2018

HIGH NATURE VALUE FARMLAND

ASSIGNMENTS

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HNV-LINK PROJECT
Deliverable D.3.18 Package of Educational Materials

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Preface

Many of Europe's most endangered habitat types and species are dependent on farming practices that have evolved in specific regions according to their particular environmental conditions. Such practices are usually of low intensity operating within the resource constraints of the regions, and they form the backbone of regional rural cultures. The concept of High Nature Value (HNV) farmland developed in the early 1990s from a growing recognition that the conservation of biodiversity in Europe depends, among other factors, on the continuation of traditional low-intensity farming systems. Nowadays, HNV farming is recognized as including both those traditional farming systems, as well as other types of low intensity farming that provide habitat for biodiversity associated with farm landscapes. HNV farming and the farmland associated with it are present in all European countries, with a diversity of types and extent.

HNV farmlands have many values – outstanding and unique natural diversity, cultural heritage and identity of regions, unique and high quality products, employment in marginalized regions, local production with minimal environmental impact – but most of these belong to public goods that are not supported by market systems. Many HNV farmland regions undergo abandonment or transformation into intensive production systems. The challenge is to improve the social and economic sustainability of HNV farming without losing the HNV characteristics. For this, HNV farmland needs to find its place in education and advisory services as part of the overall sustainability challenge.

This compilation of assignments belongs to a HNV farming educational package, which also includes seven sets of presentation slides, and a database of resources on the HNV farmland theme. It was produced under HNV-Link, a project funded by the European Union Horizon 2020 Research and Innovation programme, for developing and sharing innovations that support farming systems in areas of exceptional nature values across Europe. HNV-Link is a EU-wide consortium of 13 partners and focuses on 10 HNV farmlands across Europe for developing and spreading innovations (www.hnvlink.eu).

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CONTENT

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How to use this resource

This resource puts together ready-to-use assignments to support educators in a variety of disciplines in their teaching about High Nature Value (HNV) farming and farmland. Though the focus is on HNV farming, many of the assignments can be applied to farms of any kind in connection to instruction on nature and resource management. The authors designed the assignment plans to include both classroom and field/on-farm activities and to cover a range of topics including ecological, social, and agronomic aspects of HNV farming. None of the assignments go in-depth in a single discipline (for example, specific ecological or agronomic objectives and methods). The target learning groups are vocational and higher education students, was well as advisors.

Each assignment has a brief background with key concepts, but instructors (teachers or facilitators) and students will have to consult suggested and other sources for more information. Some assignments can be run within one study hour (1.5 hours) in class or the field but some require pre-class preparation by students or longer time to implement (for example, when visiting a farm). Assignments can also be made longer by adding levels of depth in working with the collected data (for example, analysing the data by statistics or creating figures). They can be combined in a variety of ways to accommodate for longer courses and holistic investigation of HNV farmland. None of the assignments require special equipment or lab facilities, but, of course, they can be complemented with collection of other ecological, environmental or agronomic data (for example, soil samples, nutrient values of biomass). In some cases, additional skills and knowledge can be accessed through coordinated teaching within the programme or involving guest lecturers.

Depending on the assignment, students will need a sufficient number of worksheets, identification guides, calculators and access to the internet at some stages. Finally, the authors have suggested some alternative ways of working (individual or in groups) and synthesizing of information (face-to-face or using online collaborative tools such as Presemo, Flinga). This, however, is totally up to the instructors' choice depending on needs, experience and available resources.

The authors and contributors to this resource all have hands-on experience with teaching students from a variety of disciplines and countries about HNV farming and nature management on farms. The assignments are, thus, drawn from existing and tested teaching plans but a few are developed afresh. Taking into account the vast variation of HNV farmland situations and farms across the continent, the assignments can and should be adapted to the target audience with consideration of prior knowledge and regional specificity. Users are welcome to use these plans freely as a source of ideas and inspiration. The authors will be grateful for feedback or new ideas info@hnvlink.eu.

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I. In-class assignments

1. Characterisation of a High Nature Value farming system

Type: In class

Suggested target group: Master/PhD level

Courses in Agroecology / Rural development / Human geography / Landscape ecology

National or international group

Duration: One class session

Objectives:

To gain understanding of the key concepts of High Nature Value farmland framework, their characterisation and typology;

To appreciate the scope of dimensions (from ecological to social) that define HNV farming systems;

To grasp past and present dynamics of the HNV farming systems' development and to understand how these give rise to visioning for future scenarios.

Background.

There are three concepts commonly used in relation to the HNV farming concept: *HNV farming*, *HNV farming systems*, and *HNV farmland* (Keenleyside et al. 2014). These are described in Appendix A.

Methodology.

After presenting the key concepts above during the class session, the teacher asks the students to apply them to a so-called Baseline Assessment of a HNV farmland region. There are 10 assessments available online (www.hnvlink.eu). The teacher can choose one or several to work with, according to the course needs, or allow students to choose their own. If work is done in small groups, especially on different regions, it will be instructive to conduct a synthesis of the findings as a final activity.

There can be several approaches to the task.

1) The whole class works through the same HNV farmland region, especially in a course of students from the same country. This will give them the possibility to explore the case region in more detail and using, if necessary, additional information (for example, research papers, reports and other sources). Work can proceed in pairs or in small groups.
2) Several small groups each work on a different region. This will be useful especially when students come from the respective different regions and wish to explore HNV farmland in the context of their own countries.
3) Synthesising: pairs of groups with different regions exchange their key findings by looking for similarities and differences of the results from the evaluation list. They report the identified

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similarities and differences to the class, either orally or by sending their findings to an online platform (e.g., Presemo, Flinga). Synthesising can also be done using a jigsaw technique (see for example https://www.jigsaw.org/).

Task: Examine the Baseline Assessment to answer the questions on the Evaluation List. Justify your answers using concrete examples from the Assessment. Time allowing, you can use other sources as well (for example, online information).

Evaluation List

Name of the region and country _____

What farming systems are found in the region? Which of these create and maintain HNV farmland? How?

What type or types of HNV farmland can you identify? Based on what characteristics?

What are the main bio-physical features (e.g. terrain, soil type etc.) that determine existence of the HNV farming systems?

What wildlife species and/or habitats associated with agriculture give the region its high nature values? Look for a high diversity of certain groups, presence of species of conservation concern, endemic species, culturally significant species.

Which features of the region's farmland and farming practices are particularly important for the above biodiversity?

Are their social-cultural features or practices that are part of the HNV farming systems? These could be artisanal food products, festivals/events, cultural lore or folk belief, community etc. related to agriculture.

What were the primary land-use change pressures on the HNV farmland in the region in the past? Which of these remain now? Are there new ones that arose in the past couple of decades?

How are biodiversity, local culture and community affected by the land use change(s)?

Each Baseline Assessment includes a Vision statement produced by key stakeholders in the area. What does the Vision tell us about the needs and values of the people in the LA?

To what extent does the Vision statement aim at preserving the status quo versus creating new ways of managing farmland and sustaining production?

Present the key findings to another group or the whole class, compare them for similarities and differences.

Notes to teacher/facilitator:

The assignment can be an introductory one in a course, followed by work on a farm or in the field.

Supporting resources:

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Andersen, E., Baldock, D., Bennet, H., Beaufoy, G., Bignal, E., Brower, F., Elbersen, B., Eiden, G., Godeschalk, F., Jones, G., McCracken, D.I., Nieuwenhuizen, W., van Eupen, M., Hennekes, S., and Zervas, G. (2003). Developing a High Nature Value Farming Area Indicator. Consultancy report to the EEA, European Environment Agency, Copenhagen. Available online.
Oppermann, R., Beaufoy, G. and Jones, G. (Eds.) (2012). High Nature Value Farming in Europe. Verlag Regionalkultur, Ubstadt-Weiher.
Keenleyside, C., Beaufoy, G., Tucker, G., and Jones, G. (2014). High Nature Value farming throughout EU-27 and its financial support under the CAP – a report prepared for the European Commission DG Environment by the Institute for European Environmental Policy and the European Forum for Nature Conservation and Pastoralism. Available online.

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2. High Nature Value Farmland in my country

Type: In class

Suggested target group: Master level

Students in agricultural sciences / ecology

An international course (may include also students from outside the EU or Europe)

Duration: 1-2 weeks: Introducing the task (and necessary background to it), 1-2 weeks for individual work, from 30 min to 1 hour for reviewing the results in class.

Objectives:

Become acquainted with the concept of High Nature Value farmland in own country;

Gain an overview of the HNV farmland situation across the countries represented in the course.

Methodology.

Step 1: During a class session, present the concept of HNV farmland, its relevance to conservation and/or rural development, and its three types (see Assignment 1) and give students the task for individual work.

Step 2: Students work on the task during 1-2 weeks using all sources available for their respective home countries (in national languages and English).

Step 3: During a class session, review and discuss the key results. This can be done in several ways:

1. Students from different countries work in pairs or small groups and draw similarities and differences among their countries. For this, the teacher can ask them to prepare one slide summarising their national case.
2. The teacher can ask the students to think of 5 keywords that would best describe their HNV farmlands (e.g. livestock, labour intensive). Compile these while discussing together the similarities and uniqueness of situations. Make sure that all the key aspects come up leading, if necessary, towards the ones that may get missed. For example, issues of “livestock”, “pastoral”, “extensive” most probably come up but “locally unique products” or “regionally typical products”, “Products of Designated Origin”, “policy objective” may get missed. Use a flipchart, whiteboard, Presemo, Flinga or any other tool to collect and visualise the results.

Task: Based on information found for your country, students should produce an essay of appr. 2 pages (font TNR 12). Examples of what they could include, if available:

- what are the types of HNV farmland in their country, where are they situated (you may attach a map), what are the trends;
- why are they important, for what species or species groups (give examples);
- what are farming practices that create and maintain HNV farmland;

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- what are specific challenges for the continuous existence of HNV farmland.

If some students come from a country without a developed concept for HNV farmland (Eastern Europe, non-European country), they may instead search for:

- what are agricultural habitats important for biodiversity in their country (for example, traditional or multi-use farming systems, farming without or with minimal external inputs);
- what species are associated with agriculture (give a few examples and, perhaps, an estimated species number by major groups);
- legislative and other tools of protection (some species may be on the Red Lists nationally, for some there may be action plans, specific on-farm conservation programmes etc.)

They should draw a brief conclusion (and, possibly, also 5 keywords) and add sources of information. For some countries, information may be scarce, in which case they should demonstrate what sources you have tried out and what was the outcome.

Supporting resources:

Internet, self-search in own languages; www.hnv-link.eu

Notes to teacher/facilitator:

The author has successfully run this for many years. Students from countries outside Europe may require additional guidance of what kind of information to look for. These are, for example, traditional multifunctional systems, which exist in nearly all parts of the world and which tend to support high levels of biodiversity.

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3. Marketing High Nature Value farmland

Type: In class

Suggested target group: Higher or vocational level

Students in marketing, rural development

National group

Duration: 1-2 weeks: Introducing the task (and necessary background to it), 1-2 weeks for individual work, from 30 min to 1 hour for reviewing the results in class. Alternatively, one class session.

Objectives:

To get acquainted with marketing opportunities and challenges for products from High Nature Value farming in own country (region);

To gain a perspective on the value chain for the HNV farms;

To appreciate the variety of social, environmental and other values that are being communicated through use of the HNV farmland stories and pictures.

Background.

Rural entrepreneurism is important for HNV farming systems because, at its best, it can support maintenance of HNV farmland while providing employment and new markets for goods and services from HNV farming systems. Artisanal and traditional farm products, bed & breakfasts (B&B), cottage rentals and direct sales of farm products are examples of such goods and services.

Commodification is the transfer of goods, services, ideas, etc. into products. Products and services can be marketed through coupling the item for sale with values and images the consumer may want to support. Conservation and other 'intangible' social goods can also be coupled to a product to reach consumers. An example of the latter would be putting honeybee hives on a meadow and marketing the honey as a product that supports conservation. In this case, the conservation is a product which is coupled to a marketable commodity (honey) so it can be to be sold to consumers. The conservation value is thus 'embedded' in the honey.

