income countries where cooperatives

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historically have more market power. Several studies find that cooperatives can obtain efficiency gains through growing (Gezahegn *et al*., 2019; Pokharel and Featherstone, 2019; Musson and Rousselière, 2020). However, becoming a larger organisation may imply a decrease in membership commitment (Fulton and Giannakas, 2001). Large cooperatives may thus be less efficient organisations than investor-owned firms (Hirsch *et al*., 2020). This is related to their governance characteristics: in the presence of heterogeneous membership, the voting system may lead to ineffective decisions because the cooperative's strategy is not accepted by all members (Hansmann, 1988; Hart and Moore, 1996, Deng and Hendrikse, 2015). It is also worth noting that all cooperatives do not act as responsible firms or truly democratic firms. For instance, large cooperatives may, at one point, find that the democratic process is too binding to stay competitive. These cooperatives are democratic only formally and in fact behave as investor-owned firms (Nilsson *et al*., 2009). In that case, they are neither socially nor environmentally responsible either. Furthermore, legislations in many countries have allowed the cooperative firms to get external investors such as in France, Italy or China.

Overall, there is a lack of studies on the role of supply chain organisation, and in particular that of cooperatives, and on the adoption of farmers' sustainable practices. However, we believe that this is a promising avenue for research and a topical issue, in the context of the growing scarcity of public subsidies. Several solutions or incentives, both from private or public sources, have been proposed in the literature to increase the adoption of ecological practices by farmers; for example, by improving their education, delivering better extension services to them, developing specific inputs or equipment, or providing public support. This article shows that cooperatives play a non-negligible role in farm economic sustainability and in the adoption of environmentally friendly practices, suggesting that both public policies and private initiatives in cooperatives may be complementary. As regards social sustainability, there are only a few studies existing on the role of agricultural cooperatives. This is in line with the literature in general, where the social dimension of sustainability is still poorly investigated, due to the complexity of this dimension (encompassing both private aspects and public aspects) and to the difficulties of measuring it (Bond *et al*., 2012). Another issue that would need further investigation is the trade-off between economic and environmental sustainability in cooperatives, and whether these objectives are compatible, complementary, "by-products" of each other, or in competition.

3.10 Paper 10: How does horizontal collaboration influence the adoption of ecological farming practices: A choice experiment in France and Belgium

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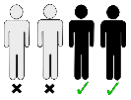
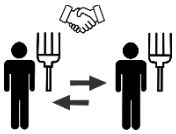
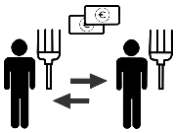
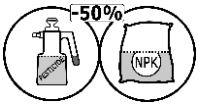
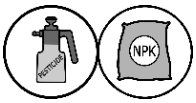
Collaborative networks - formal and informal networks designed to share, manage, and/or exchange equipment, labour and/or immaterial resources between farmers (Lucas *et al*., 2019) - offer an opportunity for farmers to overcome economic barriers by sharing mechanisation and labour costs. These also overcome cognitive barriers by sharing experiences and know-how regarding the application of ecological management practices (Groupe de Bruges, 2014; Lucas *et al*., 2019). While not as well established as in France, collaborative networks centred around machinery sharing are also present in the Belgian agricultural system. Accordingly the aim of this research is to understand what is the potential of collaborative networks, specifically centred around machinery, labour and knowledge sharing, to influence farm management practices in Belgium and France.

A discrete choice experiment (DCE) was carried out within an online survey consisting of three components; a set of socio-demographic questions, the DCE, and ten Likert-scale questions aimed at eliciting attitudes towards ecological management practices and collaborative behaviour in agriculture. Respondents were contacted first by telephone and, upon agreeing to participate, the survey link was sent to the provided email address. The survey was carried out in three case study areas, Hageland-Haspengouw (Belgium), Puy-de-Dôme (France), and Brittany (France). After data cleaning, in which incomplete and protest responses were removed, a sample of 138 respondents across Hageland-Haspengouw (47), Puy-de-Dôme (37) and Brittany (54) was maintained.

Table 10.1 describes the attributes, levels and pictograms used in the design of this DCE. The first attribute, freedom of entry, describes the ease with which a farmer can enter into the hypothetic collaborative network. This attribute was defined over two categorical levels: 1. free entry for all - new members may enter the network without any selection procedure or prerequisites, and 2. entry upon selection - new members are selected into the network through a selection procedure carried out by current members. No entry fee is charged but there is a formal agreement upon entry. In order to exit the network, agreements must be made with the remaining members.

