UNISECO

UNDERSTANDING & IMPROVING THE SUSTAINABILITY OF AGRO-ECOLOGICAL FARMING SYSTEMS IN THE EU

Deliverable Report D2.2: Typology of AEFS and Practices in the EU and the Selection of Case Studies

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DATE OF APPROVAL:	22.02.2019
APPROVED BY PROJECT COORDINATOR:	Gerald Schwarz (Thünen Institute)
DATE OF APPROVAL:	22.02.2019
CALL H2020-SFS-2017-2	Sustainable Food Security-Resilient and Resource-Efficient Value Chains
WORK PROGRAMME Topic SFS-29-2017	Socio-eco-economics - socio-economics in ecological approaches
PROJECT WEB SITE:	www.uniseco-project.eu

This document was produced under the terms and conditions of Grant Agreement No. 773901 for the European Commission. It does not necessarily reflect the view of the European Union and in no way anticipates the Commission's future policy in this area.

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ACRONYMS

AE	Agro-ecological
AEF	Agro-ecological Farming
AEFS	Agro-ecological Farming Systems
CA	Collective action
CAP	Common Agricultural Policy
CDISP	Communication, Dissemination and Impact Strategy and Plan
CUMA	Coopérative d'utilisation de matériel agricole
DG AGRI	Directorate-General for Agriculture and Rural Development
DG-EMPL	Directorate-General for Employment, Social Affairs and Inclusion
DG ENV	Directorate General for Environment
EC	European Commission
EIP-AGRI	European Innovation Partnership for Agricultural productivity and Sustainability
ENRD	EU Network for Rural Development
EU	European Union
FADN	Farm Accountancy Data Network
GA	Grant Agreement
IP	Innovative policies
IPR	Intellectual Property Right
KPI	Key Performance Indicator
M	month
MA	multi-actor
MAP	Multi-Actor Platform
MS	Milestone
NGO	Non-Governmental Organisation
P/S	Processing / sales
PDO	Protected designation of origin
RD	rural development
SDG	Sustainable Development Goal
SES	Socio-ecological system
WFD	Water Framework Directive

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EXECUTIVE SUMMARY

The overarching objective of UNISECO is to strengthen the sustainability of EU farming systems, through the co-construction of practice-validated strategies and incentives that promote the implementation of agro-ecological approaches. To fulfill the main objectives, UNISECO requires a typology of farm systems that supports its research requirements and methodological needs, such as the incorporation of Agroecological and Social-Ecological Systems (SES). Case studies are seletect to represent key EU farming systems, and provide a basis for learning about possible strategies to overcome barriers for transitions towards agro-ecological farming.

There is a need for a flexible typology that is able to deal with the complexity within the farming systems, which have modified their management and practices away from conventional farming. This is largely because moving away from conventional farming can take place in a number of different ways that are more or less strongly based on agro-ecological principles and practices, and that are most suited to the particular spatial context/location. Therefore, for UNISECO we have proposed a three-dimensional system of typologies to define farm production systems (D1), AEF practices (D2) and socio-economic (SES) context (D3).

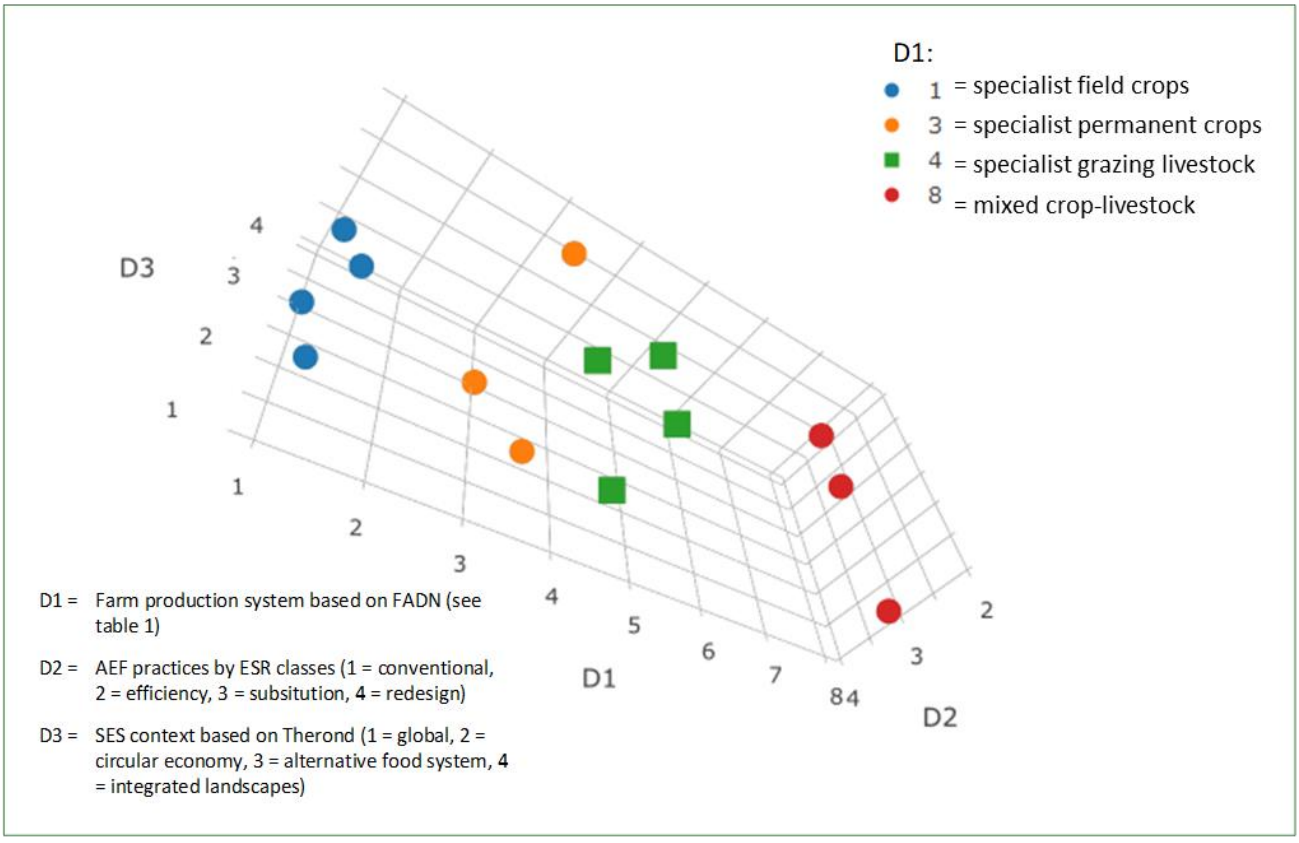

Figure ES.1. Proposed UNISECO 3D AEFS typology

The aims of the selection of case studies is to provide a basis for generating insights to factors that support successful transitions towards AEFS. To fulfil this aim, it was necessary to ensure coverage of EU farming systems that represent typical farm production types. At the same time, the cases should represent a diversity of agro-ecological practices and stages of the transition from conventional to AEFS.

The selected case studies are summarised in Table ES.1.

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Table ES.1: The results of the process of selection of case studies, summarised by selected characteristics

Partner Country (scope)	Sustainability Issue (examples)	Farm Production Type	Agro-ecological Practices (examples)	Level of Cooperation	Involvement in Value Chain
Mixed Farming Systems					
UK (North-East Scotland)	Soil degradation, water pollution	Mixed farming	Biodiversity supporting practice, nutrient budgeting	Strong	Cooperatives
Romania (Maramures Transylvania)	Economic viability, slowly increasing intensification	Mixed small-scale farming	Low intensity	Moderate	Direct sale, low processing
France (Auvergne Rhône Alpes region) Case study 1	Pesticide pollution, economic viability, food safety	Mixed small-scale farming, market gardening	Organic farming; fair access to agro-ecologically produced food for low income families	Strong	Direct sale
Permanent Crops					
Italy (Chianti Bio-district)	Nutrients and pesticide pollution, biodiversity	Permanent crops: vine production	Organic fertilisers, vegetation strips maintained, green manure	Strong	Direct sale, mostly through wholesalers
Greece (Imathia)	Pressures due to using agro-chemicals (on soils, water, biodiversity)	Permanent crops: fruit and vine production	Using alternative ways of pest control, nutrient management, biodiversity management	Strong (collective agri-environmental scheme)	Cooperatives (processing)
France (Auvergne Rhône Alpes region) Case study 2	Dependency on fertilisers, high pesticide use, low soil biology	Permanent crops (grapes)	Aiming to use green manure, reduction of pesticide use, combined cropping	Good level	Wine processing cooperative
Arable Land					
Spain (Basque country)	Environmental, social and economic viability	Grain production	Organic and practices beyond the certification standards	Strong	Short commercialisation channels
Austria (Ecoregion Kaindorf)	Water scarcity because of climate change, soil quality decline	Arable farming, pig husbandry	Soil fertility increase programme, CO_2 compensation certificates, agroforestry	Strong	Processors part of network
Germany, Lower Saxony	High pressure on ecological sustainability in general, biodiversity loss and water pollution	Arable systems (specialised and combined with livestock)	Extensive margins, nutrient management, organic farming, cover crops, linear features	Some co-operation exists (e.g. multi-actor platform for biodiversity-friendly farming)	Poor direct involvement, but generation of high added value

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Partner Country (scope)	Sustainability Issue (examples)	Farm Production Type	Agro-ecological Practices (examples)	Level of Cooperation	Involvement in Value Chain
Czech Republic	Soil degradation	Mixed farms, focus on arable land	Soil protection practices	Low	No involvement
Animal Production (on Arable Land and Grassland)					
Latvia (country)	Economic viability and adding value	Fragmented dairy farming	Organic farming, extensive farming	Low	Poor
Lithuania (country)	Economic viability and adding value	Small dairy – cheese makers	Different levels of extensive grazing, low use of additional feed	Low to moderate	Processing and marketing cheese
Switzerland, lake Sempach region	Lake eutrophication, P increase in water, ammonia emissions	Intensive pig farming, grassland beef	Nutrient balance 100%, lake contract payments, organic farming	Low	Poor
Hungary Somogy	Soil degradation, water pollution, biodiversity on arable land	Mixed intensive farming	Winter cover crops, reduced till and residues left on soil	Low	Direct sale, mostly through wholesalers
Finland (Nivala region)	Carbon emissions, nutrient recycling	Dairy farms	Carbon and nutrient management using biogas plant	All farmers in processing cooperative	Processing cooperative
Sweden	Livestock contribution to climate change	Livestock farms	Diversification to legumes for human consumption	Poor	Low level of involvement

The selection of case studies has been developed in consultation with national stakeholders in the partner countries. UNISECO has consulted with members of the EU Multi-Actor Platform (MAP) on the final case study selection and the proposed typology. The responses from the EU MAP consultation have been positive and constructive. The comments and suggestions have been taken on board in the ongoing development of the typology and the finalisation of the selection of case studies.

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1. INTRODUCTION

The overarching objective of UNISECO is to strengthen the sustainability of EU farming systems, through the co-construction of practice-validated strategies and incentives that promote the implementation of agro-ecological approaches. The project aims to enhance the understanding of socio-economic and policy drivers and barriers for further development and implementation of agro-ecological practices in EU farming systems, through the co-creation of knowledge with actors and stakeholders in such farming systems. The outputs of this process of co-creation in the case studies of the 15 European partner countries will develop innovative management strategies and incentives for the implementation of agro-ecological practices in, and assess the environmental, economic and social impacts of these practices at farm and territorial levels.

To fulfill the main objectives of UNISECO requires a farm system typology and a strategy to select case studies. The typology is required to support research processes in the study of Agroecological and Social-Ecological Systems (SES). The collection of relevant data for the sustainability assessment and SES analysis requires case studies that represent the key European farming systems, and provide sufficient basis for learning lessons about possible strategies for overcoming barriers to these farming systems transitioning towards agro-ecological farming systems.

This deliverable presents the discourse and design of the farming systems typology suitable for UNISECO, the process and results of the case study selection, and the process and key results of the consultation on both activities with the EU Multi-Actor Platform (MAP).

The UNISECO typology of AgroEcological Farming Systems (AEFS) will provide a theoretical and operational overview of the diversity of farming systems across the EU. The draft typology has been supporting the selection of case studies, and when analysed in the other Work Packages it captures the diversity of farming systems and innovative agro-ecological approaches in Europe. A typology has been developed based upon: i) a review of literature of trends and drivers of different eco-functional intensification paths across the EU (Section 2), and ii) feedback from the consultation of local and EU level stakeholders via the Multi-Actor Platforms (MAPs; Section 5).

The review has been used to design a typology of AEFS, which combines farming systems and agro-ecological approaches, reflecting key characteristics of agro-ecological farming such as low inputs and high labour intensity. The process of developing a typology has been undertaken in parallel, and informed, the case study selection process. The proposed typology combines dimensions of size, intensity, land use and specialisation with implemented agro-ecological approaches (Section 2).

The transition from conventional to agro-ecological farming represents a complex process of change. A Social-Ecological Systems approach was chosen as an assessment framework for the case studies because the aim is to increase understanding of complex transition processes, and to inform the development of strategies that could supporting such transitions. For this purpose the case studies need to provide a good representation of European farming systems and a rich source for learning about the transformation process (e.g. its barriers and drivers). Section 4 describes the principles and the approach of the case study selection process. A brief overview of case studies is presented in Section 4.6, and the results of the consultation process with European MAPs are summarised in Section 5.2.

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2. REVIEW OF TYPOLOGIES FOR FARMING SYSTEMS AND AGRO-ECOLOGICAL APPROACHES

The review aims to identify the different farm and farming typologies used by other projects, which can inform the creation of an AEFS typology for UNISECO. The nature of the assessments conducted within UNISECO require the flexibility to compare farming systems based on different agro-ecological approaches or practices used by farmers to move towards more sustainable agriculture as well as the socio-ecological context in which they are operating.

2.1. Method of Literature Review

The title, abstract and keywords of journal papers recorded in the SCOPUS and Web of Science literature data base were searched using different AEFS related words with a view to reporting on typologies of (agro-ecological) farming systems. The results were narrowed to references relating and relevant to the European context only, and addressing farming systems in general. The review focused on studies that address typologies and the process of change, and not on studies of individual productions systems, although some of these were included. Results from relevant EU projects (in particular SEAMLESS and PEGASUS) have also been included.

2.2. Definitions

General definition of a farming system

The FAO defines a farming system as '… a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate. Depending on the scale of the analysis, a farming system can encompass a few dozen or many millions of households.' (Dixon *et al.*, 2001).

However, given the high level of diversity within and between farming systems, Giller (2013) questions whether farming systems should consider the diversity of farm enterprises rather than 'broadly similar' nature of farms. He argues that farm systems exhibit varying degrees of interdependency and interact in their use of common property resources. For UNISECO, which aims to assess the sustainability of different farming systems, the FAO defintion is commonly used. However within the context of the SES framework, Giller's suggestion to define farming systems may be a valuable alternative worth considering for UNISECO.

Definition of Agro-ecology and Agro-ecological Farming Systems

Currently, there is no widely agreed definition of agroecology, or official standards as there are for organic farming. Consequently, there are many different interpretations of the concept (FAO, 2017). For UNISECO, definition adopted is that of the Association of Agroecology Europe (www.agroecology-europe.org): *"Agroecology is considered jointly as a science, a practice and a social movement. It encompasses the whole food system from the soil to the organization of human societies. It is value-laden and based on core principles. As a science, it gives priority to action research, holistic and participatory approaches, and transdisciplinarity including different knowledge systems. As a practice, it is based on sustainable use of local renewable resources, local farmers' knowledge and priorities, wise use of biodiversity to provide ecosystem services and resilience, and solutions that provide multiple benefits (environmental, economic, social) from local to global. As a movement, it defends smallholders and family farming, farmers and rural communities, food sovereignty, local and short marketing chains, diversity of indigenous seeds and breeds, healthy and quality food."* (Wezel *et al*., 2018).