This assignment focuses on what social, environmental or other values are communicated through the use of the HNV farmland stories and images and how HNV farmland is used to market products and services.

Methodology.

A common method of marketing rural goods and services is through dedicated websites. The assignment uses elements of 'content analysis', which is a quantitative process for analysing communications (Allen 2017). It involves evaluating the frequency of specific ideas, concepts, terms, and other message characteristics.

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Step 1: Provide necessary conceptual background to the task. Step 2: students work on the task individually or in small groups during 1-2 weeks using the internet and fill the findings into the worksheet. The teacher may need to define a geographic region for their web-based search so that the search covers a HNV farmland region. The students can analyse all farms they will find or up to an agreed maximum number, depending on time available and likely number of suitable farms. Step 3: During a class session, review and discuss the key results.

Alternatively, all steps can be conducted during one class session using one-two farms as examples.

To add a dimension to the assignment, the students can also compare the websites to the farms' other social media (like Facebook) or marketing, if they have any. Is there consistency across the platforms? How are HNV farmland elements used in sites that may be updated much more frequently that webpages?

For a more in-depth analysis of data, the students can enter the data into a spreadsheet (in Excel) to produce visual summaries in graphs or create a wordcloud based on the keywords and/or values.

Task 1. Using web-based search, chose a farm (or farms) with direct sales and/or tourism services in a HNV farmland region, so that either a) production of the farm is based on HNV farming system or b) the farm is embedded into the HNV farmland. In searching for suitable farms, use such sources as tourism bureaus, municipal or regional governmental information pages, and keyword searches to find the farms with direct sales and tourism/farm visits.

If you find many suitable websites, rate each of them on a scale of 1-3 based on how much information it provides:

1) 'skeleton' website (e.g. a single page with contact information or a website with multiple pages but no actual content);
2) moderate amount of content that outlines basic information + some narrative such as a mission statement, farm history or similar;
3) a detailed website with multiple sections, narratives, images, etc. If possible, limit further analysis to only categories 2-3.

Conduct content analysis for the chosen website(s). Assess the imagery and text to identify what values are associated with the HNV farmland according to the marketing (website): how are they 'sold' with the product or service from the farm? The values might include family/cultural values, animal welfare, food quality, etc. When listing values, explain or justify why you think the images/texts represent these particular values. When summarising over the website, think of the main message(s), prominence of the imagery and emphasis (are any of them are the mission statement?).

Summarise your findings for multiple websites.

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Worksheet

1. Search	
1a. Geographic region	
1b. Search keywords:	e.g. farm visit, name of a specific HNV farmland system for the region (e.g. dehesa in Spain), farm product + direct sale, etc.
1c. Site search:	list websites used, e.g. municipal tourism bureau
1d. Total number of potential HNV farms	

2. Farm data				
2a. Name of farm	2b. Website	2c. Website rating (1-3)	2cd Products/ services	2e. Value chain
1 EXAMPLE Mörby Farm	*http://www.morby.fi/eng/#thefarm*	*2*	*Grains, root vegetables, potatoes, beef cattle, Christmas market + other events*	*Direct farm sales; local shops.*
2				
…				

3. Content analysis for a website	
3b. Total number with HNV elements	*3*
3c. Description of HNV elements in photos	*Cows on semi-natural meadow (2); farm shop with organic products from the farm (1).*
3a. Total number of photos	*8*
3d. Values promoted or represented in HNV photos (justification)	*Cultural landscape*

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	Animal welfare (contented cows) *Clean/healthy food (organic sign in shop; meadows)* *Local foods/community (farmer & consumer interaction)*
3e: Text keywords:	*[Introduction text of the site]: Family, daughter-farmer, beautiful hilly, cultural landscape, fresh air, direct sale, farm shop, visit, authentic, grassfed.*
3f: Values promoted or represented in text (justification)	*Family farm continuity (history, daughter running the farm)* *Community (events & farm shop)* *Cultural landscape and local history* *Environment (eco agriculture)* *Wellbeing (eco agriculture; fresh air)*

4. Summary of HNV farm website	
Main message of the website	*Local organic family farm with a long history has direct sales and events and is open to the public to visit.*
Summarize the main values communicated in the order of importance (frequency and prominance of use)	*Family farming, cultural landscape, community, clean food*
Describe the role and importance of HNV farming to the farm's narrative and communicating the values above.	*Cows and semi-natural meadow are central image of the website and organic production is emphasized. The semi-natural meadows and cows convey a positive image of the farm, but nature management is not explicitly discussed.*

Discuss your findings:

How are elements of high nature value farming used in marketing the farm's products?

What values are associated with the high nature value farming according to the marketing (website)?

If working with multiple websites, look at frequency of different values represented in narratives and images. What narrative elements and values are common across the websites, and which narratives stand out as unique to specific farms?

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Supporting resources:

Allen 2017 Content Analysis, Definition of. In: The SAGE Encyclopedia of Communication Research Methods (open access). http://methods.sagepub.com/reference/the-sage-encyclopedia-of-communication-research-methods/i3242.xml

Notes to teacher/facilitator:

One of authors has successfully run this assignment. It works best when the students come from a region with well defined HNV farmland in which direct sales and tourism is well developed or is increasing.

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II. Field assignments

4. Functional groups of vascular plants

Type: Field work.

Suggested target group: vocational or higher level

Students in agronomy /environmental sciences / biology

Duration: one field session.

Equipment: quadrats or transect lines for standard vegetation sampling; plant identification guides (also as apps if available), data worksheets, calculators.

Objectives:

To recognise multiple functions performed by native (non-sown) species of plants in an agroecosystem.

To practice a field survey of a vegetation community and its basic analysis.

Background.

Plant communities are at the basis of the ecosystem functioning, including the agricultural environments. The key one, and often the only acknowledged by agricultural producers, is biomass production. All plant species not contributing to this function are commonly labeled as “weeds”. The whole range of other functions of spontaneous vegetation on farmland gets overlooked. Among these are erosion control, maintenance of soil structure and fertility, water retention, as well as supporting diversity of associated invertebrate, bird and other species (Moonen and Bàrberi 2008). Among species dependent on spontaneous vegetation are functionally important pollinators and pest predators, or attractive species such as farmland birds. Finally, some of the unsown plant species are on the brink of extinction in modern farmland. The importance of “weeds” to agricultural systems is being has been increasing explored (e.g. Schwartz and Gage 2017) and novel approaches to integrated evaluation of grasslands developed (e.g. Méthode Mil'Ouv).

Methodology.

Step 1: Identify suitable areas within farmland. Depending on the context, these could be in semi-natural grasslands, fallow, margin along the field or road, margin along the forest edge, a fertilised grassland, mown or grazed.

Step 2: Chose the vegetation sampling technique that would best fit the available time and types of biotopes: sampling in a 1-sq.m quadrat is usually sufficient. Introduce the sampling techniques if they are new to the students. If some students happen to be familiar with the method, assign them to different groups as mentors.

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Step 3: Students in small groups conduct sampling of vascular plants in one to several quadrats depending on time available. Depending on the objectives and group expertise, sampling can be done with or without abundance classes for each species (Worksheet). Remember to use existing identification apps that cover your region!

Step 4: Students group the species into several functional groups (incl. relevant for production) and describe associated functions.

Worksheet

General description			
Vegetation cover, %			
Bare ground, %			
Signs of management (mowing, grazing etc.)			
Species (common name or Latin)	Abundance class	Functional groups	Function(s)
ADD LINES AS NEEDED			

Abundance classes. Choose the approach that best suits the time available and existing skills. For example, students can assess the coverage of individual species on a 9-grade logarithmic scale: 1 ≤0.125%, 2 ≤0.5 %, 3 ≤2%, 4 ≤4%, 5 ≤8%, 6 ≤16%, 7 ≤32%, 8 ≤64%, 9 >64%. Alternatively, they can use a 6-class scale: 5 points – the species dominates (over 75% of the vegetation; will be possible only for managed grasslands or those with invasive species); 4 points – abundant species (50 – 75%), 3 points – common (25 – 50%; this would usually be the highest rating for grasslands with diverse vegetation); 2 points – a fairly common species (5 – 25%;); 1 point – rare species (below 5%); and "+" – one or few specimens in a plot (see an example in Rūsiņa 2017, Table 7.4.4).

Functional groups (examples, these can be adapted according to availability of information): Edible plants, Nitrogen-fixing, Fodder plant, Deep rooted plant, Insect-pollinated, Invasive species, Seed for granivores birds, Food for game animals, Medicinal properties, Negative indicator species (for species-rich communities, that is, correlate negatively with semi-natural vegetation status), Positive indicator (for species-rich communities), Species indicating overgrazing, Species of conservation value (e.g., red-data book species), Aesthetic value.

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Functions (examples): Moderates soil composition, Improves soil structure, Significantly contributes to Ca sequestration, Prevents soil erosion, Provides nectar/pollen, Displaces native species, Provides seed for birds, Biomass production, Livestock health, Indicates eutrophication, Indicates successional change, Contributes to recreation.

Step 5: Perform an analysis (modify according to whether it is done in the field or later on in class).

1. What is the number of species (species richness) and diversity index (e.g. Shannon-Weaver) in each biotope type. To calculate the index based on abundance, the students will need to use a mid-value for the abundance classes.
2. How many different functional groups are there for each biotope type? Which are most represented (highest combined abundance)?
3. How many different functions can you identify present in each biotope type? Are these mainly agronomic, cultural or ecological?
4. How do the biotope types differ by the above parameters? What are the possible reasons?
5. As a possible method, students could use an amoeba diagramme, which illustrates a functional profile of vegetation by the combined abundances of plants with the selected functions (Figure).

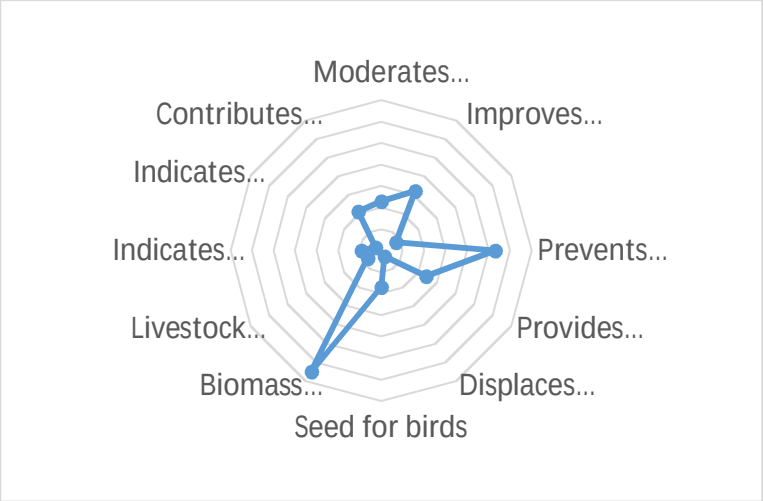

Figure. Functional profile of vegetation by functional groups of vascular plants.

Step 6: Discuss the results along several aspects. This can be done either in the field or in in class following the fieldwork.

1. Reasons for differences such as: size of the biotope, its longevity, type and intensity of disturbance (mowing with or without biomass removal, grazing, agrochemical applications and / or drift), availability of sunlight and water, gradients in resources and conditions.
2. Ask students think of how they would define a “weed” and on what grounds. Allow time for them to argue for a definition acceptable to everyone in the class. In summarising the definition, make sure that there are clear statements on the concept being purely

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anthropomorphic, utilitarian and context-dependent. Recognize that the term is often applied too loosely to many native plants, even if they are useful. Examples: Weed is any plant in a wrong place and in a wrong time (potato or oil rapeseed volunteer in the cereal crop). “Weed is a plant whose virtues have not yet been discovered” (R.W. Emerson).