Table 10.1. Design of choice experiment.

Attribute	Attribute levels	
Freedom of entry	1. Free entry for all 	2. Entry upon selection 
Purchasing arrangement	1. Private purchase 	2. Group purchase without recovery 
	3. Group purchase with recovery 	4. Machinery leasing agent 
Machinery distribution	1. First-come, first-served	2. Auction-based
	3. Reservation determined collectively	
Knowledge sharing	1. None	2. Peer-to-peer meetings
	3. Training via external advisor	4. Online only (e.g. fora/blogs)
Labour sharing	1. None	2. Labour exchange - voluntary 
	3. Labour exchange - paid 	4. Shared hiring 
Soil management practices	1. Zero tillage 	2. Conservation tillage 
	3. Conventional tillage 	
Fertilisation and pest management practices	1. Organic 	2. Low input 
	3. Integrated 	4. Conventional 
Ongoing payment (€)	400; 450; 550; 600	

The six attributes were selected to represent the different aspects of a collaborative network and two additional attributes reflect the potential farming practices adopted within the network. The levels of each attribute reflect the level of collaboration (ranging from not collaborative to very collaborative) and the degree of environmental friendliness of the practices (ranging from conventional to highly ecological). Respondents were presented with the hypothetical scenario of joining one of the collective networks represented on the choice cards. The opt-out alternative allows respondents to elect not to join either of the alternative scenarios.

The multinomial logistic model estimates indicate that respondents have a weak but significantly positive preference for certain knowledge sharing and labour sharing attributes within a collaborative network, but a negative preference for attributes associated with machinery sharing. This indicates that there is a desire amongst farmers to engage with knowledge sharing between peers across a diversity of channels. However, preferences for knowledge sharing through peer-to-peer dissemination and training via an external advisor were found to be heterogeneous within the sample, with 19.24% of respondents actually having a negative preference for such knowledge dissemination.

Respondents preferred private purchase of machinery over group purchase both with and without return on investment upon exiting the network. Once again, preferences for the latter were heterogeneous, with 31.75% of respondents actually demonstrating a positive preference for group purchasing of machinery without return on investment. Estimates also indicated respondents significantly prefer a first-come, first-served distribution system when it comes to machinery within a collaborative network. Noteworthy is the lack of significant preferences observed for farm management practices adopted within the hypothesised networks. Only a strong, heterogeneous, negative preference for organic pest and fertilisation management practices was observed. This heterogeneity indicated that despite the overall negative preference tendency, 31.75% of respondents had a positive preference for the practice in question. This is larger than the share of respondents within the sample engaged in organic agriculture (13.04%) and would thus indicate a willingness to adopt organic practices (related to pest and fertilisation management) within a collaborative network.

The latent class model identified two classes amongst respondents based on individual attributes. The main characteristic distinguishing preferences between the two classes are the estimates for the opt-out alternative. Respondents in class 1 have a strong significant positive preference for the opt-out, indicating a preference to maintain current agricultural activities rather than joining the proposed collaborative networks. Respondents in class 2, on the other hand, have a significant negative preference for the opt-out, thus signalling a preference amongst respondents to join the proposed networks rather than maintain their current agricultural activities. We see that nationality, case study area and current collaborative behaviour seem to be the strongest drivers of class membership. Class 1 has a larger share of respondents from Belgium (41.25%), while class 2 is primarily made up of respondents from France (75.86%). Consulting the variables associated with cooperative behaviour, we can see that respondents in class 2 have more experience with collaborative behaviour than do respondents belonging to class 1. Specifically, significantly more members of class 2 currently engage with machinery sharing (both formal and informal), collective marketing of productive output, and collective purchasing of agricultural inputs (seeds and other).

Through this study we aimed to explore the potential of collaborative networks to influence farm management practices in Belgium and France. We see little evidence that the networks proposed here may increase adoption of ecological farm management practices. Though organic pest and fertilisation practices may form an exception.

A secondary aim of this study was to assess farmer preferences for particular characteristics of collaborative networks. Overall, we see that farmers seem to have a preference for knowledge sharing and certain labour sharing characteristics within the proposed collaborative networks. Further, contrary to our hypothesis, farmers dislike machinery sharing opportunities within such a network. However, we see that there is a great deal of heterogeneity within our sample, with the latent class model indicating two groups of respondents based on distinct utility derivation from the proposed alternatives.