There are six of ecological principles for the design of AEFS which are biodiverse, energy efficient, resource-conserving and resilient farming systems (Altieri *et al.,* 2017). To fit these principles an AEFS must:

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i) Enhance the recycling of biomass;
ii) Strengthen the agricultural system through enhancing functional biodiversity;
iii) Provide the most favourable soil conditions by managing organic matter and enhance soil biological activity;
iv) Minimise losses of energy, water, nutrients and genetic resources;
v) Have a spatial and temporal diversity of species and genetic resources at field and landscape level;
vi) Enhance beneficial biological interactions and synergies among the agro-diversity.

However, agro-ecology as a practice is defined more broadly "*... based on sustainable use of local renewable resources, local farmers' knowledge and priorities, wise use of biodiversity to provide ecosystem services and resilience, and solutions that provide multiple benefits (environmental, economic, social) from local to global.*" (Wezel *et al.*, 2018).

A recent review of agroecology in Europe illustrates that the concept is used in different ways. Some authors consider the concept to be more of a science than a practice, and that agroecology as a social movement is limited (Gallardo-López *et al.*, 2018). Based on the results of their review, the authors identify four different scales for the analysis of agroecology, repeated below:

1) The scale of the farming system, which relates to the physical and biological factors and form a first level of analysis;
2) The scale at which the agroecosystem is used in a systems approach, which includes ecological, social and political aspects;
3) The regional scale is an intermediate scale between the agroecosystem and the food system, using a landscape and interdisciplinary approach to integrate agricultural and non-agricultural activities. The review identified different aspects at this scale (natural resources; socio-economic impacts; sovereignty; and human activities) which are forces in the process of progress towards sustainable agriculture.
4) The scale of the agri-food system which focuses on food security and sovereignty more broadly.

The analysis of agroecology in Europe illustrates that there are clear overlaps with the concept of SES. Wezel *et al*. (2018) argue that agroecology is a transdisciplinary, participatory and action-oriented approach which, as a movement, has the potential to transform food systems. However, there are a number of actions required including: developing a common understanding of agroecology; enhancing education and knowledge exchange; investing in research; developing policies to enhance agroecology; supporting agro-ecological practices and farms; transforming the food system; and, reinforcing communication and alliances. The work programme of UNISECO addresses several of these identified needs, informed by the literature review.

2.3. Results From Literature Review

2.3.1. Development of farm typologies in the EU

An early European Farming typology based on FADN data was developed in 1985, to classify and compare holdings by their main source of income. That typology has 8 farm types (Table 1) at the highest of four hierarchical levels. Its main purpose is strictly economic with a focus on industrialised agriculture (Andersen *et al*., 2007).

The impact of industrialised agriculture on the environment has driven the development of alternative practices and farming systems that aim to reduce negative impacts on the environment and to be more sustainable. These alternative approaches to agriculture are often referred to as low input farming systems as they consider ways to reduce the reliance of high external inputs by conventional farming systems. Farmers have adopted a range of different strategies to achieve this goal, which are referred to as low input

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farming and include organic farming, high nature value farming as well as a range of agro-ecological approaches (Biala *et al*., 2008).

Table 1: European Farming Typology, FADN General TF (Decision 85/377/EEC, 1985; (Andersen et al., 2007))

Code	Name
1	Specialist field crops
2	Specialist horticulture
3	Specialist permanent crops
4	Specialist grazing livestock
5	Specialist granivore
6	Mixed cropping
7	Mixed livestock
8	Mixed crops-livestock

A number of approaches have been used to develop a desciption of farms with typologies which can integrate aspects of environmental impact and levels of sustainability. They have evolved from typologies for specific groups of farms (e.g. European Livestock Policy Evaluation Network (ELPEN), Table 2; (Andersen *et al.,* 2007), two typologies of:

i) farms with High Nature Value (HNV) farmland (Table 3) (Keenleyside *et al.*, 2014; Sullivan *et al*., 2017);
ii) farming systems that extend the concept to broader bio-physical regions/agricultural landscapes (Malek and Verburg 2017; Andersen 2017), that include agro-ecological approaches, to more complex systems such as food systems (Hatt *et al*., 2016) and socio-ecological systems, i.e. SES (Therond *et al*., 2017).

Table 2: A typology for livestock farms developed by ELPEN (> 50% production value from grazing livestock (Andersen, 2017)

Variables	Classes
Grazing livestock sectors (dairy, mixed and meat)	Cattle, Grazing cattle, Sheep, Goats
Size (in livestock units LU) grazing livestock	Small scale <20 LU, Medium scale 20-100 LU, large scale > 100 LU
Intensity (input cost)	Low input (<150 euro/ha), medium input (150-600 euro/ha), high input (>600 euro/ha)
Land use (% grass in total UAA, LU per ha and grazing outside UAA)	Off farm grazing, off farm produced fodder systems, permanent grassland systems, grassland systems, arable systems

Table 3: EEA HNV types

Type 1	Farmland with a high proportion of semi-natural vegetation
Type 2	Farmland with a mosaic of low intensity agriculture and natural and structural elements such as field margins, hedgerows, stonewalls patches of woodland or scrub, small rivers etc.
Type 3	Farmland supporting rare species or a high proportion of European or world populations

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The review papers by Therond *et al.* (2017) and Wezel *et al*. (2013) provide a valuable basis for UNISECO and the development of its AEFS typology. They outlined the development of typologies in recent years, illustrating those that include environmental and socio-economic aspects of a farming systems, and consider the wider context/setting of farming system.

2.3.2. Typology of farms in agricultural landscapes

The typologies of farming systems have evolved based upon the experience with earlier typologies. The SEAMLESS project extended the original economic based EU classfication into an environmentally based EU farm typology covering all farms by including two additional dimensions of land use and intensity (Andersen *et al.*, 2007). SEAMLESS extended the farm systems typology based upon: i) farm size, intensity and land use/specialisation (

Table 4 4); ii) agro-environments and suitability for agriculture based upon bio-physical regions/agricultural landscapes; iii) socio-economic regions based on population density, employment and income (van Ittersum *et al*., 2008). It recognises the importance of territorially based agriculture in the demand for sustainable intensification. Patterns of these farming systems (i.e. agricultural component of landscapes) have been mapped for Europe by means of a cluster analysis of dominant farm types by farm size, intensity and land use (Andersen, 2017).

Table 4: Dimensions of SEAMLESS typology

Intensity Dimension	
Low intensity	Total output (= total value of agricultural products produced) per ha < 500 Euros
Medium intensity	Total output per ha >= 500 and < 3,000 Euros
High intensity	Total output per ha >= 3,000 Euros
Land Use Dimension	
Land independent (1)	Agricultural area UAA = 0 or livestock units per ha >= 5
Horticultural (2)	Not 1 and >= 50% of UAA in horticultural crops
Permanent crops (3)	Not 1 or 2 and >= 50% of UAA in permanent crops
Temporary grass (4)	Not 1, 2 or 3 and >= 50% of UAA in grassland and >= 50% of grassland in temporary grassland
Permanent grass (5)	Not 1, 2, or 3 and >= 50% of UAA in grassland and < 50% of grassland in temporary grassland
Fallow land (6)	Not 1, 2, 3, 4, or 5 and >= 12.5% of UAA in fallow
Cereal (7)	Not 1, 2, 3, 4, 5 or 6 and >=50% of UAA in cereal
Mixed crops (8)	Not 1, 2, 3, 4, 5, 6 or 7 and <25% of arable crops in specialised crops
Specialised crops (grain maize, potatoes, sugar beet, hops, soya, tobacco, medicinal plants, sugar cane, cotton, fibre lax, hemp, mushrooms, vegetables in open, flowers in open, grass seeds, other seeds) (9)	Not 1, 2, 3, 4, 5, 6, 7 or 8

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2.3.3. Typology for farms with HNV

With the introduction of the concept of High Nature Value farming, the typology for farms with HNV emerged as one of the first typologies to include non-productive elements. Sutherland *et al*. (2017) introduced the extent of these non-productive elements within their typology.

For the HNV typology a HNV farm (HNVf) is defined as a combination of HNV farmland (i.e. the presence of particular land cover types/patterns) and HNV farming systems (i.e. HNV farmland and practices). A farm can be one of three HNV farmland types and either a whole or partial HNVf (Keenleyside *et al*., 2014). Sullivan *et al*. (2017) advanced the Keenleyside typology, using 6 clusters created by Principal Component Analysis for Type 1 HNV farmland (i.e. farmland with a high proportion of semi-natural vegetation) in Ireland. They created an additional tier, based on the size of the farm and the use of common land (Table 5). The spatial diversity of crop and non-crop habitats is a means of creating benefits both at local and landscape level (Hatt *et al*., 2018).

Table 5: Typology of High Nature Value farming (HNV; Sullivan et al., 2017)

Type	Characteristics
Whole HNVf[1] - whole HNVf farms with no common land	Very high semi-natural habitat cover (~75%) Low stocking density (Avg 0.58 LU/UAA) Very high proportion of Natura 2000 land (~85%) High semi-natural grassland cover (~30%) None of the farm is made up of common land
Whole HNVf - small farms	Very high semi-natural habitat cover (~80%) Low stocking density (Avg 0.50 LU/UAA) High field boundary density (~270m/ha) Medium proportion of Natura 2000 land (~50%) High peatland cover (~60%) Medium proportion of the farm is made up of shares in common land (~45%)
Whole HNVf = large farms	Almost total semi-natural habitat cover (~90%) Very low stocking density (0.32 LU/UAA) High proportion of Natura 2000 land (~65%) Very high peatland cover (~80%) Medium proportion of the farm is made up of shares in common land (~45%)
Whole HNVf = common land farmland with intensively farmed land	High semi-natural habitat cover (~70%) Low stocking density (0.69 LU/UAA) High proportion of Natura 2000 land (~70%) High peatland cover (~60%) High proportion of the farm is made up of shares in common land (~60%)
Partial HNVf	Medium semi-natural habitat cover (~55%) Low stocking density (0.69 LU/UAA) Low proportion of Natura 2000 land

[1] HNVf = combined concept of HNV farmland (presence of particular land cover types/patterns) and HNV farming systems (HNV farmland and practices)

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Type	Characteristics
	(~30%) High semi-natural grassland cover (~20%) Low proportion of the farm is made up of shares in common land (~10%) High field boundary density (~210m/ha) High cover of semi-improved grassland (~10%)
Remnant HNVf	Low-medium semi-natural habitat cover (~30%) Medium stocking density (1.48 LU/UAA) Low proportion of Natura 2000 land (~30%) High field boundary density (~195m/ha) Medium semi-natural grassland cover (~15%) Low proportion of the farm is made up of shares in common land (~5%)
Aggregate HNVf - not in Keenleyside *et al.* (2014)	Farms in this category form small components of larger landscape-scale features. In this case it is a floodplain but it could apply to eskers, lake edges, coastal fringes etc. Semi-natural habitat cover can vary but it is always a component of a larger intact landscape feature e.g. the Shannon floodplain

2.3.4. Typology of AEFS practices

Many different farming practices have been developed to reduce the environmental impacts of conventional farming practices. Modifications to standard or conventional practices could lead to an agro-ecology approach. AEFS practices are based on the set of principles of agro-ecology (see Section 2.2), different ways of which they can be described are presented below.

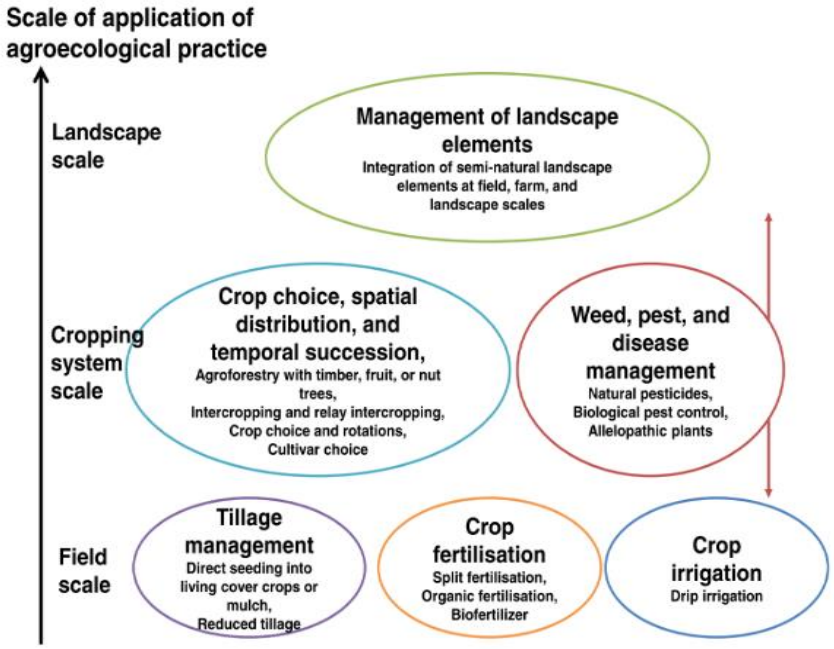

Figure 1: Agro-ecological farming systems (Wezel et al., 2013)

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AEFS practices by spatial and temporal design

Wezel *et al.* (2013) illustrate that AEFS practices can be classified by the scale of their application (Figure 1). They show that field level practices relating to soil and water management can reduce demand for external inputs, but that the extent of their impact is limited. At cropping system level, practices relate to the spatial and temporal distribution of selected crops as well as weeds, pests and disease management. At this level there is scope to use AEFS which will benefit the environment and the resilience of the farming system. At the landscape level, these practices lead to the integration of semi-natural landscape elements in farming systems, and in turn to an increase in biodiversity.

AEFS practices and an Efficiency, Substitution and Redesign framework

When considering the pathway from conventional farming to agro-ecological farming systems, farming practices have been described by the impact of the practice on the farming system. An Efficiency, Substitution and Redesign (ESR) framework was created to classify farming practices, which improve the sustainability of farming systems (Hatt *et al*., 2016).

Compared to the scale-based typology created by Wezel *et al*. (2013) the emphasis of Hatt *et al.* (2016) is on modifications that can be made to the farming practices without a structural redesign of the farming system.

- Increase efficiency and substitution of agro-ecological practices:
  - Crop choice, crop spatial distribution and temporal succession
  - Crop fertilisation management
  - Crop irrigation
  - Weed, pest and disease management
- Redesign of agro-ecological practices
  - Cover crop/green manure
  - Temporal succession of crops
  - Spatial distribution of crops, intercropping and agroforestry (Bybee-Finley and Ryan, 2018)
  - Weed, pest and disease management, use of allelopathic plants
  - Tillage management
  - Management of landscape elements.

AEFS practices and biodiversity

Biodiversity is a key component of the creation of AEFS practices. According to (Hatt *et al*., 2016) there are different ways in which the integration of biodiversity into agricultural practices can take place through:

- Planned biodiversity, i.e. biodiversity introduced by the farmer
- Associated biodiversity, i.e. biodiversity unintentionally introduced into the agroecosystems
- Landscape biodiversity, i.e. the integration of biodiversity through the structure and composition of the surrounding environment.

Spatial diversification is an important factor in the integration of biodiversity within farming systems. Hatt *et al.* (2018) show the impact of the integration at farm and landscape levels and the relationship to the farm practices that support this integration which are:

- Management - tillage, rotation, fertilisation and cutting methods (frequency);
- composition - species diversity and habitats diversity (crop-non-crop);
- design - spatial and temporal arrangement of non-productive areas.