3. Role of community diversity in:
    a. community properties (productivity, stability, resistance, resilience, support of complex food webs);
    b. production (biomass of palatable plants, diet breadth and animal health) and
    c. conservation (rarity, uniqueness, cultural values).

Supporting resources:

Moonen, A.-C. and Bàrberi, P. 2008. Functional biodiversity: An agroecosystem approach. Agriculture, Ecosystems and Environment 127, 7–21.
Schwartz, L. M. and Gage, K. L. 2017. Weed Ecology. Ecology http://dx.doi.org/10.1093/obo/9780199830060-0168
Latvia NAT/LV/00371 NAT-PROGRAMME "National Conservation and Management Programme for Natura 2000 sites in Latvia" http://nat-programme.daba.gov.lv/public/eng/habitats/grasslands/ Rūsiņa, S. 2017 Protected Habitat Management Guidelines for Latvia. Volume 3. Semi-natural grasslands. Nature Conservation Agency, Sigulda. 450 pp. ISBN 978-9934-8703-2-3 http://nat-programme.daba.gov.lv/public/eng/documents_and_publications/ - provides general knowledge on ecology and conservation of semi-natural grasslands.
Méthode Mil'Ouv: Adaptation pédagogique. Life + Mil'Ouv project. [In French] http://idele.fr/reseaux-et-partenariats/life-milouv/publication/idelesolr/recommends/methode-milouv-livret-pedagogique.html

Notes to teacher/facilitator:

The authors have successfully run this assignment. Adapt the method and analysis to the duration of work, number of students and their background. For students without prior training in botany and for species-rich sites, identification can be slow and difficult. Students could identify some (or most of the species) to the family (especially, for grasses), or give own working names to difficult species (pseudospecies). Correct identification of all plants is not the key learning objective here.

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5. Pollination services in High Nature Value farmland

Type: Field

Suggested target group: Higher or vocational education level

Students of biology/agronomy

Duration: one field session of 2-4 hours (depending on the number of tasks and groups)

Equipment: Sampling quadrats of 1 sq.m; Identification guides to pollinating insects (also as apps if available); Data forms; Farm map (such that different land-uses can be seen); Calculators.

Objectives:

To recognise the pollination needs of crops and the diversity and sources of pollinating organisms.

Background.

Pollination of crops is one of the key ecosystem services (supporting service – use only if you introduce the whole classification and its logic. Otherwise, avoid using excessive terms). In Europe, insects comprise the main pollinator group of organisms, particularly: the domesticated bee (*Apis mellifera*) and wild pollinators such as bumblebees (*Bombus*) and hoverflies (*Syrphidae*). Agricultural crops have a limited period of mass flowering, during which they provide large amounts of nectar and/or pollen. However, all pollinators need these resources also before and after the crop flowering. They also need other resources for survival such as nesting and overwintering sites. These are found outside the crop fields, mostly on semi-natural vegetation, that is, in the grassy crop margins, uncropped patches, permanent grassland, and multi-species meadows.

Methodology.

The students will assess how much pollination a chosen crop requires (task 1), clarify the relative roles of the domesticated bee and of the wild pollinators (task 2), and identify the main sources of pollinating insects in the farmed landscape (task 3).

Before the fieldwork, the instructor will need to decide which crop (or crops, for a more demanding work) will be used in the field work. It will be important to find out in advance the extent to which a study crop is dependent on insect pollination (for example, pollination dependency levels in Suppl. material of Aizen *et al.* 2009) and how important different groups of insects are in providing pollination of this crop (for example, Fig.2 in Rader et al. 2016). The instructor may wish to contact national sources (for example, national beekeepers' associations or research institutions) for unpublished estimates. If possible, choose a crop with high dependency on insect pollinators. If this information does not exist, the instructor should chose data for a related crop, for the sake of the exercise. Also, the assumption that each developing fruit requires at least one visitation by a pollinating insect can be used here. It is important, however, to make sure the students understand the lack of firm evidence.

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Task 1: To assess the fruit set of a crop and to estimate the pollination visitations.

When in field, the students work in small groups. Each group marks a 1-m^2 quadrat in the crop field. Students count the number of plants in the square. Then they randomly choose 10 plants and count how many fruit sets (pods/berries/fruits etc.) each plant produced [(a)]. The assumption that each developing fruit requires at least one visitation by a pollinating insect can be used if there is no detailed information available for the crop [(b)]. From information on the role of the relative domesticated bee in providing pollination of this crop (for example, in Rader *et al.* 2016 or estimates from national beekepers' associations), they estimate the relative roles of the wild pollinators, that is all except the domesticated bee.

Finally, the students evaluate the minimum number of pollinator individuals required to pollinate the crop on one hectare based on the average length of the crop flowering in days (for example, 10 for the faba bean) and the maximum number of flowers that one pollinator individual can visit per day. For example, according to the Union of Finnish Beekeepers SML, honeybees make appr. 700 visits/day and bumblebees 4000 visits/day [(c)].

Every group calculates the results per hectare of the crop and then for the study field or whole farm, and the results are compared in the end.

Task 2: To count domesticated and wild pollinators across a section of a landscape.

This is possible only under at least moderately good weather conditions (warm and without heavy wind).

Choose edges of crops present in the landscape, as well as non-cultivated elements: a margin and/or other parcel of native vegetation and/or permanent grassland with relatively high plant diversity. There can be as many habitat types as there are student groups. Each group counts pollinating insects in one habitat type along a 50-m long transect line (depending on the abundance of flying insects, you can choose another length, such as 100 or 200 m). The students walk at a steady, slow pace along the transect (along the habitat edge or across it) and count all individuals of pollinating insects that they see within an imaginary 5 x 5 x 5 m cube ahead. The students record the numbers, by the major taxon, on Worksheet Task 2. Appendix 2 will provide a simple key to identification of pollinators by major groups.

An additional task could be to list flowering plants, upon which the pollinating insects are observed foraging. This will work well if the students can identify plants when walking at least to the genera level.

Task 3: Identifying the main sources of pollinating insects in the farmed landscape

Using a map of the area in which the farm is situated and based on Task 2, the students list habitats of most importance for the pollinating insects and estimate their approximate areas (or lengths) either around a 1-2 km circle around the study crop field, or within the whole farm.

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Worksheet

Task 1: Pollination needs	Results per ha	Results for the field or farm
Name of the crop and its area on the farm		X
Average number of fruit (seeds/pods, berries etc.) / plant		X
Average number of plants / m^2		X
Average number of fruit (seeds/pods, berries etc.) / ha		X
Total visitations needed / ha		
Visitations needed from wild pollinators / ha		
Number of honeybee individuals needed / ha		
Number of wild pollinators needed / ha		

X not for filling

Calculations:

Task 2: Pollinator abundance	Habitat type _____	Start: _____ , end _____ (time)
Pollinator group	Number of individuals	Flowering plants that are visited
Bumblebees		
Hoverflies		
Butterflies and moths		
Solitary bees		
Domesticated bee		

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Task 3: Pollinator habitats	Approximate area, ha / length, m

(1 hectare = 10.000 m^2)

Compare the results of the groups at the end of the field work. Review and discuss the key results either at the end of the field work or in the following class.

Suggested discussion issues:

1. The pollination demand of the key crops. Remind the students that most flowers need more than one visitation of a pollinating insect to produce a fruit. Use examples of pollination dependence levels of different crops. For example, in strawberry plant, pollen must be delivered to each of the 200 or so ovaries inside the flower. Though wind and self-pollination also occur, pollination by wild and domesticated bees improves fruit quality, quantity and market value (Klatt *et al.* 2014).
2. Importance of non-domesticated wild species in providing some of the pollination. The role of diverse pollinator groups in maintaining stable pollination under variable conditions. See supporting resources.
3. Ecology of wild pollinator groups: size of colonies of bumblebees of various species (from a few dozen to several hundred) as compared to that of the domesticated bee (10,000–80,000 individuals). Solitary bees live as individuals or in small colonies. The most important nesting and wintering sites as well as resources of pollen and nectar of these groups. Value of maintaining or establishing elements and patches with non-cropped vegetation.

Supporting resources:

Aizen, M.A., Garibaldi, L.A., Cunningham, S.A., Klein, A.M. (2009) How much does agriculture depend on pollinators? Lessons from long-term trends in crop production. Annals of Botany, 103, 1579–1588. – See pollination dependency classes (0-4) for 87 crops in the Supplementary material https://academic.oup.com/aob/article/103/9/1579/146727#supplementary-data
Garibaldi, L.A., Steffan-Dewenter, I., Winfree, R., Aizen, M.A., Bommarco, R. (2013) Wild pollinators enhance fruit set of crops regardless of honey bee abundance. Science 339, 1608–1611.
Rader, R., Bartomeus, I., Garibaldi, L.A., Garratt, M.P.D., Howlett, B.G. et al. (2016) Non-bee insects are important contributors to global crop pollination. PNAS 113, 146–151. – See the contributions of different insect groups to flower visitation can be found from Fig 2.
Klatt, B.K., Holzschuh, A., Westphal, C., Clough, Y., Smit, I., Pawelzik, E., Tscharntke. T. 2014. Bee pollination improves crop quality, shelf life and commercial value. Proc Biol Sci. 281, 20132440.
Bee pollination improves crop quality as well as quantity. "Science for Environment Policy": European Commission DG Environment News Alert Service. http://ec.europa.eu/environment/integration/research/newsalert/pdf/364na1_en.pdf
Union of Finnish Beekeepers SML https://www.polytys.fi/polytyspalvelu/mehilainen-vai-kimalainen
More information on different types of bees and their habitats: https://www.buzzaboutbees.net/

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Notes to teacher/facilitator:

The authors have successfully run various versions of this assignment. Task 2 is dependent on suitable weather conditions and can be skipped, if these happen to be poor.

(a) There are usually many seeds per pod/berry/fruit but, in most cases, counting seeds would be too much work.

(b) Based on the pollination dependency of the crop, the students estimate how many visitations are needed to the crop on one hectare. If there is no information available on how many visit is a minimum for a fruit set to develop, the assumption of one visit can be used.

(c) If available, use information for your country/region. For other pollinators, use the same as for honeybees if more specific information is not available.

Authors: Marjaana Toivonen & Irina Herzon (University of Helsinki), Tomas Roslin (SLU, Sweden).

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6. Dung decomposition in a pastoral High Nature Value farming system

Type: Field

Suggested target group: Higher or vocational education level

Students of biology/agronomy/animal husbandry

Duration: one field session

Equipment (by the number of student groups): Bucket(s) or other container(s); Access to water; Spade(s); Coarse sieve(s) (or a piece of chicken wire of a size fitting into the bucket); Fine sieve(s); Identification guides to dung beetles (if available); Data forms; Calculators.

Objectives:

To recognise the importance of invertebrates in decomposition of dung from a (permanent) pasture.

Background.

Decomposition of dung is a key ecosystem services. However, the role of organisms in performing this vital function is commonly unnoticed and under-appreciated by farmers and pastoralists. Many farming activities, such as ploughing of pasture, applications of agrochemicals, and use of anthelmintics and antibiotics in animals adversely affect the dung community and the dung decomposition. High Nature Value farmlands in which such management practices are restricted or avoided altogether are likely to have healthy populations of dung decomposing organisms.

Methodology.

Task 1: To estimate the dung decomposition demand for a pasture.

How much dung the animals deposit on a study pasture or a study farm during the grazing season? Different production animals deposit a varied amount of dung depending on their type, sex and size. For example, it is 4 – 6 % of the weight for beef cattle, and 8 to 10% for dairy cattle. The estimates for the daily rates (in kg; sources: Animal Manure Management and Northeast Recycling Council):

- a suckler cow	35	- calf	12
- heifer	24	- steer	26
- bull	42	- dairy cow	62
- horse	20	- goat	3
- sheep	2		

You can also ask a producer/farmer and check if he/she knows!