Preferences to join a collaborative network vary between respondents in our sample based on experience with collaborative behaviour. We see that respondents who have more experience with such behaviour, primarily respondents from the French Puy-de-Dôme case study area, have a stronger preference to join the proposed networks. Simultaneously, those respondents with little to no experience with collaborative behaviour, respondents from the Brittany (France) and Hageland-Haspengouw (Belgium) case study areas, have a strong negative preference to join the proposed networks, preferring instead to maintain their current agricultural activities. While for the Belgian sample, this dislike for joining the proposed networks is concluded to stem from their lack of exposure to collaborative behaviour, the explanation for the Brittany sample is slightly more nuanced. Here, production systems in Brittany may be influential in driving negative preferences, as the majority of this sample was engaged in purely dairy farming systems. Thus meaning that the attributes related to ecological farm management practices presented in the choice cards are not relevant for these farmers. However, substantiating this conclusion requires more research to be done.

3.11 Paper 11: Organic leakage in the beef sector and its impacts on the value chain

Authors: O'Donoghue, C.[1], Jin, Y.[2], Kilcline, K.[2], Ryan, M.[2], Clavin, D.[2], Leavy, E.[2]

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Various organic supports have been offered worldwide to encourage farmers to respond to the market demand for organic foods and stimulate conversion from conventional organic production (USDA, 2020; European Commission, 2019). However, due to a lack of market and processing structures and supports, there is anecdotal evidence of leakage of organic products to the conventional (non-organic) value chain (Baecke *et al*., 2002; O'Donoghue *et al*., 2018). Thus the policy support may result in both private and public costs and less than effective policy incentives. To the best of our knowledge, little literature refers to organic leakage.

To fill this gap in the knowledge, this study contributes to the literature in three ways: (i) illustrating the leakage of animals from the organic to the conventional value chain and its mechanism from a theoretical perspective; (ii) quantifying the level of organic leakage and its impacts on the value chain based on a Bio-Economy Input-Output model; (iii) providing policy implications on the viability and potential improvement of the incentive schemes based on the implementation and effectiveness of the current policy support.

Various segments of production are required to generate a desirable beef product across the value chain. This study specifically examines organic leakage in the Irish beef sector. For both organic and conventional farms, their value chains and the links between them are identified, i.e. organic conversion and organic leakage. Potential leakage between segments of production across the beef value chain is also identified and presented in Figure 11.1.

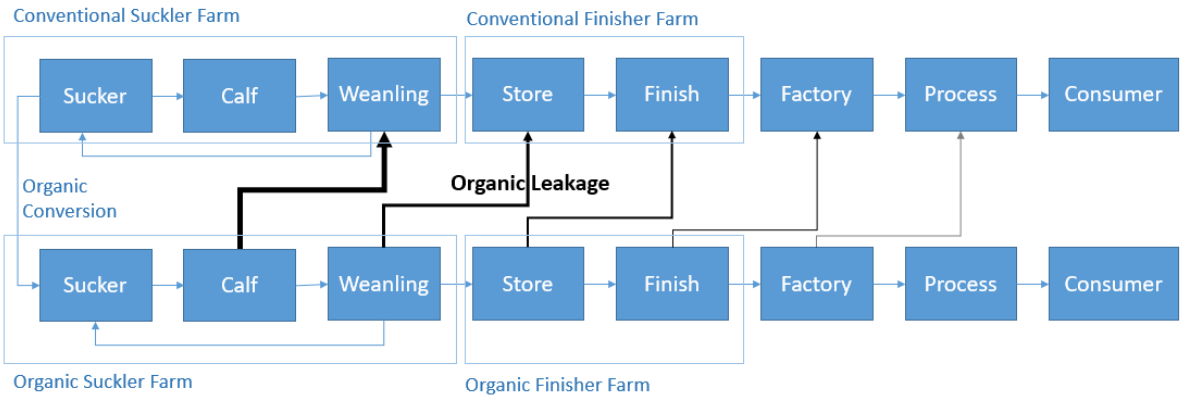

Figure 11.1. Organic leakage between segments of production across the beef value chain

Next, production at farm gate is segregated in fine detail (from suckler to finish) in order to be able to focus on where most organic leakage occurs. Data are used from the Central Statistics Office in Ireland and the Teagasc National Farm Survey (which collects farm data for the European Farm Accountancy

Data Network (FADN)). The technical parameters for the organic beef value chain are based on expert interviews with processing companies.