2.3.5. Typology of farms in context of ESS and SES

Recently the role of agriculture in the context of ecosystem services has driven the demand to extend the typologies of farms. The discourse has moved towards the definition of farming systems (Giller, 2013), and

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starting to consider a farming system as a complex socio-ecological system which is a part of the food system. This is driving a range of different approaches/practices that aim to create more sustainable agriculture (Therond *et al.*, 2017).

Therond *et al.* (2017) identify 3 main biotechnical types of farming systems based on their broad approaches/strategies to farming that have unique objectives:

1) Chemical input-based farming systems
   a. specialised farms with standardised practices in simplified crop sequences based on external chemical inputs;
   b. the main objective is to increase input efficiency and decrease pollution which is often associated with "sustainable intensification";
2) Biological input-based farming systems
   a. specialised farms with standardised practices in simplified crop sequences based on external biological inputs;
   b. the main objective is to decrease impacts on biodiversity and human health by replacing some or all chemical inputs with biological inputs ("ecological intensification");
3) Biodiversity-based farming systems
   a. diversified farms with site-dependent agro-ecological practices in diversified crop sequences;
   b. the main objective is to develop and manage biodiversity to increase the provision of ecosystem services and to decrease external inputs, often associated with "agro-ecological intensification".

Overall, sustainble, ecological and agro-ecological intensification maybe helpful when distinguishing between farming systems. However, Wezel *et al.* (2015) conclude that the concepts should be used with care because the overlap between these three concepts can be the cause of confusion, and they urge that authors should explicitly state the definition to which they are referring and include reference to the underlying practices (Wezel *et al*., 2015).

Therond *et al.* (2017) recognise that, in addition to the biotechnical types, there are four broad socio-economical contexts in which farmers operate:

1) Globalised commodity-based food systems
2) Circular economies
3) Alternative food systems
4) Integrated landscape approaches.

2.4. Proposed AEFS Typology for UNISECO, for Discussion with Stakeholders

In UNISECO the aim is to define an AEFS typology that enables the differentiation between farming systems that have modified their management and practices away from conventional farming systems, and recognises farming systems as part of a wider socio-economic, institutional and political context. It also needs to address challenges that include consideration of the wide range of agro-ecological farming systems and practices across the EU.

The typologies described above are based on:

- agricultural production system
- size
- grazing density
- area of non-productive land /semi-natural vegetation
- farming practices
- biotechnical functioning
- socio-economic context.

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The range of typologies illustrates the complexity of describing and distinguishing farming systems which has led to questions about whether fixed typologies as the best approach (Padel *et al*., 2017).

There is a need for a flexible typology that is able to deal with the complexity within the farming systems, which have modified their management and practices away from conventional farming. This is largely because moving away from conventional farming can take place in a number of different ways that are more or less heavily based upon agro-ecological principles and practices, and that are best suited to the particular spatial context/location.

Ideally, a typology for UNISECO will be flexible, and able to represent a farming system with a unique combination of agro-ecological practicies that do, or do not, conform with established farming types (e.g. organic farming, conservation farming, etc.). It should include aspects of SES such as the position in the value chain, levels of cooperation, circular economy and governance, in addition to the extent of its agro-ecological design. Therond *et al.* (2017) made an important advance in assessing farming systems as a SES and developing a multi-dimensional approach to defining farming systems. Their biotechnical continuum from external outputs to Ecosystem Services aligns largely with the Efficiency, Substitution and Redesign framework, and can be seen as a continuum, however it is less well aligned to socio-economic contexts.

A three-dimensional system of typologies is proposed for UNISECO, to define farm production systems, AEFS practices, and the socio-economic (SES) context.

First dimension: It is proposed that the first dimension will build on the typologies commonly used for standard/conventional farming systems. This dimension provides an opportunity for integrating the emerging knowledge and understanding from UNISECO's sustainability assessment of a range of different farming systems and approaches into existing knowledge and European data bases such as FADN. This dimension is based on:

- production type – FADN classes
- size – outcome in Euro per ha
- land use
- livestock – density
- non-productive land.

S**econd dimension**: The second dimension will define the farming system by the AEFS practices at the three levels (landscape, farming system and field), as presented in Table 6.

This detailed matrix enables a range of different practices and approaches to be considered. The matrix proposed allocates practices of farming systems with respect to landscape, farming system and field levels, and an Efficiency, Substitution and Redesign approach.

A **third dimension** will be added to define the farming system based on the SES that reflect:

- existing markets
- level of cooperation
- role of policies in supporting agro-ecological practices
- presence of innovative policy tools
- key actors.

Initially, this third dimension will draw upon the biotechnical types defined by Therond *et al*. (2017). The results emerging from the SES assessment by UNISECO will be used to consider and inform the development of an alternative typology for this dimension. Until the evidence for alternatives emerge from UNISECO, Therond's typology will be used for classifying farming systems.

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Table 6 Agro-ecological practices with respect to field, farming system and landscape levels

	AEF practices	Chemical input-based		Biological input-based	Biodiversity-based
		Not Agro-ecological	Weak Agro-ecological		Strong Agro-ecological
		Conventional	Efficiency	Substitution	Redesign
Field level	Fertiliser management	chemical fertiliser	precision application chemical fertiliser	organic fertiliser	green manure
	Weed, pest and disease control	chemical control	precision application chemical control	natural pesticide; biological pest control	allolepathic plants; crop diversity
	Livestock feed and grazing practices	silage, concentrate feed	selecting animals with high feed-efficiency, adaptive feeding opportunities, intensive grazing on temporary grassland	use industry waste for feed; grass-fed livestock, grazing on temporary and permanent meadows	integrated livestock, extensive grazing on permanent meadows
	Tillage	standard tilling	reduced tillage	conservation tillage	no tillage
	Soil Management	erosion prevention measures	Soilless production (aggregate and substrate)	Steaming of soil; mulching	preserving soil-fauna and micro-fauna
	Water management	irrigation, drainage	target irrigation	crop selection for drought tolerance	water conservation
Farming system level	Crop selection	high yield	resistant to pest and diseases	inclusion of legumes; inclusion of cover crops	Inclusion of interdependent crops
	Crop spatial diversity	single crop	mixed variety	multiple/mixed crops	intercropping; agroforestry, permanent meadows
	Crop temporal diversity	simple /standard rotation	simple /standard rotation	rotation including legumes	wider/complex rotation
	Livestock density	high stocking rates	high stocking rates	reduced stocking rates	low stocking rates
	Livestock diversity	specialised	specialised	modified to make best use of local conditions to produce protein	livestock diversity and closely integrated with other farm activities
Landscape level	Biodiversity	linear features (buffer strips, beetle banks, hedgerows) - legislation	linear features (buffer strips, beetle banks, hedgerows) - legislation	linear features (buffer strips, beetle banks, hedgerows)	integrated biodiversity; preserving food webs
	Management landscape elements	large plots without hedges	small sized hedges (frequent partial cutting)	diverse hedges	diverse and numerous semi-natural habitats

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UNISECO will start the case study activities using the proposed typology with its three dimensions as described above. Figure 2 illustrates the 3D typology for UNISECO based on the summary descriptions of its case studies.

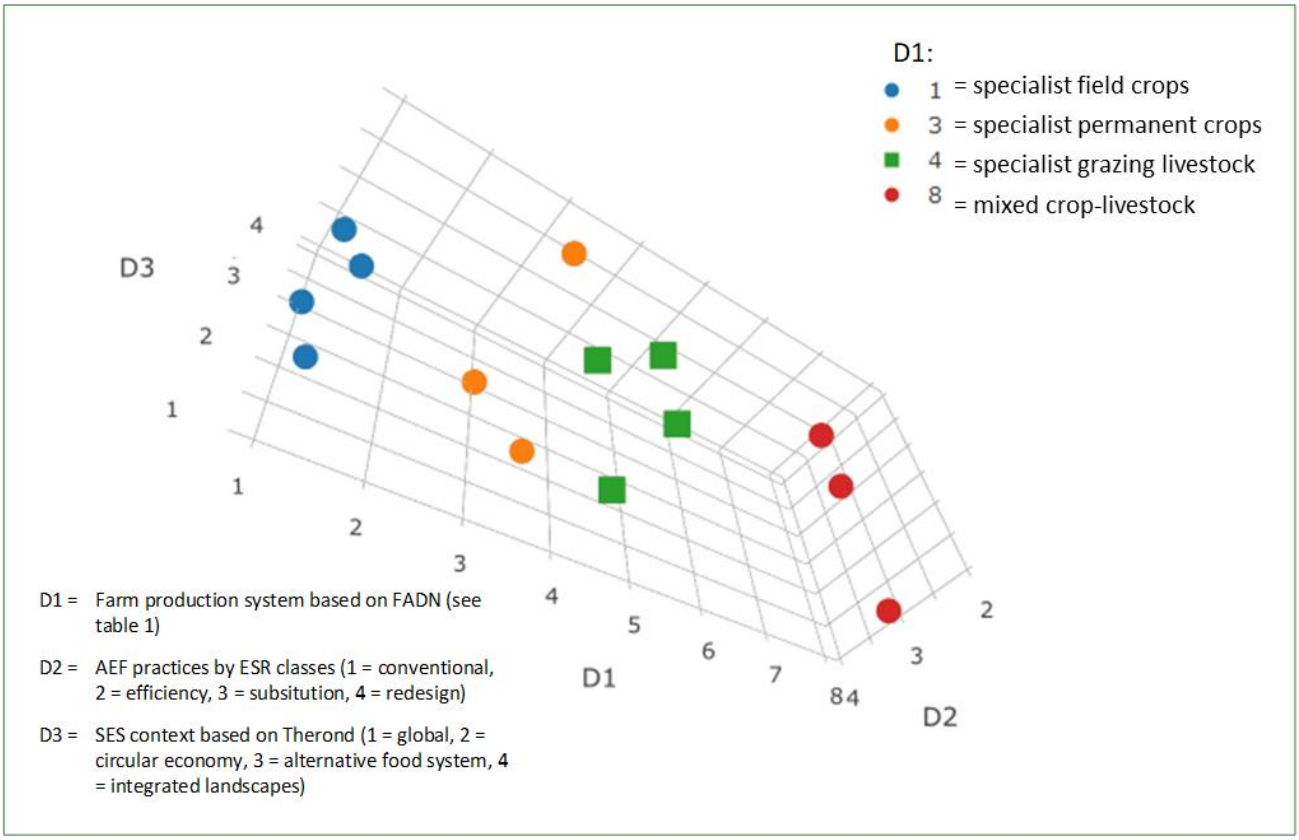

Figure 2: Proposed UNISECO 3D AEFS typology

The proposed AEFS typology for UNISECO was presented to, and discussed with, UNISECO partners during the full partner meeting, Venice, November 2018. There, it was agreed that the proposed typlogy provided a good starting point, recognising that it will evolve over the life-time of the project. This will enable development of the third dimension based upon the results that emerge from the work in the case studies and related analysis.

The process of selecting case studies will take account of all three dimensions when considering representation of: i) a diversity of farming systems; ii) diversity of agroecological pratices; and iii) a diversity of socio-economic/institutional farming system "contexts".

A formal consultation has taken place with newly recruited members of the EU MAP to consider and incorporate the views of EU level stakeholders into development of the typology. The description of the consultation process and its outcomes is reported in Section 7.

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3. TRENDS AND DRIVERS OF DIFFERENT ECO-FUNCTIONAL INTENSIFICATION PATHS ACROSS THE EU

3.1. Literature Review

During the review of literature undertaken for creating the typology of farming systems papers were identified of relevance with respect to trends, drivers and the transition towards sustainability. These have been used in a 'snow-ball' approach to identifying additional papers, particularly about transition or intensification pathways.

This approach to the review identified a number of scientific review papers which address transitions towards sustainable and biodiversity-based agriculture that consider the possible type of transitions (Duru *et al.*, 2015a), and options for the intensification of agriculture to meet the growing demand for food and food-security (Wezel *et al.*, 2013; Mahon *et al.*, 2017). The emergence of conceptual frameworks such as ecosystem services (ESS) and socio-ecological systems (SES) have informed the evolution of agricultural systems towards sustainable food systems (Hatt *et al.*, 2016). These reviews represent recent scientific discourse regarding complex systems, which has seen a shift in agriculture from production optimisation, to managing ecosystem services, to the development of resilient socio-ecological systems, landscapes and communities.

3.2. Drivers of Change

In recent years the loss of biodiversity and the resilience of farming systems in the face of climate change and growing demand for food production and food security are driving a search for alternative models to that of conventional farming (i.e. alternatives to high input farming). This poses important challenges to farming systems. Fisher *et al*. (2017) have illustrated these challenges with four archetypal farming systems (intensive agriculture, degraded landscapes, fortress conservation, agro-ecology) using hypothesised socio-ecological features, drivers and feedbacks.

3.3. Transition of Farming Systems

The redesign of farming systems towards greater sustainability, based on the principles of agro-ecology, is linked to the wider benefits to ecosystem services they can provide (Altieri *et al*., 2017). Agro-ecological transitions can benefit from the integration and consideration of ecosystem services (Dendoncker *et al*., 2018), which could change the role of farmers in agricultural intensification (Caron *et al*., 2014). The transformation of farming systems into AEFS means adopting agro-ecological principles, practices appropriate for both productive and non-productive land, and approaches to the redesign of systems, which combined improve the properties of sustainability (Bonaudo *et al*., 2014).

Based on a review of agroecological cropping practices three strategies for a transition towards sustainable agriculture have been identified: **efficiency increase**, which reduces input consumption and improves crop productivity; **substitution of chemical for natural inputs;** and, **redesign** which changes entire cropping or farming systems (Wezel *et al*., 2013).

The design of agro-ecological transitions in farming, uses the integration of three conceptual analytical frameworks (farming system, socio-ecological system and socio-technical system) to develop a five step participatory methodological process (Duru *et al.*, 2015a). The transition towards biodiversity-based agriculture progresses along a continuum of ecological modernisation from efficiency/substitution-based agriculture to biodiversity-based agriculture (Duru *et al.*, 2015b).

The conceptualisation of a transformation pathway for niche/local practices towards sustainability is based upon the time and nature of the multi-level interactions experienced *en route* to technological substitution

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and reconfiguration (Geels and Schot, 2007; Geels 2010). This conceptualisation of transition dynamics is illustrative of the way local practices can change towards sustainability through opportunities to introduce innovation into the "socio-technical regimes"of markets, industry, policy, culture, science and technology. One example of the development of niche trajectories for sustainability transitions in an agri-food system is presented by Bui *et al.* (2016).

3.4. Intensification

Definitions

Wezel *et al.* (2015) discuss the definitions, principles and practices of ecological, sustainable and agro-ecological intensification reported in the literature. All three of these types of intensification have a common aim of increasing production whilst minimizing the impact on the environment. Each type has a different emphasises such as on ecological processes and ecosystem services (ecological intensification), natural resources/capital (sustainable intensification), and social and cultural perspectives using a systems approach (agro-ecological intensification).

Wezel *et al.* (2015) conclude that there is confusion in the literature between agro-ecological, ecological and sustainable intensification. This could be due to the reported reference to forms of ecological intensification in the development of the concept of both sustainable and agro-ecological intensification. Based on their review Wezel *et al.* (2015) propose the following definitions:

> Sustainable intensification: producing more from the same area of land while conserving resources, reducing negative environmental impacts and enhance natural capital and the flow of environmental services;
>
> Ecological intensification: increasing food production while reducing the use of external inputs and minimising negative effects on the environment by capitalising on ecological processes and ecosystem services from plot to landscape scale;
>
> Agro-ecological intensification: improving the performance of agriculture while minimising environmental impacts and reducing dependency on external inputs through integration of ecological principles into farm and sytems management.