Compare the volume (the size of this heap) to some famous building or a type of vehicle (search from internet for their volumes). Convert this farm's volume into percentage of that reference structure, so that you get a better idea of the scope of the decomposition process.

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Worksheet.

Task 1. Number of grazing animals: group 1 *(eg. a suckler cow)* group 2 *(eg calf)*	
Grazing season duration in days	
Amount of the total deposited dung on the pasture / farm during the whole grazing season, kg	
The same in m^3	
Percentage of a reference structure	

(1 t of dung = 2.5 m^3)

Calculations:

Task 2: To assess the diversity and numbers of the main dung decomposing invertebrates on a semi-natural or permanent pasture.

To extract dung beetles from dung one can use floatation method. Find a dung pat that is neither too fresh (not yet occupied), nor too old (dried out). The ideal is about 3-4 days old and having a crust on the surface. Lift it with a spade with some soil and vegetation, and put into a bucket or other container about two-thirds full of water. Press the dung pat to the bottom. For best results, keep the dung and debris underwater with a coarse sieve that allows invertebrates crawl through and rise to the surface. Skim floating invertebrates with a fine sieve.

Identify the invertebrates to the major groups of dung beetles (*Scarabaeidae*; larvae and adults), fly larvae (*Diptera*), earthworms (includes *Lumbricidae*) but also predatory rove beetles (*Staphylinidae*), using a guide available for your region.

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Discuss the results in the end of the field work. Suggested discussion issues:

1. Dung heaps as a unique habitat. It was estimated that the cow's manure is as nutrient-rich as muesli (Roslin *et al.* 2014). Therefore, it provides resources and habitat for hundreds of species of invertebrates. In Europe, the main groups are flies, coprophagous beetles (dung beetles) and annelid worms. There are about 400 species of only dung beetles (*Scarabaeinae* and *Aphodiinae*) in Europe (pers. comm. Mattias Forshage, SLU, Sweden). The diverse invertebrate communities, in turn, provide food for many bird species making pasture, especially under extensive use, exceptionally diverse areas within farmland. Curiously, the dung of hoofed animals seems to be an important source of carotenoid pigments for the rare Egyptian vultures (Negro *et al*. 2002). The birds peck on dung to keep their faces bright yellow and attract mates!

2. By decomposing the dung, these species, as well as microorganisms such as fungi and microbes, perform a vital role in the nutrient cycling, improve productivity of pasture and forage quality, as well as reduce fly numbers and spread of diseases. Decomposition of dung is an example of supporting ecosystem services.

3. Compare the numbers of beetles in your collection with some other findings for your country or region. Discuss possible reasons for differences (e.g., timing of season, sample size, farm management). For example, according to an expert estimate for the UK, one should be able to find more than 500 dung beetles in a cow pat in spring and autumn, about 30-50 or more in early summer and then about 50-100 in late summer, which should include up to 5 to 10 large tunnelling species (Richard Allison, 28/08/2014, Farmers Weekly). In The Netherlands, the largest number of all insects found in a cowpat was from a nature area (1641), followed by organic farms, both having over 50% more insects than pats of conventional farms (Geiger et al. 2010).

4. Main life strategies of dung beetles affect the species relative roles in depositing nutrients at different soil depth and how well these are mixed into the soil. The group of tunnelers is the most efficient in this but all are important in decomposing the dung.

a) tunnelers b) rollers c) dwellers

Figure. Helena Wirta, University of Helsinki

5. An example of economic and other gains from translocations of dung beetles to Australia, of modern rearing and release of dung beetles to pastures (for example, Dung Beetle Solutions Australia; Richard Allison, 28/08/2014, Farmers Weekly).

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Supporting resources:

Website of the Watford Coleoptera Group, see Dung Sampling http://www.thewcg.org.uk/pages/dungsampling.htm
(TheWCG by The WCG is licensed under a Creative Commons Attribution-Non-Commercial-Share Alike 2.0 UK: England & Wales License).
https://nerc.org/documents/manure_management/manure_generation_calculator.xls
Geiger, F., van der Lubbe, S. C.T.M., Brunsting, A. M.H., G. R. de Snoo. 2010. Insect abundance in cow dung pats of different farming systems. Entomologische Berichten 70 (4): 106-110.
http://www.farmonline.com.au/story/4668980/profit-in-poo-for-people-pastures/
Negro, J. J. et al. 2002. An unusual source of essential carotenoids. Nature 416, 807 – 808.
Roslin, T., Forshage M., Ødegaard, F., Ekblad, C. & Liljeberg, G. 2014. Nordens dyngbaggar. TIBIALE Ltd. 360 pp. ISBN: 978-952-67544-4-4

Notes to teacher/facilitator:

The authors have successfully run various versions of this assignment. You can use one or both tasks in one session.

Authors: Tomas Roslin (SLU, Sweden) & Irina Herzon, University of Helsinki with contribution of Helena Wirta, University of Helsinki.

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III. Full-farm assignments

7. Agrobiodiversity of a High Nature Value system

Type: On farm work

Suggested target group: Higher or vocational level

Students of biology / agronomy/rural development / agricultural sciences

Duration: one farm visit, may need post-visit work

Equipment: maps of a farm (could be a Google-map with the delineated fields and/or cropping map) – 2-3 copies per student group, worksheets, clean paper, (optionally) cameras. Extra, useful information: the regional averages for all farms or farms of the same production type on the relevant aspects.

Objectives:

To become acquainted with various aspects of agricultural diversity that pertain to production diversity and associated biodiversity, of which the farmer he or herself has knowledge;

To learn or practice skills in analysing diversity and interpreting results;

To get understanding of the farmer's decision-making related to management of agrobiodiversity;

To learn or practice skills in interviewing farmers/landowners.

Background.

Agricultural biodiversity is a broad term that includes all components of biological diversity of relevance to food and agriculture, and all components of biological diversity that constitute the agricultural ecosystems, also named agro-ecosystems: the variety and variability of animals, plants and micro-organisms– at the genetic, species and ecosystem levels– which are necessary to sustain key functions of the agro-ecosystem, its structure and processes (COP decision V/5, appendix). Each farm is some ways unique in its cropping patterns, structure of field and non-cropped areas, wild species that inhabit the farm, as well as its contribution to food in the markets and in people's diets. Agricultural biodiversity is demonstrated to be important for long-term productivity, resilience and adaptation to changing conditions, multiple ecosystem services, and for nutritious diets and human health (Biodiversity International 2017). Each farmer/farm owner has personal (subjective) reasoning behind management of agrobiodiversity based on knowledge, experiences and intrinsic and extrinsic motivations.

Methodology.

The best approach is to work in small teams. If the farm is large and/or diverse, the teams can divide the farm area or major functional parts for independent parallel investigation. This will need a synthesis session in the end (on-farm or during the following class meeting).

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Task 1: A farm survey.

Theme 1: production biodiversity. Through a survey across the farm, identify and map the layout of the production biodiversity of the farm. Mark them on the map or maps (if one map becomes too crowded, use a different map for mapping some aspects below). Relevant questions: What crop species and production animals are present? What functionally different crops are present and on what area: for example, annual, perennial (several years in place) or permanent crops; pastures, fodder grasses, cereals, root crops etc.; nitrogen-fixing crops, crops dependent on insect pollination? Which of these are grown as monocrops or intercrops, or polyculture?

Theme 2: non-cropped areas of the farm. Identify and map the presence of the non-cropped elements and patches: for example, margins between fields and other areas such as forest, wetland, fallows, woodlands, watercourses, buildings, orchards, woodland etc. What are their approximate areas from the map? Without spending much time on identification of plant species or faunal surveys, estimate how diverse are these non-cropped areas: Which ones are clearly dominated by one to several plant species and which have diverse species composition? What is their structural diversity? For example, they have only herbaceous vegetation, or trees and/or bushes, ad/or stones are also present. Use the map to mark your observations.

Theme 3: Structural diversity. How many land-use types overall does the farm have (for example, crop fields, pastures, fodder grasslands, woodlands, orchard etc. – summarise from Themes 1 and 2)? How spatially diverse is the farm's layout? Are all fields in one block or interspersed by non-cropped elements? In what patterns are the fields with different crop types or functions allocated across the farm area?

Remember to write down the questions for which you need the farmer's input (for example, you are unsure about a crop). Take pictures to illustrate your questions.

Task 2: Farmer/owner interview (from one to three hours, but two hours will likely to be sufficient).

Theme 1: Explore the production biodiversity of the farm. How many crop varieties and animal species are used in production in a given year and how do they change over time (crop rotation(s) or crops tried occasionally or in the past)? For what reasons? How and why have crop or/and animal diversity change over the farm's history (the farmer can decide what time period is relevant)?

What are the uses for crops and animals? For example, cash crop (incl. animals for off-farm sale), subsistence crop, forage, animal feed, ornamental, medicinal, home cooking (e.g. herbs), exchange with neighbours and/or relatives.

Theme 2: Explore the associated biodiversity, of which the farmer is him-/herself aware. What non-crop species and elements are deliberately introduced into the farm or maintained on it, and for what reasons? For example, living fencing, cover crop, firewood, building material, shade, windbreak, ornamental, recreational, out of interest and/or concern for certain wild species or wildlife generally.

What species of wild plants and animals, or their groups (e.g. "ducks" generally without knowing by species) does the farmer know? Does the farmer use any of these directly, for example, game species or medicinal plants? Are they mostly noticed during work or leisure, or followed as a hobby? Is the farmer aware of the functions of groups of species (pollinators, dung decomposers, soil engineers,

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biological control agents, herbivores including pests) on the farm? Is the farmer aware of the presence of any rare or protected species on the farm?

Does the farmer support or enhance any of the species and by what activities?

Theme 3: What are the reasons for allocating different crop types or functions across the farm area?

Add the discovered details into the map(s). Fill in the information for Worksheet A.

Task 3: Analysis.

If relevant, the students may calculate the diversity index (such as Shannon-Weaver) for the land use and/or field functional of the farm, based the number of types and their areas.

Worksheet

1. Production diversity	
Number of crop species	
Number of production animal species	
Number of crop varieties	
Functional crop types and their areas (ha)	annuals: perennials: permanent: nitrogen-fixing etc.
Diversity index of the functional crop types	
The main crop rotation(s) and occasional or past crops	
Has crop or/and animal diversity change over farm's history?	
Use for crops and animals in the order of importance (volume or/and revenue)	

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2. Associated biodiversity	
Number of the non-cropped area types	
List the non-cropped areas in order of their diversity by number of plant species or/ and their structural diversity; mark those that are deliberately introduced into the farm or maintained on it, add the reasons the farmer provided	
List the farm's wild species, of which the farmer is aware, by their functional groups (including rarity)	Pollinators: Biological control insects: No (appreciative) function:
Direct use of wild species	
Activities the farmer performs to maintain any of the species	
3. Structural diversity	
Number of the main land-use types	
The land-use types with their areas (exactly or approximately)	
Diversity index for the land-use types	

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Discuss your findings. Suggested aspects:

How does this farm compare to the regional average farm of the same production type on the aspects for which the averages exist? Has it changed – how and why?

How does the farm structure relate to its resource-use efficiency, resilience, profitability, social pressures, policy impacts.

Connectedness of the farm to local economy and social structure, as well as global system.

Farmer's decision-making basis on aspects related to diversity of all kinds. Role of knowledge (internal and external) and experience.

Possible contributions of various elements and aspects to sustainability at the farm, regional, national and global levels.

Notes to teacher/facilitator:

The author used the elements of the assignments. The assignment gives an equal weight to production and associated biodiversity of the farm with a focus on the farmer's perspective. For alternative approaches see Gliessman (2014) or Agrobiodiversity Index developed by Biodiversity International. If you use the latter, consider giving the feedback to Biodiversity International.