To analyse the value generation across the value chain and the interdependencies between various inputs and outputs among segments of production, we adapt a Bio-Economy Input Output model (BIO) with a detailed disaggregation of the agri-food sector and energy sector (O'Donoghue *et al*., 2019). To assess the change of value added at various stages of the beef industry, we further disaggregate the BIO model to include an additional 26 sectors for cattle at various age groups (male and female, conventional and organic), as well as additional sectors for processing and retailing conventional and organic beef products. By disaggregating, the BIO model captures the individual flow of cattle movements across 0-12 months, 1-2 years, and > 2 years age categories at farm level, where most organic leakage occurs. We also disaggregate the organic value chain from the conventional chain since exist extra inputs are required in organic farming (e.g. more expensive organic feeds and extra housing), organic processors (e.g. extra segregation costs, more costs for labour and facilities), and organic retailers (e.g. extra segregation costs and more advertisement).

This disaggregation enables us to analyse the interdependencies that exist at the farm gate of the beef industry in detail, differentiating the production costs between conventional and organic sectors, and quantifying the value added across the value chain. To analyse the impacts of organic leakage across the value chain, we implement the organic leakage in the model for both conventional and organic animals under 12 months and compare the change of value added before and after the implementation. To be more specific, the change in the individual flow related to organic leakage leads to a change in the total output. The corresponding changes in value added resulting from the changes in output are the impacts of organic leakage for various sectors across the value chain.

By mapping the progression of animals through the organic value chain, results show that the leakage of animals from the organic to the conventional beef sector in Ireland can be between 15 and 20%. There exists a lesser focus on the wider value chain and unbalanced development of various segments of production, which results in leakage from organic to conventional value chains. In this study, organic leakage in the Irish beef sector is quantified, the impacts of organic leakage are assessed and the potential for similar leakage in various organic sectors worldwide is inferred along with their corresponding impacts.

Inefficient schemes that do not target the development of the entire value chain may not provide good value for money in relation to public spending. To stimulate organic conversion, it is crucial to take into consideration the potential leakage across the value chain and its impacts. In other words, it is necessary that policy measures go beyond production to include processing and retail, as well as developing the demand side. By mapping the value chain, our study provides insights for stakeholders, especially for policy makers in policy design and for future improvements. The results also have important implications for discussions on effective and efficient policy schemes on organic conversion internationally.

3.12 Paper 12: Can marketing channels influence the participation in organic label or in agri-environmental schemes?

Authors: Candemir, A., Duvaleix, S., Latruffe, L.

INRAE, France

Negative environmental effects of agricultural practices are highly debated nowadays. As Saitone and Sexton (2017) emphasise, the supply of agricultural goods that are more environmentally friendly is expected to rise to respond to increasing consumers' sensibilities and governments' initiatives. However, improvements of environmental quality in agri-food industry face supply side-related economic obstacles, contributing to the explanation of the persistence of conventional practices even if there is growing demand for environmentally friendly practices (Barbieri *et al*., 2016; Cecere *et al*., 2014). Various drivers may be listed to examine farmers' choice of practices (Dessart *et al*., 2019). This literature is rich-especially on organic practices- and offers several results about drivers and obstacles behind adoption decisions from an empirical point of view (Casagrande *et al.*, 2016; Hansson *et al*., 2019; Jouzi *et al*., 2017; Latruffe and Nauges, 2013). Firstly, socio-demographic characteristics have significant impacts on farmers' decisions; namely age, education level, political or ideological opinions and beliefs of farmers, or household composition. Secondly, farms' economic characteristics, such as organisational structures, size, indebtedness or main production, play a crucial role. Finally, external factors like market prices and government interventions, via policies and regulations, have direct effect on the adoption decision. To our knowledge, little is known about the role of marketing channels in the adoption of environmentally friendly practices.