Practices

A broad range of practices have been identified as being used to develop intensification. Those identified in the review by UNISECO are:

- mixed cropping systems, diversified crop rotations, use of cover crops, direct-seeding and mulch-base cropping;
- conservation tillage, minimizing soil compaction and detoxification (Bilandzija *et al*., 2016);
- integrated pest management (Brzozowski and Mazourek, 2018; Zhao *et al*., 2016);
- improved fertiliser and nutrient management (Chen *et al*., 2018);
- biodiversity preservation and promoting of allelopathic effects (Cheng and Cheng, 2015)
- use of legumes, cover crops and catch crops in rotation;
- soil conservation;
- mulching, intercropping, crop rotation and integrated soil and nutrient management;
- Soil and water conservation;
- Use of organic input with balanced/more efficient use of fertiliser.

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Agro-ecological transitions

Agroecological transition is the development of territorial biodiversity-based agriculture (Wezel *et al.*, 2016). A four step approach towards agro-ecological transitions has been developed by Dendoncker *et al.* (2018), based on integrated assessment of Ecosystem Services. Those steps are:

1) Development of a shared systemic approach;
2) Exploration of potential to evolve the system;
3) Selection of acceptable pathways of change;
4) Collective proposal and implementation of change.

Transformation pathways for AEFS in context of SES have been identified by Hubeau *et al.* (2017), with 10 strategies, numerous actions, and seven shared transition pathways, listed below:

1) Prevention - stimulate experiments on radical innovations;
2) Adaptation - incremental innovation to increase efficiency and resilience of the agri-food system;
3) Restoration - the maximal closing of mineral cycles;
4) Restoration - establish equitable relationships by knowledge and information exchange and increased transparency;
5) Restoration - increase community involvement and social well-being;
6) Reduction – reduce the use of the scare resources and increase the use of renewable resources;
7) Reduction - stimulate co-creation of knowledge of sustainability practise in the agri-food system.

UNISECO is exploring different possible transition pathways for farming systems from the conventional towards agro-ecologocial and sustainable agriculture (Figure 3). Through the identification and assessment of different transition pathways (Work Packages 3 and 4) UNISECO is examining the key barriers and drivers for farmers to adopt more sustainable practices in the context of governance innovation (Work Package 5).

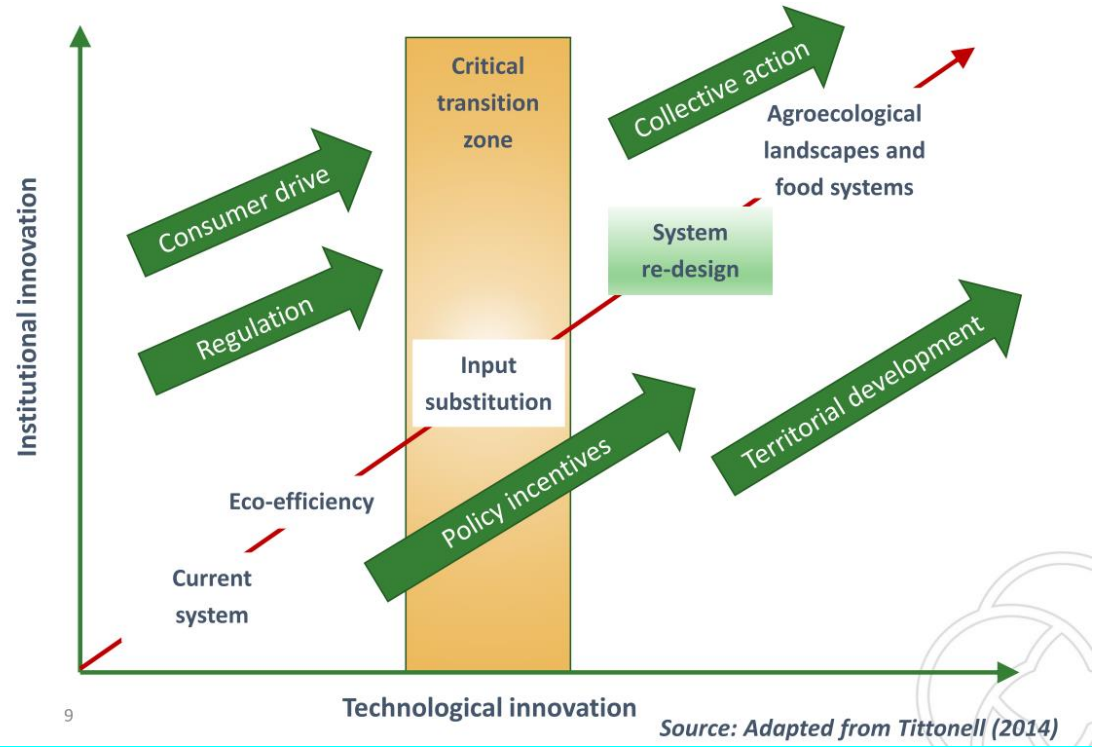

Figure 3: Incentives for agro-ecological transitions (adopted from Tittonell, 2014)

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4. CASE STUDY SELECTION

4.1. Introduction

The aim of the process of selecting case studies is to provide a basis for creating insights to the factors of a successful transition of farming systems towards AEFS. To fulfil this aim, it was necessary to ensure a representation of typical farming systems in the EU whilst also providing a suitable diversity of farming systems in different stages of transition from conventional to AEFS. The case study selection process has been informed by the proposed typology of AEFS, developed in parallel.

The selection of case studies is also informed by the Social-Ecological Systems (SES) approach. This is to enable a qualitative assessment of the transition dynamics of farming systems towards agro-ecological farming. In order to get a sufficiently diverse set of case studies for UNISECO, selected variables from the SES approach have been used as characteristics to be used for the case studies.

Based upon these different perspectives, a final set of characteristics for case studies was identified. These were used for the initial description of each case study, and as the basis for subsequent steps in the process of selecting a final set of case studies. However, consideration was given to the number of such characteristics required to cover the range of situations whilst keeping the number manageable. Given the limitations on the final number of case studies which will be carried out in sufficient depth, some specific production types (e.g. the diversity of horticulture crops) could not be included in the final selection.

4.2. Selection Process

At the Kick-off meeting of UNISECO the core steps of the selection process were agreed, and guidance to partners drafted, discussed and agreed. The process for selecting case studies is described in following steps:

1. Formulation of the purpose of the case studies, and guidance for their description using defined characteristics.
2. Selection and description of two to three candidate case studies per partner country, in consultation with local stakeholders and based on the defined characteristics.
3. Review of the candidate case studies by the team in Work Package 2 with respect to the extent to which they cover European farming systems, and whether they are likely to provide sufficient materials to answer the project research questions.
4. Provision of guidelines to project partners to refine the selection to a single case study per partner country.
5. Consultation with local stakeholders to agree the final case study selection for partner countries.
6. Consultation members of the EU level MAP regarding the process and final selection of case studies.
7. Final selection of UNISECO case studies.

The selection process includes three steps of stakeholder involvement (two at the level of the partner countries and one at EU level). National and regional stakeholders were consulted by project partners on the topic of identifying potential case studies. After the review of the candidate case studies and the identification of selection priorities, the national and regional stakeholders were consulted again on the selection of a single candidate case study per partner country. Across the partner countries this consultation at national level was an influential factor in the selection of the final case studies.

Partners documented (for internal use) the selection process including consultations with stakeholders (i.e. brief description of the meetings, opinions expressed by stakeholders, and how agreement was reached). The selection process was developed using the expert knowledge of key informants (e.g. advisors, farm representatives), rather than relying upon a survey to collect data for each of the characteristics and dimensions. Therefore, it was necessary to define robust, simple, and easily understood set of characteristics for partners to describe the candidate case studies.

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4.3. Guidance to Partners for Describing the Case Studies

Guidance for describing case studies was provided to partners. It required a brief overview of the purpose of the case study, the research questions, description of the case study selection process, and a template for the collection of the characteristics and description of the case studies. The template was populated with examples of a draft response (Appendix 1). The selection criteria are:

- **General description**:
  - Geographic coverage and size of case study area
  - Farm production type
  - Agro-ecological approaches / practices currently applied in the farming systems
  - Dilemma to be addressed in the case study and natural resources potentially impacted
- **Key SES variables [or key aspects] of sustainability assessment**
  - Institutional settings
  - Socio-cultural settings
  - Key value chain issues
  - Demographic characteristics
  - Gender issues
  - Data availability and access
- **Characterisation of the existing farming systems**
  - Area of case study
  - Existing markets
  - (Expected) new agro-ecological approaches / practices to be assessed
  - Level of experience with implementation of agro-ecological approaches / practices
  - Level of cooperation in the case study area
  - Presence of formal networks
  - Key role of policies in supporting the initiative
  - Presence of innovative policy tools
  - Key actors

A case study could consist of two groups of farms (intensive and AEFS) and correspond to two SESs. Or, there could be one group of farms analysed with the aim of increasing understanding of the dynamics of transformation from one farming system to AEFS (therefore, only one SES is studied).

The description of the case study size should be congruent with level of cooperation. If there is no cooperation and individual farmers operate only in the wholesale market, then the characteristic size of the case study is the number of farmers. However, if a collective action governs the system then the size of the case study should conmprise the number of other actors involved in addition to the number of farmers.

The initial collection of characteristics and description of a case study may need confirmation with key informants before its completion. In some cases, the description of the case study area and its borders are based upon geographical boundaries, but include actors with headquarters outside these geographical boundaries.

Overall, the case studies should provide UNISECO with:

- a **good overview of production types** of farming systems across of EU; and
- a **good overview of levels of cooperation,** so there should be a representation of collective actions in some of the case studies.

The inclusion of both successful actions and failures in transition to AEFS would also be of value, helping in the investigation of the dynamics of the change.

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4.4. Analysis of Characteristics of Candidate Case Studies

After the descriptions of candidate case studies were completed, they were analysed to assess their representation of the diversity of European farming systems, and their contribution to improving our understanding of drivers and barriers of transitions to AEFS.

Case study characteristics were highlighted which were considered important for answering the research questions of UNISECO. During the selection process those case studies with such characteristics were prioritised for inclusion in the final set, ensuring the presence of examples of unusual or rare characteristics and limiting those which are common across the set of candidates. In total, 42 candidate case studies were collected and their characteristics analysed. A simple matrix of case studies and characteristics was populated in MS Excel, and absolute and relative values of each characteristic recorded.

In Tables 7 and 8 the totals do not total the number of case studies (i.e. 42). This is because: i) details of characteristics were not provided in the descriptions of all of the case studies; ii) some case studies include more than one type of characteristic (e.g. in one case study there could be more than one farm production type present).

The candidate case studies covered the main production types in Europe. The number of each of the farm production types represented within the candidate case studies is shown in Table 7. The selection process took account of risks of omitting an important farm type, and of maintaining the distribution across the range of farm types.

Table 7: Coverage of farm production types (number of case studies)

Arable general	Arable - specific crops	Beef/ sheep/ goats grass based	Milking cows on grass	Beef/ dairy mainly on arable land	Pig/ poultry	Mixed (also with grassland)	Permanent crops	Horti-culture	Bee-keeping
10	1	4	8	5	1	8	9	6	1

Amongst those case studies 22 are region-based, 9 are network-based, and 4 are a combination of region and network-based. In most cases, network-based studies are in production farm types distributed across the partner country. In several cases there are links between these farms (e.g. member of an association, common activities). Region-based studies are more suitable for the SES analysis than network-based case studies, therefore the proposed proportion of these two groups was maintained and no attention was paid to these characteristics during the final stages of the selection process.

Good quality data are available for most of the case studies. For only 3 case studies are the quality of available data reported as being poor. For a few case studies, there is some uncertainty reported with respect to data availability. Only three case studies have a limited number of farms in their areas (e.g. below 15 to 20 AEFS farms) as a basis for sampling. Both of these aspects have been taken into account in the final stages of the selection process.

Approximately half of the candidate case studies (15) were classified as currently being “conventional” farming systems with an expectation of the introduction of new agro-ecological farming practices. There are 24 case studies with examples of established AEFS and thus include already applied agro-ecological farming practices.

Most of the farms classified as AEFS (30 case studies) already have experience with agro-ecological farm practices, which is not a critical characteristic for the selection of a case study. However, an important factor for the transition to AEFS and for sustainability is the level of cooperation in the case study (and farming system). The number of case studies with existing collective actions in general is low. This is an important characteristic, so in the selection process case studies with such actions have been given priority in order to provide a good balance of case studies with different levels of cooperation.

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In a few case studies, farms are not part of formal networks. Five case studies were identified as "conventional" and only two AEFS case studies identified in which farmers are not part of any formal network. The guidelines indicated that, as a priority for the final selection process, some of these case studies would be included.

Table 8: Case study selection criteria (number of case studies)

		Conventional	AEFS
Use of inputs	Intensive level of inputs	27	
	Extensive level of inputs		28
Cooperation	No cooperation	12	7
	Good level of cooperation		17
	Collective action	4	10
Role of policies	Important	16	22
	Not important	14	13
Innovative policy instruments	Present	5	10
	Not present	19	17
Involvement of farmers in processing and sales	Key actors involved	18	17
	Actors involved up to processors	2	5
	Actors involved up to retailers	7	9

There is a low representation of innovative policy instruments, and more representation of AEFS in the candidate case studies. This could be an important source of better understanding of ways of facilitating the transition of farming systems towards AEFS. This has been an important characteristic in the final selection and discussions with actors.

The involvement of farms in processing and sales is an important characteristic. It could have a key role in the assessment of, for example, the adaptation of farming systems to pressures such as low prices for production, by adding value through processing or retailing the production. Table 9 shows the number of case studies which represent farming systems in which farms are involved in processing or sale. Such farms may be varied in relation to other characteristics (e.g. ownership, cooperation etc.). Lower numbers of cases with processing and higher with sales could be explained by direct sale/common sale (e.g. through cooperatives), or of low volumes of processed outputs (e.g. milk, vegetables, fruits).

4.5. Selection Priorities

Feedback on the review of case study characteristics was provided to partners, together with guidance for the final steps of the selection process. This was to narrow the options of candidate case studies to a single choice.

Some characteristics were not well represented in the candidate case studies, but are not considered crucial to the process of selection. Other characteristics are important for the assessment of different AEFS transition paths, and for the development of final recommendations for the facilitation of such transitions (e.g. level of cooperation, presence of innovative policies).

Characteristics deemed as most important, or for which there are very few examples included, have beentaken into account when providing feedback on preferences between potential case studies. This is important to ensure that the final portfolio of case studies is balanced. This feedback was provided in advance of the consultation with stakeholders on the final selection of a case study.

The following are important characteristics of the individual candidate case studies but were not used as specific criterion in the selection of the final set.

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- Gender issues (all selected case studies cover this criterion)
- Level of external inputs
- Data availability
- Number of farms in a case study (although important for a minimum sample)
- Experience with agro-ecological practices
- Farms as members of formal networks
- Importance of policies for the initiative
- Expected new farming practices
- Organic farming

The following are characteristics of the individual candidate case studies which have been used as specific criterion in the selection of the final set.

- Level of cooperation (important for SES assessment)
- Presence of innovative policies
- Presence of processing and involvement in marketing/sale
- Labour issues
- Production farm types

Those case studies which contain Collective Actions (representing a high level of cooperation), Innovative market and policies and processing/sale in the SES are presented in Table 9.