Supporting resources:

The Convention on Biological Diversity on https://www.cbd.int/agro/whatis.shtml
Gliessman, S. R. 2014. Field and Laboratory Investigations in Agroecology, Third Edition. RC Press. 256 p. – or any other edition.
Remans, R., Attwood, S., Bailey, A., Weise, S. 2017. Towards an Agrobiodiversity Index for sustainable food systems. Biodiversity International.

Authors: Irina Herzon, University of Helsinki; adapted from Gliessman, S.R. (2004).

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8. Rapid assessment of nature values at farm scale

Type: Project-based assignment

Suggested target group: Higher or vocational level

Students of agronomy, agricultural or environmental sciences, ecology, biology

Duration: 3-5 days including preparatory work, one farm visit and post-visit analysis and write-up

Equipment: Map of the farm, literature to help with semi-natural habitat description and assessment, worksheets for collecting data in the field, locally relevant geographical data (land cover, land use, protected areas, topography, hydrology, etc.), field equipment (measuring tapes, camera, identification guides for species of particular interest or apps).

Objectives:

The overall objective is to assess the natural values of a study farm and to compile a report for the farmer presenting the farm assessment as well as suggestions for practical measures to maintain and/or enhance the farm's nature values.

The learning objectives are:

- To gain understanding of the relationship between a farm and the wider landscape context within which it is located and to identify relevant local environmental issues;
- To learn techniques for mapping and describing non-cropped elements and semi-natural habitats of potential value to biodiversity of a farm;
- To learn about how these elements and habitats are integrated into the farmer's management choices,
- To explore management options that are relevant for maintenance and/or enhancement of the farm's natural values.

Background.

Every farm has some natural values. Being able to recognise these, measure maintain or enhance them does not only contribute to conservation on a side scale but also to sustaining important functions, on which the farm's production depends. Among such are soil formation, nutrient cycling, pollination, biological control, water purification but also farm's aesthetics and farmer's quality of life (overview in, for example, Tscharntke et al. 2012).

Particularly important are various areas and elements that are not under crops, called in their totality *non-cropped areas,* or *semi-natural habitats*. Among these are field margins, hedges, woodlots, ditches, stone walls, heaps of stones, barns and old farm buildings, wetlands, areas under ruderal vegetation ("wasteland"). Of grasslands in use, so-called *semi-natural grassland*, that is, permanent grassland that is not re-seeding or fertilised and used extensively, for haying or as pasture, are especially valuable. These tend to have the highest overall diversity of vascular plants as well as other

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taxa. Apart from supporting functionally important species (of pollinators or biological control agents), they may provide refuge for rare species.

Some types of fields can also be valuable: fallowed fields or fields specially created for biodiversity, or some crops that attract and support high numbers of wild species or rare species (for example, fields supporting migrating birds or currently rare hamsters).

Every such element or habitat would provide unique resources for species on a farm scale, and thus would contribute to the farm's heterogeneity and overall natural values (see, for example, Benton et al. 2003). These are all major foraging areas, refuges, over-wintering sites, and sources of populations for re-colonisation of disturbed areas.

There are various ways of managing such non-cropped areas across the whole farm to maintain and enhance the farm's natural values. This need not interfere with crop production (see, for example, Berger et al. 2003). Recreating or establishing new elements is also possible.

In some countries, a full-farm survey protocols have been developed with an aim to mainstream biodiversity or nature evaluations at a farm level and draw attention of farmers to these values (Oppermann 2003; Birrer et al. 2014; Gottwald and Stein-Bachinger. 2018).

Methodology.

1. Preparatory work before the farm visit

You have been provided with a map of the land managed by your farm. From this starting point you will gather as much information from online sources as possible to prepare for the farm visit.

1A) Study the landscape surrounding the farm and the general environmental context within which it is situated. Answer the following questions:

- In what type of landscape is the farm embedded? Examples: arable plain, river valley, mixed farming, monoculture, mountain.
- What data are available from the area to give you some idea of the environmental conditions? Examples: geology, hydrology, soil type, topography, land cover and land use.
- Is the area prone to certain environmental risks? Examples: flooding, nitrate pollution, wild fire.
- What habitats and species are present on the farm's surroundings and are any areas protected for conservation? What are the environmental or conservation issues in this area?

  Based on this, you may want to prepare a small identification guide for species of particular interest (such as rare or characteristic, or indicator species), which you are likely to encounter on the farm.
- What agricultural data are available for the region?
- What is the history of the area and important changes to land cover and land use?

1B) Study the farm itself more closely through information which can be obtained from maps and aerial photographs.

- How is the farm's land distributed (grouped or scattered land parcels)?

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- What is the shape and size of the fields?
- What non-cropped elements and semi-natural habitats (hedges, ditches, old farm buildings, woodland, scrub etc.) are visible from aerial photographs?
- What are the quantities of these habitats and how are they distributed on the farm?
- From the ordnance survey map, look at the topography and try to locate sloping areas or wet parts of the farm.
- If a farm has a website, study it in advance to avoid asking the owner questions, to which you already have answers.

1C) Prepare paper maps and worksheets to use during the field visit

One or several maps showing the diversity and distribution of semi-natural habitats on the farm may serve as a basis for:

- Discussing these areas with the farmer, their management, etc. It is easier to be sure of the identity of a habitat when pointing to it on a map!
- Carrying out field checks of the location and types of semi-natural habitat present.

Depending on your case, you may like to present other information to the farmer regarding important elements in the neighbourhood of the farm or about the farm's recent history, using older aerial photographs if available.

You should also identify a selection of semi-natural habitats which may be described in further detail on site. For example you might want to examine the structure and composition of certain hedgerows or assess the ecological value of a pond or disused farm building. Use the available literature to determine which characteristics of these habitats may be important and produce worksheets for field use. You will find examples below. The idea is to focus on simple criteria and not to carry out lengthy plant or animal surveys for which we will not necessarily have the required time or the skills.

Finally you should prepare a list of questions for the farmer, based on your analysis of his farm and the semi-natural areas you have identified. You will find a suggested list of questions below but you may wish to modify it depending on your farm's context.

2. Farm visit

The course group could divide into teams of 3-5 students in order to cover different areas of the farm. The teams could work at different locations of the farm (if it is too big to cover in one day) or at different types of habitats (for examples, teams focusing specifically at margins, non-productive or extensive grasslands, woodlands and hedges, farm stead). Depending of the course size, a smaller student group (2 - 5 people, for example one person from each group) should conduct the interview with the farmer.

2A) Complete the inventory of semi-natural habitats on the farm, their type and location. The prepared paper maps may be extensively annotated during the visit. Bring spare copies of these maps and plenty of paper for field notes.

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2B) Assess the quality of semi-natural habitats that you select as a focus, using the worksheets below.

2C) Carry out the interview with the farmer. You may wish to ask the farmer if he objects to the interview being recorded in order to check field notes later. It is very important to let the farmer express him or herself freely but also to steer the discussion back to the subject of semi-natural habitats and their management when necessary. Farmers generally find it easier to talk about the management of their productive areas than about non-cropped areas.

3. Analysis of field notes and report write-up

Go over all the collected material and discuss your findings. Exchange information between different field teams. You should now be in a position to produce new, detailed maps of the quantity and distribution of different types of semi-natural habitat on the farm. In your report you will give further information about their structure, composition and value for wildlife and explain how they are considered and managed within the farm strategy.

Based on your knowledge of agroecology and searching advisory sources online, you should make some proposals about which habitats should be maintained or enhanced, which management practises may be improved, or which habitats may be important in a wider landscape context. Be realistic here in terms of what can be achieved i) with no extra cost, ii) with minimal cost, or iii) only with financial and other support (such as public subsidies or involvement of an NGO).

Your report should therefore answer the general question: “How do non-cropped areas and semi-natural habitats contribute to maintaining the farm’s general and functional biodiversity and how are they integrated into the farm’s management?”.

The report should be of no more than 15-20 pages including maps and other illustrations. Write it in a language that a farmer can easily understand, accurate, but avoiding scientific terms. Use names of species in a native language as well as Latin names. Add sources for more information.

Alternatively, the project can culminate in a student seminar with or without the farmer attending it. The groups could present their key results and provide feedback to each other, and the whole course participants summarise their learning experiences. Another optional activity is for the course participants complete the project task by integrating the separate group reports into one report for the farmer.

Notes to teacher/facilitator:

The teacher will need to locate one or more suitable farms for the study, accessible to the students, with a surface area that can reasonably be covered (approximately 50-100 ha is ideal). If several students/groups are participating it is interesting to choose farms in contrasting landscape situations and with different types of production. Farms with scattered land parcels are typical, but you may need to consider students’ transport options if large distances are involved. The farmer will need to allow students free access to all parts (or most) of the farm and to allocate approximately 1-2 hrs for

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answering student questions. You will also need the farmer to provide you with a clear map of the land he/she farms.

Students will require some guidance in locating geographical and historical data online. You should provide links to geographical databases or to the websites of major organisations providing freely accessible maps, aerial photographs (at different dates), farming statistics, etc.

Before the student report is sent to the farm, is very important if the teacher could revise its draft with each student group or the whole course. This way many simple mistakes can be avoided, students get better focused at essentials and gain more confidence.

Options in working approaches:

1. GIS-based planning. If students have already had some training in the use of GIS, they may wish to take advantage of this assignment to practise and develop their skills. The maps for use in the field can be generated using GIS software in order to highlight features of particular interest. After the fieldwork, different non-cropped elements and semi-natural habitats may be digitised to produce high quality maps for the final report to the farmer. This is an opportunity to practise creating different point, line and polygon shapefiles, with appropriate attributes. Using GIS can make it easier to more accurately quantify the areas occupied by non-cropped elements and to compare this information between different farms or contexts. It is also a good way of storing the assessment for later use.

2. Using scoring approaches for habitats and farms such as Nature Balance Scheme (Oppermann 2003), credit point system (Birrer et al. 2014), Farming for Biodiversity- model (Gottwald and Stein-Bachinger 2018), or results-based payment schemes for biodiversity on farmland ( ).

Supporting resources:

Birrer, S., Zellweger-Fischer, J., Stoeckli, S., Korner-Nievergelt, F., Balmer, O., Jenny, M., Pfiffner, L. 2014. Biodiversity at the farm scale: A novel credit point system. Agriculture, Ecosystems and Environment 197, 195-203.
Oppermann, R. 2003. Nature balance scheme for farms—evaluation of the ecological situation. Agriculture, Ecosystems and Environment 98, 463–475.
Benton, T.G., Vickery, J.A., Wilson, J.D., 2003. Farmland biodiversity: is habitat heterogeneity the key? Trends in Ecology & Evolution 18, 182-188.
Berger, G., Pfeffer, H., Kachele, H., Andreas, S., Hoffmann, J., 2003. Nature protection in agricultural landscapes by setting aside unproductive areas and ecotones within arable fields ("Infield Nature Protection Spots"). Journal for Nature Conservation 11, 221-233.
Gottwald, R., Stein-Bachinger, K. 2018. 'Farming for Biodiversity'—a new model for integrating nature conservation achievements on organic farms in north-eastern Germany. Org. Agr. (2018) 8:79–86. DOI 10.1007/s13165-017-0198-2
Tscharntke, T., Clough, Y., Wanger, T. C., Jackson, L., Motzke, I., Perfecto, I., Vandermeer, J., Whitbread, A. 2012. Global food security, biodiversity conservation and the future of agricultural intensification. Biological Conservation 151, 53-59.

Advisory materials available online (mostly in English with examples from other countries):

Nature Conservation in Organic Agriculture – a manual for arable organic farming in north-east Germany http://www.bfn.de/fileadmin/MDB/documents/service/Fuchs_Stein-Bach_Nature-Conservation-Organic-Agriculture.pdf
RSPB pages on working with farmers on conservation https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming
A toolkit on conservation on farmland for England developed under the EU LIFE+ Programme http://www.farmwildlife.info/

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Best practice guidelines for farmers in the Burren, Ireland http://burrenprogramme.com/wp-content/uploads/2018/04/BP-Best-Practice-Checklist-No.-1-Optimising-your-I-1-Field-Score.pdf
RBAPS Project. Developing Results Based Agri-environmental Payment Schemes in Ireland and Spain https://rbaps.eu/documents/best-practice-management-guidelines/ and https://rbaps.eu/documents/scorecards/ - scoring guidance and best practice guidance for floodplain meadows, species rich grassland and Mediterranean permanent crops.

