# Grasslands, Biodiversity and Business

Latvian Fund for Nature
December 2019

## Author:

Traci Birge, DSc. Agriculture and Forestry,
Department of Agricultural Sciences and HELSUS Helsinki Institute of Sustainability Science, University of Helsinki, Finland



## Editor:

Inga Račinska, GrassLIFE, Latvian Fund for Nature

## Advisors:

Andrejs Briedis, Baiba Strazdiņa (GrassLIFE, Latvian Fund for Nature) and Solvita Rūsiņa (GrassLIFE, University of Latvia)

## Contributions to the report:

Annely Holm, (LIFE+ Nature project LIFE to alvars project coordinator, Estonian Environmental Board) provided suggestions and materials for Estonian cases. Eija Hagelberg (Baltic Sea Action Group, Finland) provided case study suggestions. Anu Vehmaa (University of Helsinki) proofread Chapter 6 “Honey”.

Individuals or organisations who provided feedback for case studies: Anna Carytoniuk, Annely Holm, Bryony Morgan, David Rizzo, Jörgen Andersson, Kristiāna Antonišķe, Marianne Høitomt Dahl, Mārtiņš Bērziņš, Thomas Laursen, Torsten P. Wetche.

## Copy-editing and proofreading:

Jerome Simpson, Outsmart Consulting

## Photos:

All photographs used with permission. Photographs provided by: Traci Birge, Baltic Unique Solutions, Fjällbete, Thomas Laursen/ Wildfooding, Bryony Morgan/ Fair Wild Foundation, Kjartans Honning, AS MADARA Cosmetics, Naturbeteskött i Sverige Ideell förening, Pasture for Life, Savory Institute, Thise Dairy, Hia Sjöblom/ Nature and Game Management Trust Finland, Valdo Kuusemets, Talu Toidab, Avo Kiisk, Silvia Lotman, Juris Ross, Pixabay, Kristaps Kalns and GrassLIFE, Mārtiņš Cīrulis/Institute for Environmental Solutions, Annely Holm.
Cover photo: GrassLIFE, Latvian Fund for Nature.

## Publisher:

Latvian Fund for Nature, GrassLIFE project LIFE16NAT/LV/262
ISBN 978-9934-8885-0-2

## Citation recommended:

Birge T. (2019). Grasslands, Biodiversity and Business. Report to the GrassLIFE project, Latvian Fund for Nature.

More about GrassLIFE project please read on the website www.grasslife.lv

Latvian Fund for Nature gratefully acknowledges the financial support from EU LIFE programme in funding this publication. All opinions expressed in the publication are solely those of Latvian Fund for Nature.

# PREFACE

This study was prepared as part of the EU-LIFE-funded project, 'GrassLIFE: Restoring EU priority grasslands and promoting their multiple use' (LIFE16 NAT/LV/262)[1]. GrassLIFE is led by the Latvian Fund for Nature and focuses on developing, optimising and improving the conservation status of five EU priority grasslands in Latvia. This report contributes to the project objective of improving the economic aspects of sustainable grassland management.

The study consists of three parts: i) a literature review concerning five categories of grassland products and referencing the current state of European scientific knowledge vis-a-vis their potential added value in terms of quality and embedded ethical values, as well as the corresponding knowledge shortfalls; ii) a set of 20 case studies, deriving from the literature review, which describe products of grassland origin and illustrate the ways in which they can be differentiated in the market, for instance, through certification programmes; and iii) a framework and set of tests that can be carried out to assess added value. The product categories (and products) assessed for this study include meat, dairy, honey, grass products, as well as wild medicinal plants. Additionally, two textile examples are included as case studies.

The focus of this study is the Boreal biogeographical region[2] and, specifically, Northern Europe. However, it also includes case studies and research drawn from other regions. The Latvian Fund for Nature will use this study to further develop semi-natural grassland (SNG) products and their marketing in Latvia and to underline the importance of semi-natural grasslands as agricultural farmlands of high nature value.