Table 9: Indication of presence of characteristics in candidate case studies

Case Study	Level of Cooperation	Innovative Policies	Processing/ Sale	Production Type
DE - Diepholz, Nienburg*		X		Arable, dairy mainly on arable
DE – Eifel*		X	X	Beef/dairy mainly on grass
IT - Chianti Classico*			X	Permanent crops – vine
IT – Piceno AETA***	X	X	X	Permanent crops
AT - Bio-Heu region**	X		X	Milking cows on grass
GR- Imathia**	X	X		Permanent crops
GR – Attica			X	Permanent crops, horticulture
FR – CUMA de la Pacaudiére**	X	X		Mixed
FR – CUMA de la Pollionay**	X	X		Beef/dairy on arable land
LT - Milk/cheese production*			X	Milking cows on grass
CH – Seeland			X	Horticulture
CH - Sempach, Sursee distr.*		X		Pig production
CH - Flaachtal*	X			Mixed farms
Fi – Nivala**	X		X	Milking cows on grass
FI - South Savo*			X	Beef/dairy mainly on arable
SE - OF Dairy*			X	Beef/dairy mainly on arable
ES - Basque Kolektiboa*	X			Arable
ES – Ebro valey*	X			Permanent crops, horticulture
CZ - OF dairy**	X		X	Dairy mainly on arable

Case study* – one priority characteristic exists
Case study** – two priority characteristics exist
Case Study*** – three priority characteristics exist

Using the priorities described above, the case studies can be grouped as:

- 4 with innovative policies;
- 6 collective actions;

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- 7 in processing or retailing.

To increase the number of case studies with innovative policies, the candidate from Switzerland of Sempach was preferred for inclusion. The final criterion considered was that of production types (Table 10).

Table 10: The last selection criterion is production farms type.

Case Study	Level of Cooperation	Innovative Policies	Processing/ Sale	Production Type
DE – Eifel*		X	X	Beef / dairy mainly on grassland
DE - Diepholz, Nienburg*		X		Arable, dairy mainly on arable land
IT – Piceno AETA***	X	X	X	Permanent crops
AT - Bio-Heu region**	X		X	Milking cows on grassland
GR- Imathia**	X	X		Permanent crops
FR – CUMA de la Pacaudiére**	X	X		Mixed
FR – CUMA de la Pollionay**	X	X		Beef/dairy on arable land
LT - Milk/cheese production*			X	Milking cows on grassland
CH - Sempach, Sursee district.*		X		Pig production
Fi – Nivala**	X		X	Milking cows on grassland
FI - South Savo			X	Beef/dairy, mainly on arable land
SE - OF Dairy*			X	Beef/dairy, mainly on arable land
ES - Basque Kolektiboa*	X			Arable land
ES – Ebro valey*	X			Permanent crops, horticulture
CZ - OF dairy**	X		X	Dairy, mainly on arable land

The identified combination of the characteristics Level of cooperation, Innovative policies, Processsing/sales and Production type provided the information and priorities for the next steps of the selection process. Proposed case studies were marked with asterixes (*) according to the number of these characteristics and it was possible to assess the balance of the production types of farms covered. The assessment was provided to partners as a guide in the stakeholder discussions in the final case study selection process.

Overview of priorities for selection by partner

Table 11 presents an overview of suggested case studies for discussion with national and local stakeholders. These materials were for use as an input to discussion with stakeholders, noting the importance of the factors listed when considering how the case study contributes to the goals of the project, and its relevance to EU wide issues. Proposed priorities to be addressed within the case studies are summarised in the right hand column.

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Table 11: Priorities for the process for selecting case studies

Partner (Country)	Case Study Proposal	Notes on Factors to Consider: Collective action (CA), Innovative Policies (IP), Processing/Sales (P/S)
TI (DE)	Two options: 1. EIFEL; 2. Nienburg	EIFEL: Processing/sales included, little arable land; Nienburg: more intensive and pressure on natural resources, result-based policy measures, arable land.
CREA (IT)	Piceno ETA	CA, IP and P/S present
FIBL (AT)	Bio-Heu-region	CA and P/S present
AUA (GR)	Two options: 1. Imathia; 2. Attica	1. CA and IP present, slightly preferred; 2. P/S present, but also covers horticulture which is rare in the candidate case studies; So either or both options could be selected.
HUT (UK)	Two options: 1. Mixed farming and general cropping; 2. horticulture (soft fruits)	Mixed farming and general cropping slightly preferred due to coverage of farm practices.
ISARA (FR)	Two options: 1. CUMA de la Pacaudiére 2. CUMA de la Pollionay	If only one case study chosen, then preference for CUMA de la Pollionaydue to its production farm system coverage. However, both examples could be included.
BEF (LV)	Two options provided. "Dairy" has slight priority	Each option has advantages 1. extensive/intensive milk 2. bee keeping as a rare production farm type Feedback: propose stakeholders "vote" on choice of option
BEF (LT)	Milk/cheese	Processing/sale
FIBL (CH)	Sempach	Evidence of IP present; slight priority Sursee or Seeland could selected as horticulture is rare in the candidate case studies.
GEO (HU)	Two options: 1. Heves; 2. Somogy	Arable, agro-ecological practices both options provide useful coverage, Preference for Somogy because it is more regionally based.
LUKE (FIN)	Two options 1. Nivala; 2. Savo	Nivala has slight preference - CA, P/S; Savo covers arable land.
SLU (SWE)	Organic dairy	P/S present
GAN (ES)	Kolektiboa	CA, arable, Organic and other AE practices present
WWF (RO)	Maramures/ Transylvania	Small mixed farms with which different levels of intensity and stage of transition to AEFS could be studied (P/S)
BIOINSTITUT (CZ)	Organic dairy	CA, P/S present

In the final step of selecting case studies, account was taken of the key characteristics amongst candidate case studies. The options narrowed progressively as decisions were made about each case until the final selection was complete.

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4.6. Case Studies Selected

This section presents results of the case study selection process (Table 12). Two case studies were selected for France, one of which was for the assessment of SESs only, and one in each of the other partner countries.

Table 12: The results of the process of selection of case studies, summarised by selected characteristics

Partner Country (scope)	Sustainability Issue (examples)	Farm Production Type	Agro-ecological Practices (examples)	Level of Cooperation	Involvement in Value Chain
Mixed Farming Systems					
UK (North-East Scotland)	Soil degradation, water pollution	Mixed farming (including general cropping)	Biodiversity supporting practice, nutrient budgeting	Strong	Cooperatives
Romania (Maramures Transylvania)	Economic viability, slowly increasing intensification	Mixed small-scale farming	Low intensity	Moderate	Direct sale, low processing
France (Auvergne Rhône Alpes region) Case study 1	Pesticide pollution, economic viability, food safety	Mixed small-scale farming,market gardening	Organic farming; fair access to agro-ecologically produced food for low income families	Strong	Direct sale
Permanent Crops					
Italy (Chianti Bio-district)	Nutrients and pesticide pollution, biodiversity	Permanent crops: vine production	Organic fertilisers, vegetation strips maintained, green manure	Strong	Direct sale, mostly through wholesalers
Greece (Imathia)	Pressures due to using agro-chemicals (on soils, water, biodiversity)	Permanent crops: fruit and vine production	Using alternative ways of pest control, nutrient management, biodiversity management	Strong (collective agri-environmental scheme)	Cooperatives (processing)
France (Auvergne Rhône Alpes region) Case study 2	Dependency on fertilisers, high pesticide use, low soil biology	Permanent crops (grapes)	Aiming to use green manure, reduction of pesticide use, combined cropping	Good level	Wine processing cooperative
Arable Land					
Spain (Basque country)	Environmental, social and economic viability	Grain production	Organic and practices beyond the certification standards	Strong	Short commercialisation channels
Austria (Ecoregion Kaindorf)	Water scarcity because of climate change, soil quality decline	Arable farming, pig husbandry	Soil fertility increase programme, CO_2 compensation certificates, agroforestry	Strong	Processors part of network
Germany, Lower Saxony	High pressure on ecological	Arable systems	Extensive margins, nutrient	Some co-operation	Poor direct involvement,

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Partner Country (scope)	Sustainability Issue (examples)	Farm Production Type	Agro-ecological Practices (examples)	Level of Cooperation	Involvement in Value Chain
	sustainability in general, biodiversity loss	(specialised and combined with livestock)	management, organic farming, cover crops, linear features	exists (e.g. multi-actor platform for biodiversity-friendly farming)	but generation of high added value
Czech Republic	Soil degradation	Mixed farms, focus on arable land	Soil protection practices	Low	No involvement
Animal Production (on Arable Land and Grassland)					
Latvia (country)	Economic viability and adding value	Fragmented dairy farming	Organic farming, extensive farming	Low	Poor
Lithuania (country)	Economic viability and adding value	Small dairy – cheese makers	Different levels of extensive grazing, low use of additional feed	Low to moderate	Processing and marketing cheese
Switzerland, lake Sempach region	Lake eutrophication, P increase in water, ammonia emissions	Intensive pig farming, grassland beef	Nutrient balance 100%, lake contract payments, organic farming	Low	Poor
Hungary Somogy	Soil degradation, water pollution, biodiversity on arable land	Mixed intensive farming	Winter cover crops, reduced till and residues left on soil	Low	Direct sale, mostly through wholesalers
Finland (Nivala region)	Carbon emissions, nutrient recycling	Dairy farms	Carbon and nutrient management using biogas plant	All farmers in processing cooperative	Processing cooperative
Sweden	Livestock contribution to climate change	Livestock farms	Diversification to legumes for human consumption	Poor	Low level of involvement

For further details of the case studies see Appendix 5.

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5. CONSULTATION PROCESS WITH EU MAP

5.1. The Process

The process of recruiting EU-level MAP members and the development of guidelines for the consultation process are reported in Irvine *et al*. (2019; D7.2). These guidelines include a set of questions which aim to develop and plan the consultation process (Appendix 2).

The consultations for the typology and the case study selection were planned to be undertaken separately. However, due to the very similar timeline for these two tasks it was agreed that the respective consultation with the EU level MAP would be organised as one. Accordingly, the documentation and questions were combined into one form.

The recruitment process for the EU-level MAP was not complete by the time the consultation on the typology was due. Therefore the conslutation was with the six members of the EU-level MAP who had already agreed to participate by the relevant time.

The preferred consultation format, i.e. a face-to-face workshop with members of the EU-level MAP, was not practical in the time available, therefore, it was undertaken as an email-based consultation. The members of the EU-level MAP were send a document with set questions aiming to elicit their feedback on the proposed approach to the AEFS typology and the case study selection, to be returned by email.

The approach to the typology was presented at a joint seminar of the UNISECO and LIFT projects, at DG AGRI in Brussels, 21st January 2019. This provided an opportunity for additional feedback from those present from DG AGRI and DG ENVIRONMENT.

5.2. The Feedback

5.2.1. Typology

The summary of the typology developed, and the proposed 3D typology, was send to the members of the EU MAP for consultation (Appendix 3).

Overall, the feedback about the proposed approach to development of the typology was positive. However, individuals highlighted concerns in relation to the terminology and the consistency of its use. The concerns raised reflect similar debates in the scientific literature. Further efforts are needed to improve the clarity and consistency of the use of terminology within UNISECO in a way that can inform and benefit policy decision making. This point was highlighted in the feedback during the seminar hosted by DG Agri, Brussels, January 2019.

Some concern was expressed about the use of existing typologies noting, for example, that the existing typologies have a limited ability to describe all of the systems effectively. There was also concern about the flexibility necessary to assess them (i.e. the use of FADN), and the capability for producing an effective classification of practices by farmers (in a Efficiency, Substitution and Redesign framework). Overall, these concerns challenge the practicality of the proposed classification.

Feedback from the EU-level MAP recommended that the diagram of the three dimensions of the typology required improved to resolve confusion in its interpretation (e.g. misinterpreted as a trend in a 2D diagram). In this document the 3D diagram has been revised, and the UNISECO case studies added, based upon the summary of their descriptions.

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5.2.2. Case study selection

The members of the EU-level MAP received a condensed description of the selection process (Appendix 4) and a description of the case studies selected. The reason for not presenting all of the details of the process and results of the analysis of the coverage was to make the consultation process practical for busy experts who are members of the EU-level MAP.

Questions posed and specific feedback are summarised below:

i) Comment – Some members of the EU-level MAP asked for more explicit descriptions of the selection process, and expected that the assessment of the coverage was carried out to identify potential gaps.
Response – This had been done but may have needed a better explanation.

ii) Comment – Some members of the EU-level MAP identified gaps in specific production farm types, such as small scale labour intensive horticulture. Members also asked for more specific descriptions of some characteristics (e.g. who cooperates with whom), sometimes requesting details about what will be collected when conducting the case studies.
Response – The lesson learnt was that the provision of more information would have been appropriate, and let the consultees choose the depth of information they required for their feedback.

iii) Comment – A clearer link to be provided between the selection process and the farming system typology. A query was whether project partners can justify why some farm types are not covered by sample.
Response – Some of the farm types are covered, but the description was not so detailed to show that. In addition the total number of case studies is limited and it does not allow to cover all types of production.

iv) Comment – Why we did not cover “trending topics” such as protein crops.
Response – This topic is covered in one case study, but the condensed description did not present sufficient details for that to be obvious.

v) Comment – A more detailed description of specific characteristics of farming systems (e.g. level of intensity under “grazing livestock mainly") was required to show the diversity of cases also on factors relevant for transition of conventional farm systems to AEFS.
Response – These characteristics are recognised by project partners as being important and will be covered in case studies.

The description of the selected case studies in the consultation documents, have been modified to include the size of the case study area as requested by EU-level MAP (Appendix 5).

5.2.3. The way forward

The consultation with the EU MAP has been positive and constructive. The comments and suggestions are helpful and have been taken on board both in the development of the typology and the finalisation of the selection of the case studies.

The comments raised regarding the typology reflect, in part, the debate taking place in the literature as well as the challenge of removing ambiguity from commonly used terminology in a transdisciplinary context. UNISECO will continue to refine the definitions and the application of terminology. UNISECO has a clear role to play to develop more clarity in the terminology and a workable typology that could help fill the current knowledge gap. Evolving the typology during this project will enable the outcomes from UNISECO to include a final typology of AEFS which addresses the feedback received during the consultation.

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The concepts underpinning the current draft typology received positive feedback in the consultation. However, areas identified for improvement are:

- The terminology needs to be more clearly defined;
- For dimension 1 the FADN classification needs to be critically reviewed as the basis for the farm production typology. A key question is whether there is sufficient detail in the FADN, or if there is a need for additional information or more detail in this dimension of the AEFS typology. This work will take place in parallel to the case study activities in Work Packages 3, 4 and 5.
- Dimension 2 in itself is multi-dimensional. Although the concept of ESR is valuable, UNISECO has a contribution to play in testing its applicability as a typology of agro-ecological practices. The proposed typology for this dimension will be reviewed using the case study results. It is anticipated that this dimension can be tested using the results emerging from the examination of transition and transition parthways;
- Consider the inclusion of agro-ecological zones in the typology as this would represent place-based constraints on farming system and practices. In the ongoing the development of the typology the value of incorporating the local conditions (through agro-ecological zones) will be considered;
- Dimension 3 is the least developed dimension of the typology. Results emerging from UNISECO will inform modifications to the initial typology proposed for this dimension by Therond *et al*. (2017).
- Improve the visualisation of the three dimensions of the typology.

The consultation process has led to improvements in the presentation of the case studies, and highlighting the need for particular aspects of future analysis (e.g. level of production intensity) to improve the accuracy of the assessment of farming systems.

6. ACKNOWLEDGEMENTS

This report is compiled for the H2020 UNISECO project (Grant Agreement No. 773901). Colleagues at partner organisations have contributed information on the consultation and design of the selected case studies. We would also like to thank members of the EU-level MAP for their useful comments and suggestions in the consultation of the candidate case studies and draft typology. In addition, we would like to thank the national and regional stakeholders in the partner countries for their valuable contributions to the discussion of candidate case studies.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773901.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N° 773901.