Our study aims at capturing how marketing channels choices can influence the farmers' choice on their participation in ecological agricultural practices. Using data from the LIFT large-scale farmers' survey, we observe a diversity of marketing channels used by farmers. The sample used gathers 702 farms from 7 EU countries (Germany, France, Greece, Ireland, Poland, Romania and Sweden). The database provides information about the shares of output sold through 6 marketing channels. Most farms choose a dominant marketing channel (cooperative/producer' organisation-PO, processor, wholesaler, retailer, consumer, and other type of marketing channel), where dominant is identified when at least 50% of the output is sold through this channel. We also identify the farms that do not have a dominant marketing channel and instead sell most of their output through two or more different marketing channels. Cooperative/PO channel is the dominant option with the highest number of farms namely 270 farms (38.46 % of the sample). The processor as a dominant option is chosen by 179 farms (25.50 %). The wholesaler as a dominant channel appears for 83 farms (11.82 %). Direct sale to consumer is dominant for 61 farms (8.69 %). 27 farms (3.83%) choose the option of retailer as the dominant marketing channel. 35 farms (4.99 %) define their dominant marketing channel as 'other'. Finally, there are 47 farms (6.70 %) without any dominant marketing channel.

In the sample, we observe a diversity of marketing channels across countries, and depending on farm specialisation. In Germany and Greece, wholesaler, cooperative and processor are mostly chosen as marketing channels. However, in German livestock farms, farmers mostly choose to sell products to processors and Greek farms in the sample are solely non-livestock farms. In France, most farms sell their outputs to cooperatives. Wholesaler and cooperative options dominate in Ireland for both non-livestock and livestock farms. In Poland, non-livestock farms have very diversified choices of marketing channels. Mostly chosen channels are processor, retailer and wholesaler. Polish livestock farms largely

use processor channel. The large majority of dairy Romanian farms use processor as marketing channel. Finally, In Sweden, we have a very diversified portfolio for both livestock and non-livestock farms. More interestingly, direct sales appear as an important channel.

We consider two types of adoption of ecological practices: certified organic farming, and the participation in agri-environmental schemes (AES) other than organic. In 2018, farms with organic certification represent 26 % (184 farms) of the sample, and those who participate in AES other than organic are 207 farms out of 702 (29.49 %). In the preliminary econometric analysis that focuses on the organic certification and AES participation, we control for farm characteristics and country effects. First results show that only cooperative marketing channel has a significant effect on the probability of being certified organic farming and this effect is negative. Further analysis will provide additional results depending on the farm specialisation and countries.

3.13 Paper 13: Adopting environmentally friendly farming practices and the role of quality labels and producer organisations: a qualitative analysis based on two European case studies [5]

Authors: Duvaleix, S.[1], Lassalas, M.[1], Latruffe, L.[1], Konstantidelli, V.[2], Tzouramani, I.[2]

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The increasing awareness of consumers about the impacts of farming systems has led food operators to develop private labels with the aim of achieving higher quality products and encouraging environmentally friendly practices. Furthermore, the organisational structures present in supply chains may have significant impacts on the adoption of environmental innovations (Karantininis *et al*., 2010) since, for instance, producer organisations (POs) and the food industry might provide technical support and enhance farmers' skills (Menozzi *et al*., 2015). Hence, there is growing pressure on farms to adopt environmentally friendly practices. Various drivers behind the adoption of such practices have been investigated in the literature such as farmers' motivations and attitudes, farms' structure and management, and policies (see a recent review in Hansson *et al*., 2019). However, little attention has been given to the role of food supply chains, and in particular to the role of quality labels and of POs. Our research aims to examine how specific instruments used by economic actors in food supply chains influence the adoption of environmentally friendly practices by farmers, namely through both the development of quality labels and various other incentives implemented by POs.

We compare two different case studies in the EU: pig production in the western region of Brittany in France, and olive oil production in two regional units of Crete (Heraklion and Lasithi) in Greece. The productions are contrasting in the sense that they are: (i) animal versus crop; (ii) short-life (pig) versus long-life (olive oil); and (iii) a national driven market (pork) versus an export driven market (olive oil). In addition, the organisation of the supply chains is different, with a highly concentrated sector of pig production in Brittany where most of the production is sold through POs, and scattered olive producers but well-developed public quality labels in Crete. POs denote all entities that gather agricultural producers, whether or not they are recognised by public institutions. They can take different legal forms, such as agricultural cooperatives, associations, or private companies. Whilst in the French pig sector, POs are formally recognised legal entities, in the Cretan case study a significant number of entities did not appear in the form of an officially recognised PO.