Agriculture et Biodiversité. http://www.agriculturebiodiversite.fr/presentation-du-programme.html - the farmers are invited to observe biodiversity of their farm and to learn about the wild species and their role in the farming environment.

LPO https://www.lpo.fr/agriculture-et-environnement/agricultures-et-biodiversite - advice on creating management plans for the farms.

NABU. http://www.nabu.de/imperia/md/content/nabude/landwirtschaft/naturschutz/5.pdf - advice on farmland birds.

BoerenNatuur. http://www.boerennatuur.nl/

Foundation Adept, Romania. https://fundatia-adept.org/

Authors: Joséphine Pithon and Guillaume Pain, Ecole supérieure d'Agricultures d'Angers, Irina Herzon, University of Helsinki with contributions from James Moran, GMIT and Brendan Dunford, Burren Programme.

Worksheets 1.

These are not finished and will give you an example of how to construct your own. Always think about the type of information you wish to collect, the method you will use to collect it and how you will interpret the results.

1a. Hedgerow

Observable criteria	Expected results	Interpretation
Adjacent land cover	Examples could be road, watercourse, crop, grassland	There are many interactions between a hedgerow and its environment and the adjacent land cover can influence the structure and composition of the hedgerow. Some species move between the hedgerow and adjacent habitat to exploit different resources.
Number of connections with other semi-natural habitats including other hedges	Examples: hedge-hedge, hedge-woodland, hedge-river	Hedge intersections have been found to be more species rich. A dense network of hedges is likely to be suitable for birds and corridor effects may favour insects, amphibians, small mammals etc.
Age	An estimation, if possible	It is particularly important to distinguish very young hedgerows. The older a hedgerow the more different woody species it will contain and associated flora and fauna.

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Hedgerow structure - Height (maximum and mean) - Width (mean) - Estimated cover of each vegetation layer (field, shrub and tree)	Height and width in metres Classes of vegetation cover for field, shrub and tree layers could be 0 = 0% / 1 = 1-10% / 2 = 10-25% / 3 = 25-50% / 4 = 50-75% / 5= 75-100%	The structure of the hedge (height, width and number of vegetation layers) influences habitat quality (shelter, microclimate) and also the quantity of vegetation (volume, heterogeneity), which in turn influences the flora and fauna.
Add more rows if needed		

1b. Pond

Observable criteria	Expected results	Interpretation
Number of ponds on the farm and distances between ponds	A simple count of ponds (checking for those which may be undetected on aerial photographs or at certain times of year) and distances in metres	Amphibians often use a network of ponds and so the possibility of being able to move between several ponds may be beneficial.
Habitats surrounding the pond	Crops, grassland, grass strip, woodland	Crops bordering a pond without buffer vegetation may lead to risks of eutrophication or other types of pollution. Semi-natural grass and woodland habitats are favourable for amphibian movements.
Surface area	0-5m^2 / 5-50m^2 / 0-500m^2 / 500-5000m^2 / >5000m^2	The value of a pond is not proportional to its surface area but the size will give some indication of the function of the pond in conjunction with its depth, type, shape etc.
Function Permanence	Use: Fishing, water for livestock, storage of surface run-off, drainage Temporary (dry at certain times of year) or permanent	The way the pond is used may influence its value for wildlife. For example a pond with fish will be less favourable to other forms of life due to predation. Animals and plants may not be able to survive in ponds with frequent dry periods. Amphibians need a certain length of wet period to complete their reproduction.
Add more rows if needed		

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1c. Farm building

Observable criteria	Expected results	Interpretation
Type and location of different buildings	Presence of buildings that provide potential habitats: - lofts, eaves, old or abandoned buildings, ruins, stone walls, piles of stone, stables etc.	Such elements are potentially useful habitats for roosting or nesting birds (owls, swallows) but also for bats, reptiles, amphibians etc.
Function	Not used / Occasional use / Frequent	Gives some impression of the level of disturbance; the more the building is used the less likely it is to host species sensitive to disturbance.
Signs of species presence	Traces such as owl pellets, faeces, nests or direct observation of reptiles, birds, plants etc.	Detecting species using the building could help the farmer to decide upon management options, for example, some species may be beneficial (e.g. owls in controlling rodents).

Worksheets 2. Farmer questionnaire.

You will need to start the interview with a few standard questions about the farm's main characteristics and current objectives. When constructing the questionnaire, always think about the reason for asking the question and expected results, as shown below with suggested options. This will help you to steer the farmer towards talking about the semi-natural habitats on his farm.

Questions	Reasons for asking the question and expected answers	Other comments
Have you made any changes to the semi-natural habitats on your farm? Prompt questions: - Creation or destruction of hedges, woods, trees? - Sown grassy strips? - Habitat restoration, conversion of arable land to grassland or vice versa, pond or ditch restoration or destruction?	This question should give us an idea of how the farmer considers semi-natural habitats. As a help or a hindrance? Also how willing he/she is to engage in habitat improvement or restoration.	The answers may also help to update your map of semi-natural habitats.

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How do you manage the semi-natural habitats on your farm? Prompt questions: - Do you manage your roadsides and paths? How and at what time of year? - What machinery do you use for hedge maintenance? - When and how often are your hedges cut? - Who carries out hedge maintenance on your farm?	This question is intended to give us information about the compatibility of semi-natural habitat management, farmer objectives and wildlife requirements. If the farmer manages the habitats him/herself, it may be easier to suggest new methods than if the work is subcontracted.	Make sure that mowing and cutting activities are not carried out during the breeding season of many animals (spring/summer). Hedge management should not be too frequent (once every 3 years, for example) and not too intensive, to encourage flowering. Late winter management allows fruits to be available to feed fauna during the harsh winter period.
How much time is spent each year managing woody habitats?	This investment of time is not often calculated by farmers. How is this habitat management work perceived and considered in the context of the farm strategy?	
How useful do you consider the semi-natural habitats on your farm? Prompt questions: - Habitat for beneficial organisms? - They connect habitats? - Barrier to pests and diseases? - Windbreak or shelter for livestock? - Erosion or pollution control?	This should inform us of the value the farmer associates with such habitats, in absolute or in agroecological terms.	Some farmers consider such habitats as an integral part of their system, others as merely a constraint. As the Common Agricultural Policy evolves, the question of how farmers value the semi-natural habitats, which they will be required to maintain, becomes of increasing relevance.
What are the main environmental constraints or issues in your local area?	This will enable you to see if the issues you have identified are known to the farmer and to integrate his response to these issues in any proposals.	For example, if the study area is vulnerable to erosion, look for any anti-erosion measures in place or possible. If the farm is close to a protected area, check for impacts of the farm management on the flora or fauna of this area.
How do the actions of neighbouring farms impact your own strategy? Prompt questions: - Incompatible practises between neighbouring farms? - Opportunities for habitat creation, hedgerow planting?	Like the previous question, this one encourages the farmer to look beyond the frontiers of his/her own farm to consider possibilities at landscape scale.	For example, an organic farmer may be impacted by more intensive agricultural practises from nearby. If the farmer aims to increase habitat connectivity and dispersal of beneficial organisms, it may be worthwhile acting in collaboration with neighbouring farms.

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9. Assessing vulnerability and resilience of High Nature Value farming systems

Type: Project-based assignment, either using a real farm as a case (includes field work, such as interviewing the owners) or virtual farm case (in class work).

Suitable for: vocational or higher education level; Students of agricultural studies / environmental studies / "futures" – related studies. It could also be used for training advisors or community/NGO group for work with farmers.

Objectives:

To become aware of various aspects of a farm's resilience and indicators to measure resilience.

To learn or practice skills in analysing diversity and interpreting results in light of the resilience concept.

Methodology.

Adopted from Altieri, M. 2016. Developing and promoting agroecological innovations within country program strategies to address agroecosystem resilience in production landscapes: a guide. GEF Small Grants Programme, UNDP.

The assessment is based on a set of indicators that are possible to measure at the farm and landscape level and which signal the performance of the farming systems in terms of its resilience.

Task 1. Evaluate the farm based on the indicators.

The indicators are valued separately and, to make them comparable across the various aspects of performance, are assigned with a relative value between 1 and 10, according to the farm or landscape attributes. 1 is the least desirable value, 5 a moderate or threshold value and 10 the most preferred value. The values need to reflect a particular context, for example, amount of food consumed by family produced on farm will vary wildly depending on the farm type and family employment situation. Not all indicators will be equally applicable in every region and for every farming system. Some additional indicators may be needed to adequately grasp and describe the situation. Ideally, this should be determined by a group of farmers and other rural actors through a participatory process. They should be critically assessed and modified according to the best evidence.

Worksheet. Indicators, example of thresholds and rationale for choosing them. Students should fill in the latter column.

Indicators	Threshold (examples)	Rationale
Landscape diversity (amount and type of vegetation surrounding farm) / farm size	Noticeable presence of hedgerows, corridors, riparian forests, crops dedicated to biodiversity (e.g. game fields); no less than 50% of such features protected	
On-farm crop and animal diversity (number of species)	At least 3 species including at least one legume	

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Genetic diversity (number of local crop varieties and/or animal breeds)	At least 2 varieties per crop species of which one is a local variety or landrace	
Soil quality (organic matter content, structure, soil cover, infiltration, etc.)	More than 70% of land covered by vegetation most of the year	
Signs of degradation or resource losses (soil erosion signs, deforestation, fragmentation, state of water courses, efficiency in use of water, nutrient levels, etc.)	No more than 25% of land area showing signs of degradation (erosion rills, deforestation, fragmentation, overgrazing, falling water table etc.) - in order to visualise this on the diagramme, take a reverse value.	
Plant health (presence of pests, diseases and weeds, crop damage)	No more than 10% of the crop area with considerable damage to the yields -in order to visualise this on the diagramme, take a reverse value.	
Dependence on external inputs (% of inputs originating from outside of farm)	More than 70% of inputs (biomass, nutrients, water, etc.) originating on farm	
Level of food self-sufficiency (% of food originating on farm)	More than 80% of food consumed by family produced on farm. More than 9 months of household food provisions available.	
Interactions and bio-resources flows between farm components (recycling of crop residues and manure; effective use of biomass, complementarities between plants; level of natural pest control, etc.)	More than 70% of non-saleable biomass originating on farm is re-used on farm or in immediate vicinity	
Resilience to external disturbances (capacity to resist and recover from pests, droughts, storms, etc.)	This value depends on the farmer's self-assessment based on own experiences, value between 0 and 10 where 0 is least resilient and 10 is highest	
Use of renewable energy (windmills, biogas etc.) and level of energy self-sufficiency	More than 70% of the energy to run the farm originates internally (biogas, windmills, solar, animal or human labour, etc.)	
Other potentially relevant:		
Income of the farm, its stability or positive development	On-farm income is stable or increasing taking into account the production costs and inflation rate (at least 30% income surplus)	
Social networking, employment	Direct sales, visitors to the farm	
Area of habitats protected by national legislation or maintained for nature voluntarily, number of species characteristic of nature-friendly farmland occurring on the	Percentage of the farm or number of species - whichever is most applicable	

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farm or the area of the farm where they occur		

Task 2. Visualise the indicators and compare them.

Once the indicators are ranked, the students can visualize the conditions of the farm, noticing which of the landscape, soil or plant attributes are sufficient or deficient compared to the threshold value of 5. The results can be visualized by an amoeba-type graph (Figure). The closer the amoeba approaches the full diameter length of the circle the more sustainable the system is (a 10 value). Farms with an overall value lower than 5 in soil quality and/or crop health are considered below the sustainability threshold. It is here that a farmer / group of framers / whole community should prioritize interventions. Farms with values above 7- 8 can be considered "lighthouses", and their experiences could be featured in field days or other farmers exchange activities.