APPENDIX 1: TEMPLATE FOR CASE STUDY DESCRIPTION WITH EXAMPLE DESCRIPTION FROM ITALY

Criteria	Case study area description
Geographic coverage and case study area size *(approximate total number of farms; if possible in hectares/km^2)*	Chianti Classico, an area of approximately 71,800 ha in Tuscany (IT), located in the Provinces of Florence (30,400 ha) and Siena (41,400 ha). There are approximately 9,000 hectares of vineyards. The case study focuses on the Chianti bio-district, comprising 8 municipalities of Chianti Classico where almost 90% of wine farms (60 to 70 farms) adopt organic methods
Farm production type *(Arable - general, Arable - specific crops, Beef/sheep/goats grass based, beef/dairy mainly on arable land Mixed (also with grassland), Permanent crops, Horticulture).*	Permanent crops, mainly specialised vineyards and, to a lesser extent, olive groves
Agro-ecological approaches / practices currently applied in the farming systems *(key examples).*	Vineyards cultivated with organic methods according to EU regulations and, on several farms, additional practices are adopted which go beyond organic production methods. Key agro-ecological practices are: the use of nitrogen fixation plants, organic fertilisation, selection of local varieties, green manure, maintenance of natural planting and management of vegetation strips, hedges and more generally the maintenance of habitat for natural predators. Some farms use conventional practices.
Dilemma to be addressed in the case study and natural resources potentially impacted *(i.e. competition vs. biodiversity protection; water quality, soil quality…)*	**Reconciling** agro-ecological principles with a strongly market-oriented and specialised farming system. A territorial adoption of organic and/or agro-ecological practices could have a positive effect on many local resources, including biodiversity (habitat), water quality, soil quality, landscape
Key SES variables [or key aspects] of sustainability assessment	
Institutional settings: governance structures of agriculture and major policies with a multilevel perspective if needed (select which are most important for the case)	The *Chianti Classico Consortium* is a powerful organisation grouping together **all of the wine producers**. In the area there are many local wine producers organisations with a direct and consistent involvement of municipalities in several initiatives. As regards as the bio-district initiative, key actors who are important in governance are the organic certification bodies and SPEVIS (local centre for sustainable viticulture).
Socio-cultural settings: main social and cultural features of the case study (capacity to cooperate between sectors and actors, social dynamics, cultural identity, …)	The identity of the Chianti area as a specific wine territory is historically rooted. From very early times, economic development and the environmental and cultural heritage of the area have been linked by wine production. The area is considered one of the wealthiest in Tuscany and one of the best examples of the regional model of rural development. The capacity to cooperate is high.

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Key value chain issues *(name few briefly)*	The key role of the *Chianti Classico Consortium* in implementing regulatory mechanisms (supply) and in guaranteeing the compliance of producers with specific production requirements	
Demographic characteristics *(please briefly: e.g. declining, stable, increasing population in area)*	Between the 1950s and the 1970s the Chianti area faced high levels of depopulation as local sharecroppers abandoned the land to work in other industries and moved into urban areas. During the 1980s the depopulation trend reduced and was substituted by an opposite, and on-going trend, of population growth reflecting the increasing attractiveness and quality of life for urban people (in particular from Florence). In addition, the reputation of the area has attracted a large number of wealthy foreigner incomers.	
Gender issues *(YES/NO, brief description if YES)*	Good proportion of women amongst the farmers adhering to the Chianti bio-district	
Data availability and access *(good/poor)*	Good	
Characterisation of the existing farming systems	**Conventional / intensive farming system**	**Agro-ecological farming system**
Case study area size *(approximate number of farms, hectares estimate where possible)*	30 to 40 farms	60 to 70 farms
Existing markets (if possible, to be specified for both agro-ecological farming systems and conventional ones) *(key markets named)*	Chianti wine is exported all over the world. Production (80% of the territorial area), is delimited by the borders of the Certified and Guaranteed Designation of Origin (DOCG) of Chianti Classico.	No differences
(Expected) new agro-ecological approaches / practices to be assessed *(name briefly please)*	Integrated production	Organic production
Level of experience with implementation of agro-ecological approaches / practices *(describe briefly)*	-	Good level of experience, due to the presence of local experimental units on sustainable viticulture (SPEVIS)
Level of cooperation in the case study area (collective governance, networks….) If possible, to be specify for AEFS, conventional or other relevant network of cooperation *(e.g. rough classification: no cooperation, weak cooperation, strong cooperation, collective action)*	Good level of cooperation at municipal level, difficulties at territorial level.	Good level of cooperation amongst the farmers adhering to the bio-district (territorial level)
Presence of formal networks involved – *YES/NO (brief characteristics is enough*; e.g. biodistricts, organic associations, networks for sustainable agriculture, etc.*)*	YES Municipal wine producers' associations Chianti Classico Consortium	YES National and international bio-district networks Municipal wine producer

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	Rural District of Chianti	associations Local Bio-district
Key role of policies in supporting the initiative *(e.g. important role of policies – not important)*	Important	Important
Presence of innovative policy tools *(present/not present + if present brief characteristics -e.g. integrated policies, payments by results, collective schemes)*	Not present	Not present
Key actors involved *(not only farmers but also processors, retailers, consumers, educators, consultants, associations, policy makers etc.) (please name them briefly)*	Chianti Classico Consortium, farmer's associations, municipalities, consumers and cultural associations, SPEVIS	Chianti Classico Consortium, farmer's associations, municipalities, consumers and cultural associations, SPEVIS

NB: **natural resources** represent relevant externalities/public goods, ordered from the most influenced/produced to the least influenced/produced under the farming system.

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APPENDIX 2: PREPARATION FOR CONSULTATION

UNISECO MAP Engagement Tasks 2.2 & 2.3

Clarification Questions for Work Package 7 Transdisciplinarity Framework

As part of the guidance for transdisciplinarity, the following questions are provided to facilitate the development of a more detailed description of what you want to do, and how you plan to design the interaction and engagement with actors. These questions are to foster greater understanding across the project of our engagement with actors and will inform the final UNISECO Guide to Transdisciplinarity for Partners (D7.2).

Please consider the following questions in as much details as possible with respect to the following UNISECO Tasks and Activities:

Task	Activity	Task Contact Person	Description	Lead Partner(s)	Start and End Date[a]
Task 2.2	2.2.9	Inge Aalders	Consultation with EU-level MAPs on farming systems and agro-ecological approaches, inventory and typology	Task Leader HUT	~~1 Nov 31 Dec 2018~~ 1 Dec 2018 to 31 Jan 2019
Task 2.3	2.3.5	Jaroslav Prazan	Complete identification of case studies (involving EU-level MAP) and synthesise case study inventory	Task Leader UZEI	~~1 Nov 31 Dec 2018~~ 1 Dec 2018 to 31 Jan 2019

[a] original timescale for implementation modified due to availability of EU-level MAP; strikethrough indicates original dates

Purpose for Engagement

1. What is (are) the purpose(s) for this activity for (i) UNISECO and (ii) MAP members. For example, to acquire information/data, to build capacity/empower others through training, to co-create a solution with practitioner?

   Activity 2.2.9

   i) Purpose for UNISECO: The purpose of the engagement is to review with key actors at EU-level whether the proposed Agro-Ecological Farming Systems (AEFS) typology effectively captures the more sustainable farming practices and systems in the EU. The developed AEFS typology should be logical and provide a meaningful link to the typologies used in other projects. The aim of the activity is to engage the EU-level MAP members, and use their expertise, in the process of finalising the typology, to simplify the complexity of the UNISECO project in a clear, robust and flexible way.

   ii) Purpose for EU-level MAP members: With the EU-level MAP, we want to explore whether the proposed typology can be effective in capturing information about sustainable farming practices and systems in EU.

   Activity 2.3.5

   (i) Purpose for UNISECO: A substantial part of the UNISECO research is based on case studies – one case study per partner country. Therefore, the purpose of the engagement is to evaluate the robustness of the selection process for the case studies and to validate whether the case studies

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cover the EU situation in a balanced way.. The intended outcome is to have good coverage of key characteristics of AEFS across the case studies, reflecting the diversity of the situation in Europe. The basis for the case study selection process should be well documented and justified. The case study selection is is being co-constructed, after using consultations within partner countries.

(ii) Purpose for EU-level MAP members: Based upon the suggestions of EU-level MAP members, there is an opportunity for a final assessment of the research needs, the opinions of local actors, and to modify decisions on the final selection of case studies. This process will raise awareness of UNISECO among members of the EU-level MAP, and provides an opportunity for them to start to engage with the project.

People / Participants

1. Please specify the type of individual actors (i.e. specific target group(s)) you want to involve in the activity (e.g. farmers, advisors, etc.). The more specific you can be, the more likely the interaction will be useful for both UNISECO and MAP members.

   Actors with a good practical knowledge and experience of AEFS practices and farming systems in Europe. They should be capable of: i) reviewing, modifying and helping to finalise the AEFS typology; and ii) assessing the proposed set of case studies (one per partner country) regarding coverage in terms of key characteristics of AEFS and the diversity of farming within the EU.

2. Please provide a range for the number of people you want to involve in the activity (minimum and maximum number of people you plan to participate in the activity).

   We have agreed that, given the short timescale, approximately 5 people would be sufficient for this consultation.

Process / Approach / Method

3. Please specify the method/tool you want to use, or will be most appropriate, for your purpose (e.g. focus group, interviews, workshop).

   A workshop format was the preferred option for this activity with MAP members. However, due to the tight schedule, we modified the preferred format to a written review approach. Two separate summary documents were prepared, one describing the AEFS typology, one describing the case studies. These were circulated along with three review questions via email to EU-level MAP members. These individuals were asked to review the documents and respond to the three review questions. Additional e-mail exchange occurred as needed. We have taken advantage of an opportunity provided by a project-related seminar with EC-level actors who were not part of the UNISECO EU-level MAP. An interactive discussion session was incorporated into the seminar through which participation by attendees provided additional input.

4. Please specify whether a specific procedure/format/structure needs to be followed exactly by partners, or whether partners can modify and be flexible how they do the activity.

   The original plan was to hold a one-off workshop with members of the EU-level MAP, meaning that partners did not require to run workshops. This plan has been changed to a written consultation and email exchanges with EU-level MAP members, providing summative information sheets about both the typology and case study selection accompanied by a few, open questions to which actors were asked to respond.

5. Please specify whether partners need to be trained before they can undertake the specific activity.

   No needs identified.

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Practicalities

6. Please specify if there is a requirement for a particular venue/location at which the activity should take place (e.g. at the farm, conference room, etc.).

   Given the change in the format we no longer require a meeting room which could accommodate interactive activities ('Post-its' or mindmaps) to modify the draft typology and add examples of agro-ecological practices or the data projector that would have help with discussion of the case study selection process.

Outputs and Outcome

7. Please specify the intended outcome for: (i) the UNISECO project, and (ii) MAP members.

Activity 2.2.9 – Typology

Output:

UNISECO: comments on the AEFS typology

Actors: increased awareness of the UNISECO project

Outcome:

UNISECO: revised AEFS typology

Actors: increased engagement with the UNISECO project

Activity 2.3.5 – Case study selection

Output:

UNISECO: comments on the AEFS typology

Actors: increased awareness of the UNISECO project

Outcome:

UNISECO: revised and agreed case study selection with good coverage of key AEFS characteristics and the diversity of EU farming

Actors: increased engagement with the UNISECO project

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APPENDIX 3: TYPOLOGY CONSULTATION

What is the purpose of this consultation?

We very much welcome your views on the proposed typology of Agro-ecological Farming Systems. We would like to know whether: 1) you agree that the approach taken, 2) the typology covers European farming systems comprehensively; and 3) there are important gaps or limitations that will affect UNISECO achieving its aims?

Why is there a need for an AgroEcological Farming System (AEFS) typology?

UNISECO aims to assess the environmental, economic and social impacts of agro-ecological practices in EU farming systems. For this assessment it is important to be able to describe **farming systems** and their practices in the context of the concepts of **agro-ecology (AE)** and **socio-ecological system (SES**), which can facilitate the assessment of AEFS transition pathways.

How to define the key concepts?

Farming system according to FAO is*: '… a population of individual farm systems that have broadly similar resource bases, enterprise patterns, household livelihoods and constraints, and for which similar development strategies and interventions would be appropriate…' (Dixon et al. 2001).*

The Association of Agroecology Europe considers **agro-ecology** as a science, a practice and a social movement, encompassing the whole food system from the soil to the organisation of human societies. UNISECO defines agro-ecological farming systems as a 'set of agricultural practices based on a holistic use of ecological inputs and processes, in which farmers use their knowledge and prioritise decisions for the sustainable use of local renewable resources and biodiversity, to provide multiple benefits from the levels of agricultural practices to of the farming system, local community and food system'.

SES is a theoretical framework (Ostrom, 2009) used to understand drivers and barriers towards agro-ecological transition both individually and collectively. The SES framework links technical, environmental, social, economic and political dimensions of agro-ecological transitions within a complex set of interactions. It includes drivers and barriers that may not be related directly to agricultural practices and farming systems, but do influence them (i.e. markets, local dynamics, interactions between farmers and environmental NGO's, policies).

What are the key challenges?

Currently, there is no widely agreed definition of agroecology, or official standards as there are for organic farming.. Different sustainable farming systems have been developed that have modified their practices in different ways to reduce the environmental impact of farming. Only Organic Farming has formally recognized standards. There are overlapping practices that can create confusion and barriers to innovation and further transitions. At the same time there are many modifications to farming practices that do not completely belong to one of the sustainable farming systems (e.g. low input farming, organic or conservation farming), but could improve sustainability. There are many options for farmers to consider when moving away from conventional farming. The many possible transitions towards sustainable farming require a better understanding of farming systems.

What can be learned from existing typologies?

Within Europe the FADN data is an important basis for the development of farming typologies. However that database captures, predominantly, the economic aspects of farming and not the environmental context. Over time additional dimensions (intensity and land use) have been added (e.g. by the SEAMLESS project). For UNISECO the most interesting and relevant developments on typologies has been the work of: i) Therond *et al.* (2017) which recognizes that farming systems are SES and provides a typology for AEFS practices; ii) Wezel *et al.,* (2013) which acknowledges that AEFS practices have impacts at different levels; iii) Hill *et al.* (1996) on the Efficiency, Substitution and Redesign (ESR) framework, which conceptualizes the transition from conventional to sustainable agriculture.

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The typology of UNISECO builds on the work by Therond *et al.* (2017), Wezel *et al.* (2013) and Hill *et al.* (1996). The main objective is that the typology should be able to describe conventional farming systems as well as the existing types of non-conventional/sustainable farming systems in a way that they can be compared.

How to structure the AEFS typology?

The proposed typology has three dimensions (Figure 1): 1) a general farming typology (i.e. farm specialization classifications based on FADN, Table 1); 2) agro-ecology practices (Table 2); and, 3) a SES context (Table 3). The typologies for each of the dimensions represent all possible combinations. However, each farming type will have a unique set of AEFS practices and SES context. Dimensions 1 and 2 align with Therond's biotechnical types. For dimension 3, initially UNISECO will use Therond's SES context, however this will be updated during the lifetime of the project using the evidence which emerges from the case studies.

Why will UNISECO develop the typology as an iterative process ?

At this stage of the project there is a need for a typology that supports the development of the case studies and the models, unconstrained by the existing definitions of sustainability farming systems, and with the flexibility to enable a new understanding of sustainable farming and farming practices to emerge.