We conducted semi-structured interviews with supply chain stakeholders to explore how food supply chains influence the adoption of environmentally friendly practices on farms. In total, 9 stakeholders in Brittany and 11 in Crete were interviewed, with each respondent having a specific role in the organisation (such as manager, person in charge of environmental matters, person in charge of quality matters, etc.). The questionnaire was divided into three parts. The first section collected the characteristics of the organisation represented by the respondent. The second section dealt with the role played by

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the supply chain stakeholders in encouraging the adoption of environmentally friendly farming practices. The last section asked the respondents to rate quality labels according to the changes in the production system that the adoption of these practices would generate. The face-to-face interviews lasted between an hour and a half to two hours, they were conducted in January–February 2019. Furthermore, across our case studies, we identified 25 quality schemes with environmental requirements: 21 in Brittany's pig sector and 4 in the Cretan olive oil sector. Among the 25 schemes, 4 of them are certified by public authorities, either recognised at the European level (Protected Designation of Origin (PDO), organic farming, and GMO-free), or recognised at the national level: in France the "Label Rouge" and the "Haute Valeur Environnementale" (HVE (high environmental value)) and in Greece the AGRO 2.1 & 2.2/3. The other quality labels are private labels, initiated by supply chain stakeholders or associations.

Our study highlighted the existence of European public labels in both case studies (in particular, organic farming or PDOs), a couple of national schemes in both case studies, and a proliferation of private quality labels in the pig sector in Brittany. However, many of the labels are not specifically aimed at improving the environmental impacts of farming through environmentally friendly practices, but rather focus on improving animal welfare or sanitary quality. It can also be underlined that an economic motive is the strongest reason for support of environmentally friendly practices in Brittany's pig sector. This is also a strong motive in the Cretan olive oil sector, with the aim of promoting Cretan products and gaining export shares. Furthermore, it is worth noting that the pig sector faces difficulties in putting a value on the labelling of environmentally friendly practices on all pig products. French consumers are mainly interested in labels when buying ham and do not take them into account for fresh meat.

A clear finding from both our case studies is the role of advisory services. All organisations taking part in our survey provide technical advice to their members, whether through research programmes (research and development programmes on pig farms in Brittany), specific events (agronomic meetings in Crete), or on the spot, e.g., when producers come to deliver their olives to the mills. In Crete, it should however be underlined that the advisory services about technical issues are provided mainly to the members of POs that are recognised by public authorities, through their participation in EU support programmes, while only limited advice is extended to other farmers.

Another issue for further discussion is the multidimensional aspects of quality labels. For example, PDO labels, through their strong linkage to geographical origin and the product attributes associated with the intrinsic environmental factors (natural and human), as stated in the European regulation 1151/2012, may play an essential role in working towards sustainable development goals. Geographical indication (GI) products can be an important contributory factor in all three dimensions of sustainable development (economy, environment, and society) at a territorial level (Vandecandeleare *et al*., 2009). Overall, future policies should take into consideration quality labels in the design of financial instruments, as they might constitute a powerful tool in fostering sustainable development. For example, in Crete AGRO 2 may serve as a particularly useful environment-oriented instrument in the design of future agri-environmental policies at both the national and EU levels. Public support for POs might also be incorporated in the design of policies, even more so as farmers consider such experts to be an informed and trusted source of knowledge for making their decisions (Van Herck, 2014, Inman *et al*., 2018). This may come in the form of the legal recognition and support for an association of POs, as recommended for the Irish beef industry (Hooks *et al*., 2018). Associations of POs may be a more efficient alternative to scattered POs in providing advisory services to farmers, as it may favour the exchange of knowledge between POs, increase the complementarities, and decrease the cost.

3.14 Paper 14: Consumers' preferences for environmental credence attributes of vegetables and the trade-off with an overall Eco-Score. A choice experiment with Belgian food consumers

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Although consumers' willingness to account for the environmental impact of their food has increased throughout recent years, this is still only moderately reflected in food choices (Shaw *et al.*, 2016; Vermeir and Verbeke, 2006). The need to streamline the evaluation and communication of environmentally-related food attributes has been addressed within the European Commissions' Single Market for Green Products initiative, the 2020 Circular Economy Action Plan and in the Farm to Fork Strategy (European Commission, 2013, 2020). The aim is to eventually present all environment-related information in one standardised way, based on the Product Environmental Footprint (PEF) methodology, which includes the calculation of a product's total environmental impact throughout its entire life cycle. In this light, some retailers in France and Belgium very recently introduced a new "Eco-Score", which reflects the overall environmental impact of food products (Retail Detail, 2021). The objectives of this study were to evaluate consumers' preferences for existing and alternative environmental-related attributes of vegetable supplies. More precisely, preferences for seasonality restrictions, localness, and organic production were compared to and traded-off with a more aggregated Eco-Score. Before evaluating these preferences, we aimed to manipulate consumers' (un)sustainable self-view and thought-confidence(doubt) in that view in order to steer more (less) environmentally friendly choices.