Farms across the whole landscape can be compared this way, or the same farm can be followed across years.

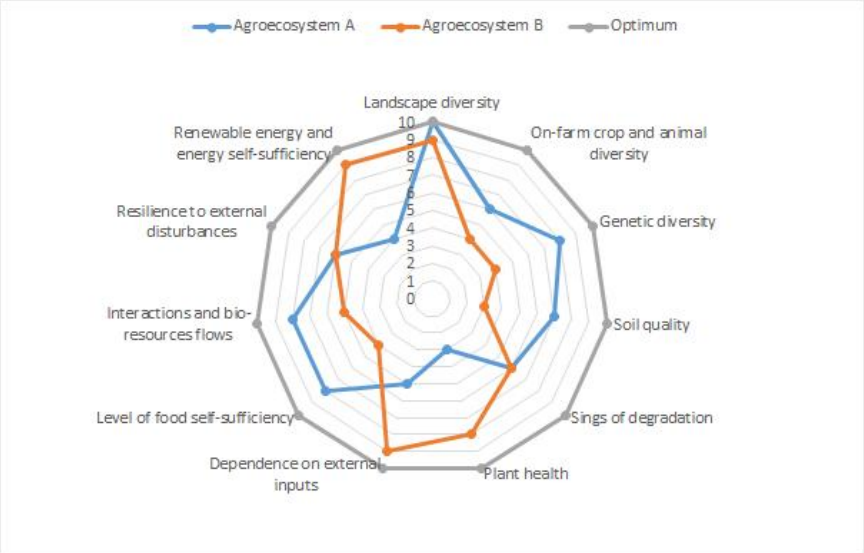

Figure. An example of an amoeba type diagram visualising the farm's performance on the indicator values in two agroecosystems. The optimum is set at 10. Modified after Altieri 2016.

Authors: Irina Herzon, University of Helsinki; adapted from Altieri, M. (2016).

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IV. Training for advisors

10. Management plan for a semi-natural grassland

Type: Project-based assignment

Suitable for: vocational education level, also for advisors creating training module for farmers

Duration: 8 hours classroom work, 8 hours field visits (2 trips), estimated 5 hours independent group work including expert feedback and revision. A final student seminar is optional.

Objectives:

To become acquainted with the basic principles and reasoning for semi-natural grasslands conservation and management that supports nature values;

Learn to recognize and systematically describe semi-natural grassland qualities and nature values;

Gain skills to complete a management plan, including restoration if necessary, of a semi-natural grassland parcel.

Background.

Semi-natural grasslands and grazed woodlands (hereafter “semi-natural grasslands”) are the most important farmland areas for biodiversity, and their presence is the most important feature of High Nature Value farmland in the EU (Collins and Beaufoy 2012). They harbour the majority of EU farmland biodiversity and farmland carbon and also provide water catchment services on farmland (*ibid*). In most European countries, the areas of semi-natural grasslands have declined and are threatened by inappropriate management, ranging from substantial land use change (e.g. afforestation) to intensification or abandonment. Management and restoration of the semi-natural grasslands across the EU are supported with funds from the Rural Development Programme (agri-environment-climate measures and non-productive investment) and other sources.

For conservation measures to be effective, each grassland parcel should have a management plan. Having a management plan is also important, or in some countries is a prerequisite to enter the management agreements under the agri-environment-climate measures. In Finland, for example, the management plan describes actions for compliance with established best practice (*e.g.* grazing pressure appropriate for grassland type, plan for removal of hayed material, appropriate consideration for conservation of protected species and culturally important archaeological structures and artefacts). These management plans are made either by consultants or the farmers themselves. Another approach is found in Latvia. In 2016, Latvia instituted obligatory training for farmers applying for or already receiving payment for semi-natural grasslands. The training focuses on grassland management and requires that the participants each make a management plan for one of his/her grassland parcels. This assignment is adapted from the Latvia training and draws on the experience in Finland. It does not aim at developing the management plan of a standard required for the official application for the agri-environment-climate funding, though it could support it. Instructors should adapt the training to the particular circumstances of their country.

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Methodology.

Stage 1. Theory and principles (c. 4 h):

1. Introduction to semi-natural grasslands (c. 1 h lecture, 0.5 h interactive work): semi-natural grasslands in Europe and in own country, their classification, values for production, conservation and other, distribution, threats.
   An interactive activity could include group brainstorming, where participants (either as a class or in break out groups) list all grassland values of which they are aware and which they use.
2. Introduction to the national-level public support for semi-natural grasslands (c. 0.5 h presentation): the relevant agri-environment-climate scheme(s) in the country, their key prescriptions.
3. Introduction to inventories and management plans (c. 1 h lecture, 0.5 h interactive).
   a) The concept and main objectives for inventories and management plans
   b) Essential and desired elements for a management plan: type of grassland, management history, description of current condition and management, maps, species inventory (not essential), special considerations (historical, rare species, landscape/aesthetic value, etc.), aims/desired outcome for management, plan for future management (incl. costs and farmers wishes- e.g. fits his/her farm production and available resources).
4. Preparation for upcoming farm visit (0.5 h): intro to the objectives, place and material that will be used.

Stage 2. Field day 1 (c. 4 h):

Visit a grassland representing different semi-natural grassland types, preferably with adjacent cultivated grassland for comparison. Students should receive a map of the grassland and the inventory and management plan worksheets (if they did not receive the materials in class). If a management plan exists for the farm, students can get this also.

1. Introduction to the farm and the grasslands (c. 1.5 h): The format may include, for example:
   a) Farmer explains grassland(s) management history and current management, as well as provide a short background about the farm. Students ask questions and fill in the Worksheet 1a (c. 1 h).
   b) Expert (*e.g.* ecologist, botanist) introduces main semi-natural grassland habitat types, shows dominant, typical and indicator species, drawing comparison with the cultivated grassland; students name species they know and ask questions (c. 1 h).

2. Students work in pairs or small groups to assess the current management (30-50 min).
   a) Option 1: If a management plan exists for the semi-natural grassland, the students should evaluate it using Worksheet 1b.
   b) Option 2: If no management plan exists, students should conduct an assessment of the current management based on available information (written materials, farmer, and expert) and own observations. Recommended method is Strengths Weaknesses Opportunities Threats (SWOT analysis) and recommendations for management Worksheet 1c.
   c) NOTE: In both cases, students should fill in Worksheet 1a. This worksheet will be part of the management plan, and can continue to be developed in Stage 4 (below).

3. Discussion (1 h)

If groups were assessing a management plan, they can each present and discuss their findings. If groups conducted a SWOT + recommendations, they discuss these findings.

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Suggestions for discussion: Did the different groups come up with similar answers or different? Why-how does own focus affect making the management plan? What grade would they give to the management plan/management?

Alternative: students can complete the evaluation of the management plan or the SWOT as a homework assignment. The instructor will need to allocate some time for presenting the results during Stage 3.

Stage 3. Theory and principles (c. 4 h).

1. If necessary, groups present and discuss their results from Stage 2 (0.5 h).
2. Use a whiteboard (or an online interactive tool, such as Flinga) to make a collective SWOT based on the results from field day 1 (0. 5 h). What are the key issues learnt and what questions remain?
3. Inventories and management plans for restoration and management. Presentation includes topics: (2.5-3 h - could be broken up by an interactive activity below)
   a) How habitat mapping is done
   b) Best practices in habitat management, innovative solutions
   c) Restoration of grassland habitats
   d) Importance of farmer/landowner views, knowledge, resources for successful management
   e) Key sources of advice available nationally or internationally
4. Interactive activities (0. 5 h) can include brainstorming on, for example, management solutions, the role of the farmer in successful management and the skills and knowledge needed, etc.
5. Introduce the management plan worksheet (Worksheet 2) and/or management plan form for semi-natural grasslands in your country, if available (0. 5 h). Give time for the student groups to think about questions they would need to ask the farmer during the upcoming visit in order to complete the plan form.

Stage 4. Field day 2 (c. 4 h): Grassland inventorying and creating a management plan.

1. Students in small groups of 3-4 will conduct a grassland inventory and develop a management plan for it using the worksheets provided (Worksheet 2). The options include: groups work on different parts of the farm's semi-natural grassland (if it sufficiently large and diverse) or on different types of semi-natural grasslands, if logistically situated close enough.
2. Students ask the farmer the information they need for the plan and discuss their suggestions with the farmer for feasibility, potential challenges and ways overcoming them.

Stage 5. Independent group work (c. 5 h)

Groups will prepare their management plan based on the completed worksheets. Groups should submit drafts of their management plans, receive feedback and revise the plans, if necessary.

It is important that the instructor (or invited expert) provides feedback on the inventory and management plans. This may be done during class presentations (seminar), separate meetings of the instructor with each group and/or through written feedback on the submitted worksheets, and especially Worksheet 2c (Management Plan). Revision of the inventory and plan may be required before the final submission and sending it to the farmer.

Notes to teacher/facilitator:

This training works best with participants who have basic understanding of grassland ecology. Understanding of grasslands as production farmlands is also an asset. Depending on the level of the students, instructors may need to build more time and content into the lesson to cover gaps in these

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topics. Other relevant fields are GIS mapping, botany and knowledge of policy support tools available for grasslands (e.g. agri-environment-climate measures).

This assignment includes visiting at least one farm with semi-natural grasslands and farmer being available to present grassland site and be interviewed by the students. If students work with this farm through the whole training, they should get the contact information for the farmer for scheduling any extra farm visits and for interviewing him/her. The assignment can be adapted so that (some) students, who have connection to a farm (family or neighbours) with a semi-natural grassland, can make the plan for their own farms instead of the farm used in the course. This option is more demanding for the instructor, who needs to plan sufficient time for feedback on diverse sites.

Supporting resources:

Latvia NAT/LV/00371 NAT-PROGRAMME "National Conservation and Management Programme for Natura 2000 sites in Latvia" http://nat-programme.daba.gov.lv/public/eng/habitats/grasslands/ Rūsiņa, S. 2017 Protected Habitat Management Guidelines for Latvia. Volume 3. Semi-natural grasslands. Nature Conservation Agency, Sigulda. 450 pp. ISBN 978-9934-8703-2-3 http://nat-programme.daba.gov.lv/public/eng/documents_and_publications/ - provides general knowledge on ecology and conservation of semi-natural grasslands.
Rūsiņa, S. 2018. Training for farmers in the agri-environment scheme "Maintaining biodiversity in grasslands". Presentation for workshop "The role of Rural Development Programmes in supporting semi-natural grassland management in Boreal countries", 26th–27th July, 2018, Smiltene, LATVIA. Provided to HNV-Link:https://hnvlink.eu/education
Collins, S. & Beaufoy, G. 2012. Improving the targeting, monitoring and management of semi-natural grasslands across Europe – essential steps to achieving EU Biodiversity Strategy targets on farmland. European Forum for Nature Conservation. 45pp.
www.efncp.org/download/grasslands_report_2012.pdf - background of grasslands as important High Nature Value farming areas.

Authors: Solvita Rūsiņa, University of Riga, Traci Birge and Irina Herzon, University of Helsinki.

FARM VISIT 1 INTRODUCTION TO MANAGEMENT PLANS
COMPLETE WORKSHEET 1a AND EITHER WORKSHEET 1b OR 1c.