Table 1: First dimension of the AEFS typology: FADN general farming typology

1. Specialist field crops
2. Specialist horticulture
3. Specialist permanent crops
4. Specialist grazing livestock
5. Specialist granivore
6. Mixed cropping
7. Mixed livestock
8. Mixed crops-livestock
9. Non-classifiable

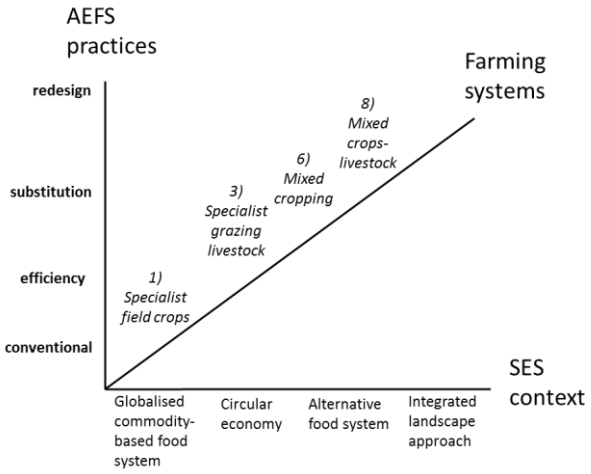

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Table 2: Second dimension of the AEFS typology: Agro-ecological practice typology

	AEF practices	Chemical Input-based		Biological Input-based	Biodiversity-based
		Not Agro-ecological	Weak Agro-ecological		Strong Agro-ecological
		Conventional	Efficiency	Substitution	Redesign
Field level	Fertiliser management	chemical fertiliser	precision application chemical fertiliser	organic fertiliser	green manure
	Weed, pest and disease control	chemical control	precision application chemical control	natural pesticide; biological pest control	allolepathic plants; crop diversity
	Livestock feed and grazing practices	Silage, concentrate feed	selecting animals with high feed-efficiency, feed to requirement or distribution of feed over day, intensive grazing on temporary grassland	use of industry waste for feed; grass-fed livestock, grazing on temporary and permanent meadows	integrated livestock, extensive grazing on permanent meadows
	Tillage	standard tilling	reduced tillage	conservation tillage	no tillage
	Soil management	Erosion prevention measures	Soilless production (aggregate and substrate)	Steaming of soil; mulching	Preserving soil-fauna and micro-fauna
	Water management	irrigation , drainage	target irrigation	crop selection for drought tolerance	water conservation
	Crop selection	high yielding	resistant to pest and diseases	inclusion of legumes; inclusion of cover crops	inclusion interdependent crops
Farming system level	Crop spatial diversity	single crop	mixed variety	multiple/mixed crops	intercropping; agroforestry, permanent meadows
	Crop temporal diversity	simple /standard rotation	simple /standard rotation	rotation including legumes	wider/complex rotation
	Livestock density	high stocking rates	high stocking rates	reduced stocking rates	low stocking rates
	Livestock diversity	specialised	specialised	modified to make best use of local conditions to produce protein	livestock diversity and closely integrated with other farm activities
Landscape level	Biodiversity	linear features (buffer strips, beetle banks, hedgerows) - legislation	linear features (buffer strips, beetle banks, hedgerows) - legislation	linear features (buffer strips, beetle banks, hedgerows)	integrated biodiversity; preserving food webs
	Management landscape elements	large plots without hedges	small sized hedges (frequent partial cutting)	diverse hedges	diverse and numerous semi-natural habitats

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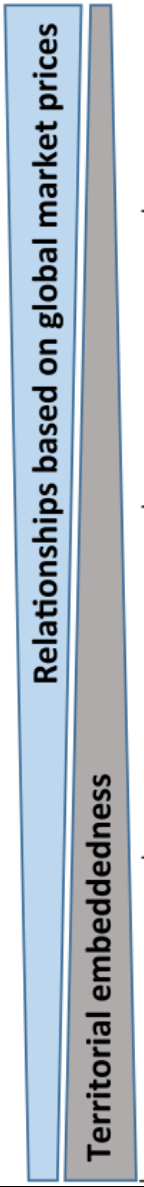
Table 3: Third dimension of the AEFS typology: Socio-ecological system typology adopted from Therond et al. (2017)



	Main objectives and characteristics	Scales
Globalised commodity-based food system	-Increase productivity and efficiency via industrial processes and standardised techniques -Generic and standardised commodities without specific quality, leading to competition centred on globalised market prices -Concentration of power in large companies while farmers have an ever-decreasing share of the total added value and decisional autonomy -Negative impacts on the environment and human health	-Regional or global levels -Exchanges occur at the regional level when regional products are competitive in the global market
Circular economy	-Developed in opposition to linear and open globalised commodity-based food systems, to limit resource scarcity, waste and pollution and possibly improve economic performances -Based on the "3R" principles (reduce, reuse, recycle) and "symbiosis networks" of a variety of complementary agents to develop eco-efficient and closed loops of material and energy -Farming systems use organic matter (for soil fertility) or produce biomass (for bioenergy) -Provides farming systems with (i) alternative locally produced inputs (e.g. organic matter) and (ii) opportunities for diversification (e.g. biomass for energy production)	-Local or regional levels
Alternative food system	-Developed in opposition to globalised food systems to address issues of human health, environment conservation, animal welfare, taste and freshness, local producers and development -Specialised agricultural products produced with specific know-how or in a specific "place" or targeted to specific consumers -Local product or local production to "re-spatialise food" -"Value-based supply chains" based on trust, collaboration, transparency and equitable relationships between all participants to "re-socialise food" -Food has multiple forms of value (beyond the price) -Provides farmers and local economies with opportunities to retain a larger portion of added value and supports diversified farming systems and landscape conservation	-Local, regional or global levels
Integrated landscape approach	-Rural/territorial development projects that support and are supported by development of multifunctional landscapes to meet social expectations about ecosystem and socio-economic services -Integrated management of the nexus of Food/Non-food/Natural Resources to develop local/regional sustainable agriculture -Collective governance of multiple land managers to design the spatial distribution of land use (crop-grassland pattern) and semi-natural habitats to increase the targeted ecosystem services provided to farmers, inhabitants and the global population -Provides farmers and local economies with opportunities to retain a larger portion of added value and supports diversified farming systems and landscape conservation	-Local or regional levels (e.g. rural park level)

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APPENDIX 4: CASE STUDY SELECTION CONSULTATION

What is the purpose of this consultation?

We very much welcome your views on the case studies selected. We would like to know whether: 1) you agree with the selection approach taken; 2) the selected case studies cover the diversity of European farming systems; and 3) there are important gaps or limitations that will affect UNISECO achieve its aims?

What are /How do we describe case studies?

A case study covers a farming system in a specific socio-ecological context considering production systems, management practices and its position in the value chain and governance.

What role of the case studies in UNISECO?

UNISECO aims to enhance the understanding of socio-economic and policy drivers and barriers for further development and implementation of agro-ecological practices in EU farming systems and to assess the environmental, economic and social impacts of these practices at farm and territorial levels. Within this overall frame the case studies are expected to provide answers to the following **key research questions**:

- *What barriers can hinder the implementation of agro-ecological (AE) approaches?*
- *How can these dilemmas be addressed / solved?*
- *Which enabling factors spur development and wide-spread adoption of AE approaches?*
- *What are the implications for the sustainability (economic, social and environmental performance) of the farming systems?*

The insights to barriers and enabling factors, and relevant system dynamics that influence farm sustainability through all of its pillars will enable UNISECO to co-construct management strategies and governance that support transition processes to agro-ecological farming systems. UNISECO will apply a social-ecological system approach as a framework for analysing different farming systems in order to obtain such insights. The farming systems studied will represent farms that have started such a transition process, and those that have not. The case studies will deal with important challenges to sustainability (e.g. soil degradation, GHG emission, biodiversity decline, low economic sustainability, labour intensity and job creation).

With limited project resources the case study selection should include a sufficient range of farming systems and socio-ecological contexts. For UNISECO to study the principles of agro-ecological transition sufficiently means providing enough examples of sustainability issues, and potential solutions for transition to sustainable farming, that will enable UNISECO to obtain insights to the barriers and success factors in this process. To achieve this, it is not necessary to select examples that represent the full range of farm production types in case studies; instead it should include the most common, major types in the EU and with typical challenges to sustainability. In addition to the transition of different farm production types, UNISECO will examine cases across a range of practical solutions for improving the sustainability of farming systems already in transition, or where the transition will be initiated by new co-constructed management strategies (e.g. technological or institutional innovations). Cases will be from different socio- or environmental contexts.

How have the case studies been selected?

Three different candidate case studies have been identified in each partner country (44 candidate case studies). The selection process was based upon: 19 characteristics used to describe the candidate case studies (e.g. production type of farms, sustainability issue, agro-ecological practices, link to value chain, network presence, level of cooperation, presence of innovative policy tools and/or market incentives). The characteristics were selected to meet the methodological needs and subject coverage. Statistics of all candidate case studies was carried out and final guidelines for the partners drafted to ensure a good balance of case studies across the EU. National stakeholders discussed the suitability of candidate case studies for UNISECO and provided their preferences for the final selection of one for research. Therefore, the case

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studies presented in the table are the result of a thorough selection process in which national stakeholders assessed the candidate case studies based on their relevance to sustainable farming at a national level.

Please consider the overview of cases and give us your comments regarding our selection, and suggestions for the last phase of the case study selection process.

Your opinion is valuable in the finalisation of the selection of case studies, adding an EU level perspective, and deepening our enquiry regarding the transition towards sustainability in the next steps of UNISECO.

Table Appendix 4.1: The results of the process of selection of case studies, summarised by selected characteristics

Partner Country (scope)	Sustainability Issue (examples)	Farm Production Type	Agro-ecological Practices (examples)	Level of Cooperation	Involvement in Value Chain
Mixed Farming Systems					
UK (North-East Scotland)	Soil degradation, water pollution	Mixed farming	Biodiversity supporting practice, nutrient budgeting	Strong	Cooperatives
Romania (Maramures Transylvania)	Economic viability, slowly increasing intensification	Mixed small-scale farming	Low intensity	Moderate	Direct sale, low processing
France (Auvergne Rhône Alpes region) Case study 1	Pesticide pollution, economic viability, food safety	Mixed small-scale farming,market gardening	Organic farming; fair access to agro-ecologically produced food for low income families	Strong	Direct sale
Permanent Crops					
Italy (Chianti Bio-district)	Nutrients and pesticide pollution, biodiversity	Permanent crops: wine production	Organic fertilisers and pesticides, inter-row grassing, green manure, crop diversification	Strong	Export-oriented; Mostly through wholesalers, Less through direct sale
Greece (Imathia)	Pressures due to using agro-chemicals (on soils, water, biodiversity)	Permanent crops: fruit and vine production	Using alternative ways of pest control, nutrient management, biodiversity management	Strong (collective agri-environmental scheme)	Cooperatives (processing)
France (Auvergne Rhône Alpes region) Case study 2	Dependency on fertilisers, high pesticide use, low soil biology	Permanent crops (grapes)	Aiming to use green manure, reduction of pesticide use, combined cropping	Good level	Wine processing cooperative
Arable Land					
Spain (Basque country)	Environmental, social and economic viability	Grain production	Organic and practices beyond the certification standards	Strong	Short commercialisation channels
Austria (Ecoregion Kaindorf)	Water scarcity because of climate	Arable farming, pig	Soil fertility increase programme, CO_2	Strong	Processors part of

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Partner Country (scope)	Sustainability Issue (examples)	Farm Production Type	Agro-ecological Practices (examples)	Level of Cooperation	Involvement in Value Chain
	change, soil quality decline	husbandry	compensation certificates, agroforestry		network
Germany, Lower Saxony	High pressure on ecological sustainability in general, biodiversity loss	Arable systems (specialised and combined with livestock)	Extensive margins, nutrient management, organic farming, cover crops, linear features	Some co-operation exists (e.g. multi-actor platform for biodiversity-friendly farming)	Poor direct involvement, but generation of high added value
Czech Republic	Soil degradation	Mixed farms, focus on arable land	Soil protection practices	Low	No involvement
Animal Production (on Arable Land and Grassland)					
Latvia (country)	Economic viability and adding value	Fragmented dairy farming	Organic farming, extensive farming	Low	Poor
Lithuania (country)	Economic viability and adding value	Small dairy – cheese makers	Different levels of extensive grazing, low use of additional feed	Low to moderate	Processing and marketing cheese
Switzerland, lake Sempach region	Lake eutrophication, P increase in water, ammonia emissions	Intensive pig farming, grassland beef	Nutrient balance 100%, lake contract payments, organic farming	Low	Poor
Hungary Somogy	Soil degradation, water pollution, biodiversity on arable land	Mixed intensive farming	Winter cover crops, reduced till and residues left on soil	Low	Direct sale, mostly through wholesalers
Finland (Nivala region)	Carbon emissions, nutrient recycling	Dairy farms	Carbon and nutrient management using biogas plant	All farmers in processing cooperative	Processing cooperative
Sweden	Livestock contribution to climate change	Livestock farms	Diversification to legumes for human consumption	Poor	Low level of involvement

* The consultation included a description of the selected case study (Appendix 5).

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APPENDIX 5: DESCRIPTION OF EACH CASE STUDY SELECTED AND ARGUMENTS FOR THEIR SELECTION

The principal dilemma for all the case studies is "How to improve/maintain environmental sustainability while maintaining or improving economic and social sustainability"? The dilemma in each case study is addressed by indicating the most deficient pillar of sustainability as an issue. Most of the case studies will include a mix of farms on which agro-ecological practices are and are not being applied. Few case studies will focus on the transformation process of farms which rarely use agro-ecological practices.

UK (North-East Scotland)

The main issue: Reconcile the management of soils (e.g. degradation, loss), inputs (including water), breeding varieties for changing climate (potatoes), animal welfare, and biopesticides and biocontrol, while producing at an economic rate of return.

Why selected: The case study represents sustainability issues relevant to the EU (soil degradation, climate change adaptation, animal welfare, environment pollution by pesticides). The farming production systems represented by this case study are relevant across the EU (i.e. mixed crops and livestock and general cropping). The agro-ecological farming practices used to address the sustainability issues are, for example: biodiversity support practices, nutrient budgeting, organic farming, permaculture and agroforestry. Farming contributes significantly to the attractiveness of Scottish landscape, evidence of which is recorded in surveys of visitors and their annual expenditure in the region. There is a strong tradition of cooperation between farmers (e.g. machinery rings for mixed farming and general cropping). An example of an innovative policy is the Knowledge Transfer and Innovation Fund, supporting initiatives including environmental performance. The case study will provide an example of a process of transformation in its initial stage. The size of the case study area is 291,826 hectares with 4,366 farms.

Romania (Maramures region and Transylvanian Highlands)

The main issue: How to maintain high biodiversity on meadows (40% of Maramures County is protected area), high diversity of land use on landscape level, and vibrant rural communities while securing livelihood of small scale farmers in the process of farming re-structuralisation?

Why selected: The high biodiversity and landscape values, as well as rural communities in Romania are exceptional and at the same time endangered due to habitat fragmentation, lack of coordinated approach, lack of integrated conservation and local development measures (part of the case study area is also close to borders with Ukraine). Current farming in the case study area is characterised by: high diversity of farming systems, low input, keeping traditional animal breeds, and fragmented agricultural landscape. These practises support a high number of ecosystem services (e.g. flood control, water quality, biodiversity). The economic viability of the farms is fragile and a significant part is subsistence farming. In the case study area (Transylvanian Highlands) there is a pilot innovative policy implemented – results-based payment for biodiversity. There is significant reluctance between farmers to associate. The socio-economic conditions are typical for a post-communist country and thus providing an interesting example in this context. The case study will provide lessons on possible pathways to increase sustainability (especially farm viability) of the farms. The case study represents quite large area of 900,000 hectares with mostly small farms (1-5 hectares).