Since an "Eco-Score" is expected to be implemented on the market, it is important to anticipate its demand in combination with and compared to the demand for existing sustainability attributes. Respondents were asked to *"think about the store where you usually buy vegetables. Imagine the management is planning to revise their vegetable supply for at least one year, but they would like to hear your opinion first."*. Subsequently, repeated choices between two hypothetical vegetables supplies for the next year were made. This long-term commitment was emphasised because consumers typically show a relatively high willingness-to-adopt sustainable food choices on the short term, but especially for seasonal vegetables, the persistence of this commitment is questioned. Five attributes were presented to respondents, including (1) seasonality restrictions, (2) organic label, (3) origin, (4) Eco-Score and (5) price.

The discrete choice experiment (DCE) was embedded in a web-survey consisting of three main parts: (1) Introductory part and manipulation, (2) DCE and (3) follow-up questionnaire. Data collection was done through a web-survey with a cross-sectional sample of Belgian household food decision makers in March 2021. Those respondents were recruited by an external agency and quotas were used to maintain representativeness in terms of age and gender. The final sample included 300 respondents.

The DCE provided relevant insights in the functioning and interplay of consumers' preferences for various environment-related credence attributes of vegetable supplies. Particularly, we observed a large market opportunity for an Eco-Score to induce a demand driven transition towards more environmentally friendly food choices, yet this transition might be hampered by the presence of organic and local claims. Furthermore, we have identified 5 latent classes, which still need further profiling. The results suggest that respondents with a confident sustainable self-view reported less sustainable preferences

while respondents with a confident unsustainable self-view reported more sustainable preferences. As this contradicts the general self-validation hypothesis, further theoretical substantiation is needed.

4 Discussion[6]

Growing societal concern towards the environmental damage caused from current systems of food production are leading to a more explicit change in the ambition for agricultural policy (European Commission, 2020). Past attempts at integrating the environmentally-friendly practices into farming have only been marginally successful but have enabled some farmers to engage in these practices. The main challenge for current and future policy is setting the appropriate institutional conditions and incentives for encouraging a transition to significantly higher levels of uptake of ecological practice. Underlying this is the desire for long-term behavioural change and understanding how the affected actors can uptake more ecological practices.

The studies presented here show the decision to adopt more ecological approaches is a mixture of exogenous and endogenous drivers.Overall, within the farming population there seems to be great heterogeneity in ecological perceptions [2] and practice uptake [1]. Constructing a typology of ecological perceptions allowed us to explain the salience of exogenous and endogenous drivers which drive membership of these groups. In particular the role of gender in determining perceptions, years of experience and farm family life-cycle factors, such as succession planning, all were found to be significantly positive endogenous effects, alongside typical exogenous effects, such as agronomic constraints and regional institutional structures. These studies provide a companion to the SEM [3] which offers a parsimonious way to measure the endogenous and exogenous drivers behind current and intended uptake. To further our understanding of behavioural constraints, those farmers who stated strong agreement with productivity objectives were less likely to uptake ecological approaches, but this varies by farming system.

What provides a basis for further study is the influence of social norms on practice adoption, whilst the SEM [3] econometrically estimates the effect of peer and neighbouring farmers, further spill-over effects are being explored in conjunction with LIFT WP4 by examining the spatial distribution of ecological agriculture. In addition, the negative associated variables around uptake of ecological approaches and use of formal information sources tends to imply that ecological adopters are more driven by personal compared to social objectives. The literature indicates that horizontal collaboration amongst farmers is able to influence the uptake of ecological approaches through addressing both these personal and social objectives [10]. The sharing of machinery, knowledge and experiences may provide a sense of community amongst farmers, fostering uptake of more ecological practices. Simultaneously, such collaborations provide farmers with the necessary inputs to overcome cognitive and economic hurdles they may face as individuals. As such, the results of these studies, in conjunction with the work ongoing in WP4, will help to identify more clearly what the impact of spill-over effects within a horizontal collaborative network may be on the uptake of ecological practices.