Worksheet 1a FARMER INTERVIEW (Farm visits **1** and 2)

Farmer/landowners' views about grassland management	
What does the farmer think about the current management? (satisfied, too much work, etc.)	
What are the farmer's aims for management?	
What does the farmer want to change/ improve?	
Does the farmer have knowledge about	

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grassland nature values and how to support those values through management? Describe.	
In the farmer's view, what does he/she need to achieve management that supports nature values? (e.g. advisory support, money, grazing animals)	
Other considerations? (e.g. farmer unsure about future of the farm or expecting change such as increasing/decreasing grazing animals)	
Notes for management recommendations	

Worksheet 1b. Reviewing **a** management plan (Farm visit 1)

Consider the inventory and management plan elements you learned about in class*. What is the quality of the management plan- is it complete? What elements are missing? *Grassland type, site history, description of current condition and management, maps, species inventory (not essential), special considerations (historical, rare species, landscape/aesthetic value, etc), management aims, plan for future management (incl. costs)	
What values (e.g. specific biodiversity or landscape aims) are being targeted in existing management and what are left out?	
Is the plan sufficient to achieve the aims? Describe.	
Evaluate the plan vs. actual management, paying attention to the	

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actions (e.g. mowing, grazing) and the aims. Does the plan match the management that you viewed in the site visit? Elaborate your answer based on your observations and the talks by the farmer and field expert.	
Based on the plan and the site visit, what are the main management problems (e.g. under- or overgrazing, fencing problems, trampling, etc.) and possible solutions?	
What are your recommendations for improving management and the management plan? Make sure to take the nature values into consideration!	

Worksheet 1c SWOT and Recommendations for Grassland Management (Farm visit 1)
Base findings on your observations in the field and the information from the farmer and expert.

Strengths (e.g. long management history, high biodiversity value)	Weaknesses (e.g. insufficient grazing pressure, history of fertilization)
Opportunities (e.g. quality can be improved through specific management, i.e, adjusting grazing pressure)	Threats (e.g. becoming overgrown, farmer unsure about continuing management)
Considering the SWOT findings, provide, recommendations for improving management.	

MAKING A MANAGEMENT PLAN
Worksheet 2 will form the basis of a management plan which, in the end, will be comprised of these sections and also incorporate the knowledge gained in worksheet 1a. Use maps to further illustrate the final management plan.

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Worksheet 2 MANAGEMENT PLAN (adapted from Latvia Fund for Nature training for grasslands management and Finnish inventory for rural biotope field visit - Rūsiņa, S. 2018)

PART 1: INVENTORY	
I. Basic information	
Name of person/group making the inventory:	
Location	Site name and number: Farm name: Municipality/country region: Site coordinates: Location description (e.g. aspect, nearby waterway or other features)
Ownership	State, municipality, private individual, other _____ Name: Address: Phone:
Grassland type* *Use the classifications appropriate for your country (e.g. Natura 2000 or other)	List grassland types and estimated percentage of each if site contains multiple grassland types
Known conservation enrolment or classification status	(examples: Natura 2000, Birds Conservation Area, Valuable Rural Biotope designation)
Current land use Answer y/n on use types; If possible, describe use: e.g. "c. 40 sheep and their lambs for	Describe the land use (e.g. whether abandoned, in production, managed specifically for nature conservation, etc.) Grazing: Haying: Forestry:

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summer grazing c. 4 month/yr"	Other:
II. General inventory	Site character (main features such as aspect, drainage, improvements, rocky, wet, etc): Borders (e.g. road, forest, field, conservation area, waterway): Soil type(s): Buildings: Landscape contribution (describes how the site fits into the landscape and whether it "adds value" to the landscape, e.g. shoreline grassland keeps shoreline open):
Sub-area inventory * *Repeat for all sub-areas in the site **Note general qualities, e.g. estimated area, management level (under/overgrazed) and other information of interest (e.g. fauna, fungi, constructed drainage, etc) ***only if different from main land use description	Wooded area: tree height:_____ coverage %_____ Tree species: **Description of area: **Management (past & present): Scrub and young trees: coverage %_____ **Description of area: ***Management (past & present): Grassland: dominant plants: typical plants: indicator species (e.g. Species of conservation importance): **Description of area: ***Management (past & present):

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PART 2: MANAGEMENT

III. Restoration activities	Necessary	Not necessary	Start date (past or future planned)	Grassland name/no.
Restorative clearing of brush				
Restorative mowing				
Restorative grazing				
Restoration of hydrological regime explanation (e.g. filling ditches, removing berms)				
Reduction of soil fertility				
Creation of species-rich sward				
Other, describe (e.g. conservation of culturally significant elements like stone walls or burial mounds)				

IV. Management activities		Current actions already undertaken	Planned actions	Grassland site (name or no.)
Mowing	Frequency/season:			
use dates where possible.	Earliest mowing time. Latest mowing time: Animal friendly mowing (y/n): - unmown islets/patches - Scaring devices - Mowing from centre to edge Mowing height (in cm): Hay removal (y/n): - large bales - stacks - small bales - silage - other (indicate)			

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	Post mowing grazing: Controlled burning: Harrowing:			
Grazing	Grazing period (x month-y month) Total number of weeks or months: Daily regime - only night grazing - only day grazing - day and night grazing Stocking method - Controlled rotational grazing - Single enclosure during whole grazing period - other (indicate) Grazing animals: - Cattle (list breed, herd composition, production e.g. meat or milk) - Sheep (list breed, herd composition, production e.g. meat or milk) - Other Grazing pressure (livestock units) Post-grazing mowing?			

V. Summary of key management recommendations.
This should include the areas in need of most urgent attention (e.g. restoration) and the most important nature values (e.g habitat for species of conservation concern) to take into consideration.

List of the indicators for monitoring management plan/ restoration progress.
These may include e.g. sward height, restoration of disturbed or damaged habitat (such as sand pits or trampled area), shift in species composition/presence of indicator species, etc.).

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Appendix A. Key concepts of High Nature Value theme.

HNV farming refers to areas where:

- agriculture is the dominant land use;
- agriculture supports (or is associated with) a high diversity of wildlife species and habitats and/or the presence of species of European/national/regional conservation concern;
- the conservation of these wildlife habitats and species is dependent upon the continuation of specific agricultural practices.

HNV farming systems are systems in which farmland of high nature value has both been created and continues to be maintained. They commonly retain semi-natural vegetation (e.g. unimproved grasslands), apply low amounts of fertilisers and pesticides, use mainly labour intensive practices, and keep traditional livestock breeds and crop varieties that are highly adapted to local conditions. Four broad types of HNV farming systems have been identified (Oppermann *et al.* 2012):

- Livestock dominated production systems – by far the commonest type; encompasses various low intensity livestock production using semi-natural vegetation for grazing and hay-making.
- Arable dominated production systems – relatively rare at EU level, but extensive dryland cereal cropping with fallows still exists on a large-scale in Spain and Portugal.
- Permanent crop dominated production systems – traditional orchards of fruits and nuts, traditional vineyards and low intensity olive and carob groves; particularly common in the Mediterranean region and south-east Europe.
- Mixed production systems and mosaic HNV landscapes – these are regionally important in many countries, but uncommon in some others.

Finally, HNV farmland is the main component of the HNV farming system that encompasses the habitats where the abundance and diversity of wildlife species is actually found. In some cases, HNV farmland dominates the agricultural landscape, in other cases it is present in small fragments within more intensively farmed or forested landscapes. Three types were identified (Anderson *et al.* 2003):

- 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, stone walls, patches of woodland or scrub, small rivers etc.
- Type 3: Farmland supporting rare species or a high proportion of European or world populations.

Sources:

Andersen, E., Baldock, D., Bennet, H., Beaufoy, G., Bignal, E., Brower, F., Elbersen, B., Eiden, G., Godeschalk, F., Jones, G., McCracken, D.I., Nieuwenhuizen, W., van Eupen, M., Hennekes, S., and Zervas, G. (2003). Developing a High Nature Value Farming Area Indicator. Consultancy report to the EEA, European Environment Agency, Copenhagen.

Oppermann, R., Beaufoy, G. and Jones, G. (Eds.) (2012). High Nature Value Farming in Europe. Verlag Regionalkultur, Ubstadt-Weiher.

Keenleyside, C., Beaufoy, G., Tucker, G., and Jones, G. (2014). High Nature Value farming throughout EU-27 and its financial support under the CAP – a report prepared for the European Commission DG Environment by the Institute for European Environmental Policy and the European Forum for Nature Conservation and Pastoralism. Available online.

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Appendix B. Major pollinator groups.

<table>
<tr><td>Honey bee
(Apis mellifera)
  </td><td colspan="2">Solitary bees</td></tr>
<tr><td></td><td>Mining bees
(Andrena sp.)
  </td><td>Grey mining bee
(Andrena cineraria)
  </td></tr>
<tr><td colspan="3">Bumblebee (Instructions for bumblebee identification:
https://www.bumblebeeconservation.org/identification-tips/)</td></tr>
<tr><td>White-tailed bumblebee
(Bombus lucorum)
  </td><td>Red-tailed bumblebee
(Bombus lapidarius)
  </td><td>Tree bumblebee (Bombus hypnorum)
  </td></tr>
<tr><td colspan="3">Hoverflies</td></tr>
<tr><td>Marmalade hoverfly
(Episyrphus balteatus)
  </td><td>Dronefly (Eristalis sp.)
  </td><td>Bumblebee hoverfly
(Volucella bombylans)
  </td></tr>
<tr><td colspan="3">Other pollinators</td></tr>
<tr><td>Bee beetles (Trichius fasciatus)
  </td><td>Small tortoiseshell
(Nymphalis urticae)
  </td><td>Sawflies (Symphyta)
  </td></tr>
</table>

Photos: M. Toivonen, H. Rajanen and J. Toikkanen.

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About the authors

Dr Irina Herzon is an agroecology lecturer in the Department of Agricultural Sciences of University of Helsinki, Finland. She holds a university pedagogy diploma and has 20 years of experience in higher education in Finland and internationally. Her main teaching areas are ecology, biodiversity in farmland, ecosystem services, nature management on farms. In her teaching, Dr Herzon implements many interactive student-centered methods with hands-on tasks and project-based assignments.

Dr Traci Birge has a degree in agroecology from University of Helsinki, where her research focuses on farm-level decision-making for high nature value farmland and biodiversity conservation targets. She has taught courses in restoration and management of cultural landscapes, and lectured on topics of ecosystem services and international conventions for environmental protection.

Dr Joséphine Pithon is a lecturer in ecology at the Ecole supérieure d'Agricultures d'Angers, France. She teaches fundamental ecology, applied and conservation ecology to students of agriculture or environment at higher level. She has led courses in general environmental science, ecoagriculture and landscape ecology. Over the past ten years, she has been involved in several national and regional projects, involving farmers, advisors and scientists, aiming to develop tools for the assessment and management of biodiversity at farm scale.

Dr Solvita Rūsiņa holds a position of associate professor at the University of Latvia, Faculty of Geography and Earth Sciences. She holds a geography diploma and has 17 years of experience in higher education in Latvia. Her scientific interests are semi-natural grassland vegetation ecology, management and restoration. She has a diverse experience in teaching of university courses in biogeography and biodiversity conservation, as well as in teaching of field courses in semi-natural grassland habitat identification and management for habitat experts and for farmers.

Dr Marjaana Toivonen is a post-doc researcher at Finnish Environment Institute, Helsinki. Her current research focuses on pollination services and on-farm practices of enhancing native pollinators. She has diverse experience in teaching in-class and in-field activities of university courses, as well as popularising science.

Prof Tomas Roslin currently works at the Swedish University of Agricultural Sciences. His research expertise ranges from functions of dung beetles in farmland to food-webs in the High Arctic. He developed numerous courses in ecology, conservation biology, agroecology and meta-population biology and is active in popularising science.

Dr Guillaume Pain is a lecturer in landscape ecology at the Ecole supérieure d'Agricultures d'Angers, France. He has extensive experience of teaching at higher level and has been responsible for the creation and coordination of Masters courses in agroecology, GIS, landscape ecology and ecological planning. He is interested in applying landscape ecology to the management of biodiversity in rural and agricultural landscapes and has been scientific coordinator of two major interdisciplinary projects focusing on the links between agriculture, biodiversity and public policy.

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