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France (Auvergne Rhône Alpes region) Case Study 1

***The main issue*:** How to build viable agro-ecological food systems accessible to low income families?

***Why selected*:** Sustainability issues of relevance across the EU addressed in this case study (water pollution, biodiversity decline, dependency on external inputs) because farmers involved in the case studies are active in improving their farming practices. In addition to consideration of these production methods, the case offers the possibility of analysing a social issue of food justice and the right of people to access to quality food. The added-value of the case is to enable the analysis of social and organisational innovations. The farming systems are diversified (vegetables production, animal production etc…), some of which are organic. There is a strong level of cooperation between farmers and consumers as producers involved in the initiative are participating in the direct distribution of their products to consumers. They are also involved in educational activities. An important aim is to empower communities. Public policies supporting the initiative are a social policy of the area. As only a limited number of farmers (13 in total) are involved in this type of initiative, it will not be possible to use the decision support tools to carry out the farm sustainability assessment. However, a full SES analysis will be carried out. There is a strong research interest in studying this case as it is complementary to the second case in France, enabling the analysis of a case from the perspective of the food system rather than one focusing on production methods.

Italy (Chianti Bio-district)

***The main issue*:** How to develop a more diversified cropping system in a highly specialised and market-oriented winegrowing area through the adoption of agro-ecological practices, in order to improve the biodiversity and landscape management of the area while maintaining the profitability of farming through local value chains?

***Why selected*:** Several EU relevant sustainability issues are addressed in the case study, including soil degradation, water pollution, biodiversity, landscape. The area under study is Chianti Classico, a highly specialised and market-oriented winegrowing area in Tuscany. Chianti Classico comprises an area of approximately 71,800 ha, located in the Provinces of Florence (30,400 ha) and Siena (41,400 ha), where there are approximately 10,000 hectares of vineyard on 28,000 ha of utilised agricultural area. The case study focuses on the Chianti Biodistrict, comprising 8 municipalities of Chianti Classico where a high percentage of wine farms adopting organic methods. A biodistrict can be defined as a geographical area where farmers, citizens, tourist operators, associations and public authorities enter into an agreement for the sustainable management of local resources, based on organic production and consumption. Also as result of this initiative, key agro-ecological practices have been introduced and widespread in wine growing, such as the use of organic fertilisers and pesticides, inter-row grassing, selection of local varieties, green manure, maintenance of seminatural features. At the same time, one of the outstanding challenges of the area is developing a more diversified cropping system, in order to further improve biodiversity and landscape, also through revitalisation of under-utilised agricultural areas (e.g. olive groves, horticulture and durum wheat). The development of the related local value chains could also increase the resilience of local farming system, by reducing the dependence from the export of a single product (wine).

Greece (Imathia)

The main issue: How to protect biodiversity and water quality in orchards whilst also improving competitiveness and market access? How to sustain the long-term economic viability of farms whilst protecting the natural resources?

Why selected: Sustainability issues addressed in this case study are of relevance to much of the EU (environment pollution with pesticides). The farming system which is the focus of the case study of permanent crops such as fruits (peach) and vines, are relevant to several areas of the EU. The farms apply

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integrated crop management methods (e.g. “insect sexual confusion methods”), and some have already implemented innovations in irrigation and plant protection innovations. There is a high level of cooperation between farmers, with some pest management approaches applied as a collective action. The strong link to processing is based upon the activities of Producer Groups and local cooperatives. There is an innovative policy which is a collective agri-environmental measure initiated by local Producer Groups. These could be source of inspiration and learning for others because the process of transformation has started. The case study area comprises 21,000 hectares and 8,005 farms.

France (Auvergne Rhône Alpes region) Case Study 2

The main issue: How to reduce external dependency on fertilisers and to reduce the use of pesticides, to increase soil biology while keeping the economy in balance?

Why selected: The sustainability issues addressed in this case study are of relevance across much of the EU (water pollution, biodiversity decline, dependency on external inputs). The farming system to be focused upon in the case study involves grapes producing farms (permanent crop with usually intensive inputs use) is of high relevance across the EU. Currently, the farming practices are typically conventional, but the farmers intend to transfer to agro-ecological practices such as the introduction of green manure to reduce the use of fertilisers, and use combined cropping to reduce pesticides use (e.g. for vine shrubs and other crops). Farmers are already part of CUMA (Cooperatives for the Use of Agricultural Equipment) network which will facilitate the process of transition and already acts as an extension service to farmers. The level of cooperation is very high and should help in the process of transition. There are no innovative policies or specific market incentives. Most of the wine produced under Protected Designation of Origin (PDO). The initiative should enable the study of, and gaining insight to, the initial stages in the process of a transformation to agro-ecological farming system. Approximately, 17 farms already in transition could take part in the case study in this region.

Spain (Basque country)

The main issue: How to maintain a socio-ecological farming model and staying economically viable in a market oriented farming area?

Why selected: Some very EU relevant sustainability issues (environmental and social values) are addressed in this case study. The case study will cover a relevant farming system in the EU, cereal production. Innovations enabling the transitioning to agro-ecological farming are here not only technological, but also social and institutional. The case study will focus on farmers in the region of the Basque Country who are associated in collective actions, who produce under organic farming rules together with more ecological farming practices (e.g. diversification) and who are involved also with consumers and other actors in the region. The collective action is led by EHKO, a farmers’ organization in the Basque Country that participates in research, organising conferences for the general public and reinforcing solidarity chains between different social actors. It secures not only environmental, but also economic sustainability, and social understanding of farming, all in a wide range of production types. Farmers are able to communicate agro-ecological values to an audience which is not usually addressed, shortening the marketing channels, and facilitating exchange of experiences through working groups where common concerns and interests are discussed (also known as “farmer to farmer”). The case study provides an example of an effort to carry out a holistic approach as the actors work with all pillars of sustainability at the same time (e.g. linking their production and processing to consumers and carrying out collective approaches for common issues’ resolution). The case study area represents a large number of conventional farms and, from the approximately 100 agro-ecological farms that are closely related to EHKO in different production types, the project will focus on the group of farms with cereal production.

Austria (Ecoregion Kaindorf)

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement N° 773901.

The main issue: How to increase carbon sequestration, prevent soil degradation and reduce the loss of soil fertility of arable land in areas of intensive arable farming and pig husbandry, whilst maintaining economic sustainability?

Why selected: The case study provides an opportunity to study sustainability issues of relevance to EU Member States (soil degradation threat, climate change, water scarcity). It covers farming systems of relevance across much of the EU (arable land and pig husbandry). Several innovations between farmers are focused on these sustainability issues in this ecoregion, both for organic and conventional farms. For example the "Humusakademie" of a compost application and biochar initiative, reduced soil tillage, and mixed cropping. Innovative policies are being implemented of compulsory green cover on arable land and CO2 compensation certificates (payments for carbon credits). The effects of carbon sequestration and water storage capacity are evaluated and reported for the region. The association "Ecoregion Kaindorf" represents an extensive cooperation through the network of farmers, politicians, consumers, education, companies, science and research partners. This is an example of a bottom-up approach supported by state policies (also referred to as a "network for a climate friendly agriculture"). This case study will enable the investigation into the process of transformation to agro-ecological farming which is already running, and comparing that with mainstream farming. The case study area comprises 2,500 hectares and 200 farms.

Germany (Lower Saxony, Nienburg)

The main issue: How to integrate agro-ecological practices on arable land (both conventional and organic) in highly market-oriented arable farming systems to reduce biodiversity loss on and water pollution threats without significant negative impacts on the economic viability of farms?

Why selected: The sustainability issues (improving farm environmental performance e.g. reducing biodiversity loss, water pollution threats and greenhouse gas emissions) and intensive farming with particular issues in arable management, are of relevance across the EU. In addition, the selected case study area is adjacent to intensive livestock regions with severe issues in manure management and impacts on land (rental) prices in the case study region. Farmers participate in relevant measures supported under the RDP, but with a relatively low uptake of dark green agri-environmental measures. Therefore, the experience with strong agro-ecological practices such as intercropping, agroforestry and integrated biodiversity is very limited. However, some experience exists with flowering strips on arable land, extensive field margins, cover crops, nutrient management and organic farming. The level of cooperation is relatively low, but multi-actor platforms for biodiversity-friendly farming exist, on which this case study can build. The combination of issues, level of current knowledge, mix of farming practices, and low level of agro-ecological innovation provides a good example to analyse what is required to initiate the transition process to agro-ecological farming based upon the co-construction of agro-ecological management strategies and incentives. The case study area comprises 83,100 hectares and approximately 1,500 farms.

Czech Republic (whole country)

The main issue: How to prevent soil degradation and reduction in the soil fertility of arable land, whilst maintaining and improving the economic viability of farms?

Why selected: Sustainability issues being addressed by the case study (soil degradation threat, landscape and biodiversity), are of relevance across most of the EU. The farming systems of the case study (very intensive mixed farming with soil issues) are also of relevance across much of the EU, although the farms are large in an EU context. Some farms have started with soil protection measures (e.g. erosion prevention, extensive use field margins, and landscape elements management), but the majority of farms are not implementing them at a national level. There are no innovative policies, and low levels of cooperation between farmers (and other actors) regarding soil management. Groups of farms are organised in cooperatives for the sale of organic milk. Conventional farmers are less well organised and sell mostly through wholesalers or directly to mills. This case study can provide experience of the initial stages of the

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process of transformation towards agro-ecological farming. There is an experienced actor (providing alternative plant protection systems) which has already facilitated a radical transformation of the vine and fruit sector, and is beginning to use innovations in plant protection on arable land. The socio-economic conditions are typical for post-communist country and thus provide an example of the transition process in that context. The case study area was chosen from a network of farms across the whole country which comprises 3,000 conventional dairy farms of which 130 farms are in transition to an agro-ecological farming system, which will be the main focus of the case study.

Latvia (country level)

The main issue: How to increase the economic viability of conventional and organic, largely grass-based, dairy farms while preserving biodiversity in grasslands and water resource quality? How to ensure that all organic milk is processed into organic dairy products?

Why selected: This case study is relevant for several EU member states as it concerns environmentally sensitive farming (extensive and organic small scale farming). Dairy production on grass and arable land is a typical farming system in EU and the Latvian case is relevant especially for countries in EU with fragmented/small size farming. The aims of the transition are especially targeted at increasing production efficiency, improve knowledge, increasing the processing efficiency, increase value added, and improve cooperation in processing (still weak cooperatives). Agro-ecological practices are mostly represented by organic farming. The level of cooperation is quite low and there are few innovative policies or market incentives. In this country an increase of viability of organic farming// represents a valuable example of farms transitioning to agro-ecological approaches. The socio-economic conditions are typical for a post-communist country and thus providing an interesting example. This case study of a fragmented dairy sector represents more than 21,000 dairy farms.

Lithuania (country level)

The main issue: How to maintain extensive management of grasslands and to be economically viable but not because of intensification?

Why selected: EU relevant sustainability issue related to extensive grassland management that helps to maintain/improve biodiversity. These systems are not profitable in many EU Member States and frequently rely on support from public funds. The extensive grazing is relevant and well represented production farm type in EU. The case study provides example of one of the transition strategies to overcome this sustainability issue i.e. processing the milk and selling cheese (selling raw milk does not provide sufficient income), which provides important insight to the links between value chain and related success/failure factors in case of extensive farming. But at the same time these farms still struggle in the process of restructuralisation (e.g. case study represents rather small farms). Therefore, the research will focus also on ongoing attempts for additional innovations, which would be needed to strengthen the economic pillar of sustainability (e.g. technological and organisational innovations, or institutional change needed for strengthening cooperation). The potential for farmer's cooperation is quite promising, because farmers already have informal network used for education purposes and cheese contest. No innovation policies are implemented. The case study is regarded as important representative of relationship between viable farming on extensively used resources and biodiversity protection. The socio-economic conditions are typical for post-soviet country and thus providing example of different environment for the transition process. The dairy sector in Lithuania represents more than 25000 farmers and the case study will focus on about 30 farms producing cheese on farm as a strategy to overcome economic weakness of relatively small farms producing public goods (e.g. biodiversity) on grasslands.

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Switzerland (Lake Sempach region)

The main issue: How to decrease water pollution and oxygen depletion caused by intensive farming, while not threatening the economic viability of the region?

Why selected: EU relevant sustainability issues include; high farming intensity with negative effects, in this case water pollution by phosphorus and ammonia emissions. Extensification could possibly negatively affect economic performance in the region. The farming system is also EU relevant and its implications are experienced across EU. In the region several alternative and quite tailored policy innovation are implemented, e.g. phosphorus ordinance and lake protection contracts ("Seenvertrag") with several options how to protect water (e.g. riparian stripes, no bare fields over winter, reduced P use, water retention measures, support of switching to other production system). Also, specific organic rules are in place, issued by the organic label "Bio Suisse". But improvements of the water quality is not sufficient, hence the transformation process should continue to improve the situation. This transformation process will be studied in the case study, especially focusing on the implementation of agro-ecological approaches. Barriers and enabling factors of the already implemented strategies will be identified. The region chosen for the case study represents around 20,000 hectares.

Hungary (Somogy region)

The main issue: How to reconcile agro-ecological challenges of intensive arable farming with improving soil quality, supporting water retention and quality (e.g. prevent agri-chemical surface water pollution), enhancing biodiversity and enriching agricultural landscapes?

Why selected: Sustainability issues addressed in the case study are relevant across the (e.g. soil degradation threat, biodiversity in arable areas, water pollution). The general cropping production type on arable land is an important system across the EU. The size of family farms in the case study area is between 300 and 2,000 ha. Some of the farmers in the region already use soil protection practices (e.g. reduced till, crop residues left on soil, green cover crops over winter). To a large extent, the produce is sold to wholesalers who have contracts to supply inputs and to purchase commodities. There is some cooperation between farmers regarding sales. The intention is to introduce conservation soil management to mitigate climatic risks. No innovative policies are implemented in the area. There is evidence of a start to transition to agro-ecological farming systems. The socio-economic conditions are typical for a post-communist country and thus provide an example of that context for the transition process. The case study area comprises an area of 200,000 hectares.

Finland (Nivala region)

The main issue: How to reduce greenhouse gas emissions, improve nutrient management (reducing nutrient loads to waters) while maintaining economic viability of intensive milk production on grass?

Why selected: This case study involves dairy production on grass silage which is relevant for several EU level sustainability issues (climate change mitigation, nutrient losses, energy saving). The farms are planning to implement circular nutrient flows under the umbrella of a farmers' cooperative (Valio) providing manure nutrient separation technology and biogas plant investment using manure collected from farms in the region. Capacity in cooperation is high, which is expressed by farmers' commitment to participate on the project and participation of also other actors in the region (e.g. municipalities, centres of economic development, transport and environment) is considered to be substantial. Technological and institutional innovations will be a valuable source of lessons in the farming transformation process. The case study will take place in an area covering about 16,000 hectares of agricultural land.

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Sweden (Livestock farms)

The main issue: How to support climate change mitigation by reducing animal densities and maintain the income level at the same time?

Why selected: Climate change and diversification are EU relevant sustainability issues. Also, animal production is a major farming production system in EU. Growing awareness of the need to reduce emission of greenhouse gasses leads to search for innovations in crop structures and commodities compositions to compensate for potential reduction or limit to expansion of animal herds. The case study focuses on the innovative shift from production of animal protein to plant protein for human consumption. Such a change could reconcile several issues on farm level, if meeting the awareness and demand of consumers. This case study will build on the experiences from a few farmers who already started this process of transformation, which is quite a unique example of the farm restructuring. In this case study an additional ten farmers will go through this process. Case study ambition is to investigate the potential for farmers' cooperation or facilitation of the process (e.g. social innovation). The process will be source of learning on the failure and success factors behind from the very beginning of the transformation. There is no innovative policy connected to this initiative, but a private company will be involved in the case study by providing a market incentive in oat production (premium price in exchange of farmers diversifying their farms and making environmental improvements). Farms involved in the case study area are both organic and conventional. The case study will be carried out in whole country on farms with livestock and arable land. If the focus is for example to dairy farms with potential to diversification, the number of farms representing the case study area is 3000 of conventional and 450 of farms already in transition to agro-ecological farming systems.

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