These econometric studies were complimented by qualitative analysis approaches towards uptake of ecological approaches within specific countries. We provide empirical examples of the means-end-chain analysis and laddering to identify how farmers characterise their decisions to run their farms and, also, what influences their choice to run an ecological compared to conventional farm [4,6]. These studies allow us to examine the chain of decision-making and emphasise how both organic and conventional farmers consider economic and non-economic goals. In some countries the underlying non-economic values, such as societal support, tend to be more present in ecological than conventional farming, but were also revealed by more complex decision making pathways.

Furthermore, positive attitudes towards ecological farming indirectly act in conjunction with conservation objectives to positively influence the adoption of these ecological approaches [3,5]. Moreover,

[6] Papers outlined in this deliverable are referred to in square brackets.

a wider variety of moral instrumental values are identified among both conventional and organic farmers when attempting to understand the logic of the decision [3,4,6]. However, this is not to underestimate the role of more traditional goals, such as productivity enhancement, within farming which can act as a barrier to adoption [1,2,3]. This leads to questions around support of the supply chain by making adoption of ecological farming more financially supportive [2,5]. In addition, there seems to be an explicit divide between those who perceive the supply chain to enable uptake of ecological approaches and those who feel constrained, predominantly through lack of trust with retailers, regardless of whether farmers have the same environmental outlooks [2,5,8,11]. Hence, future studies need to consider current supply chain constraints as a key exogenous driver to uptake of ecological approaches.

This also raises questions on how to enable these environmental outlooks through targeted information and the role of social incentives in the form of specific training or advisory services across different groupings of farmers, but also both public policy and private objectives. To stimulate organic conversion, it is crucial to take into consideration the potential leakage across the value chain and its impacts. In other words, it is necessary that policy measures go beyond production to include processing and retail, as well as developing the demand side [8,9,12,13,14].

Examining case studies of marketing channels for the uptake of ecological approaches [6] allows understanding of how farmers across a number of countries are influenced by the route in which they sell their produce. This shows the diversity of marketing channels but also that most farms have a dominant channel. Some level of agency is inferred from the variety of channels available and innovation is prevalent in those farmers choosing a mixture of channels to sell their produce. Accordingly, options to overcome some of these supply chain constraints may be offered through the diversity of channels available.

Another significant intervention which may override these barriers are contracting and other vertical coordination schemes from farm producer organisations, e.g. agricultural cooperatives, which influence the adoption of ecological approaches. Whilst more detailed analysis of contracting relationships are ongoing, the literature shows that cooperatives play an important role in farm economic sustainability and in the adoption of environmentally friendly practices, but few studies have focused on social sustainability [9]. Moreover, from our choice experiments, respondents with more experience of collaboration tend to have stronger preferences for that behaviour. Conversely, those with less experience have more resistance to collaboration [10]. This alludes to a path dependency within farming and the need to break these paths through a potential triggering event. The transition pathways identified in [7] provides a useful framework for typifying the options and the enabling conditions for change. Moreover, farmers within our choice experiment [10] have a preference for knowledge sharing, but again we find clusters of differing opinion. Accordingly, targeted social incentives, such as training or advice, for these farmers with less experience of collaboration may be a way to ensure greater uptake of ecological approaches.

Case studies were presented on the role of labelling of attributes as a means to gain a higher return to ecological practices [9]. However, it was found that for the many certification labels, for which agricultural farming systems must comply, these are not specifically aimed at improving environmental impacts. Hence, whilst this is evidence of some effect of market segmentation this may not be truly reflective of the desire to support more ecological practice. Nevertheless, economic experiments on the complexity of the purchasing process elicit consumers' motivations for products with a higher ecological quality. These indicate a large market opportunity for an Eco-Score certification to induce a demand driven transition towards more environmentally friendly food choices [14]. However, this must compete against currently established and, in some countries, multiple labelling schemes which infer ecological improvements.

Finally, as with farmers [1,2,10] we observe much heterogeneity with consumers [14], with various views and behaviours towards purchasing goods with ecological attributes. Accordingly, including both production and consumption segments in a more holistic approach would seem to be a way forward to understand how the ambitious goals of EU agricultural policy can be achieved.

5 Deviations or delays

None.

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