Briefly, the main results of the literature review are as follows:

- Meat: Evidence shows that product composition varies based on fodder and pasturage, although there are significant data gaps. Notably, however, grass pasturage results in more favourable nutrient composition of meat, particularly in regard to the type and percentage of fatty acids and vitamin E. Grass-based certification helps to differentiate products in the market and communicate to consumers the added value to health, environment and animal welfare. Several of the case studies in Part II of the report describe certification programmes related to meat derived from grass-fed cattle in a range of European countries.

- Dairy: Similarily to meat, milk composition is influenced by pasturage, which affects the quality and composition of final products such as cheese. This, in turn, has ramifications for their nomination as products of Protected Designation of Origin (PDO). As with meat, grass-based certification helps differentiate products in the market. Dairy and meat production are often coupled, and the two product groups are presented together in the case studies. The cases include examples of production, certification, processing and marketing of grassland-based dairy products.

- Honey: Although increasingly sophisticated analysis is being applied to differentiating honey, there remain substantial shortfalls in knowledge pertaining to the identification of honey emerging from particular production systems. Microelements and pollen diversity may be tested using a variety of techniques. 'Forest honey' provides examples of how natural and semi-natural grassland-produced honey could be marketed. Two of the case studies describe raw honey, one collected from semi- natural grasslands in an island environment and the other collected from heaths.

[1] Project homepage please see at www.grasslife.lv

[2] Boreal Biogeographic region - The Boreal Region of the European Union includes most of Sweden and Finland, all of Estonia, Latvia and Lithuania and much of the Baltic Sea

- Grass Products: There are a variety of existing and potential uses for grass from semi-natural grasslands and reedbeds, but the most far–reaching is as biofuel. Research has examined its potential from the perspective of quantity, energetic potential, and environmentally harmful components inherent in the raw feedstock. Overcoming the technical challenges in producing clean energy is a developing field. One of the case studies highlights an energy plant using biomass from semi-natural grassland to produce heat. There also appears to be market opportunity for increasing the production of high-quality thatch for roofing, although competition from non-European countries with regard to price and quality may pose particular challenges. The case of 'pet pellets' – fodder pellets produced from the hay from semi-natural grasslands – is also described.

- Wild Medicinal Plants: Raw material from plant species of grassland origin is used for a variety of culinary, cosmetic and medicinal purposes. There are significant shortfalls in knowledge on the potential differences in composition of herbs collected from grasslands compared to those which are cultivated. However, variations in chemical composition and the bioactivity of wild and some commercially cultivated medicinal herbs have been identified. The sustainable harvesting of grassland-based medicinal plants can positively contribute to social causes and conservation efforts. Certification programmes can also help ensure wild harvesting is maintained at a sustainable level. Case studies concerning medicinal plants include a certification programme, supply of semi-natural grassland-sourced raw material, and companies using grassland-sourced plant material in their cosmetic products.

These findings show that there is opportunity to develop production, entrepreneurship and marketing measures, with particular emphasis on the added value inherent to semi-natural grassland products in all five categories.

# ACKNOWLEDGEMENTS

Latvian Fund for Nature gratefully acknowledges the financial support from the EU LIFE programme in funding this publication, as part of the GrassLIFE project LIFE16 NAT/LV/262. All opinions expressed in the publication are solely those of Latvian Fund for Nature and the author.

The author and the Latvian Fund for Nature wishes to thank the following for their contributions to the case studies: Annely Holm for the Estonian case studies (Muhu Mesi, OÜ Lihula Soojus, and OÜ Hiiu Vill), Anna Carytoniuk (Runo Sp. z o.o, Poland), Bryony Morgan (FairWild), David Rizzo (Savory Institute, including Kering Collaboration), Jörgen Andersson (Fjällbete, Sweden), Kristiāna Antonišķe (AS MADARA Cosmetics, Latvia), Marianne Høitomt Dahl (Kjartans Honning), Mārtiņš Bērziņš (Baltic Unique Solutions), Thomas Laursen (WildFooding, Denmark), Torsten P. Wetche (Thise Dairy/ Hvanstrup Farm, Denmark), Pasture for Life (UK).

The author also thanks Anu Vehmaa for proofreading Chapter 6 "Honey" as well as Eija Hagelberg for her case study suggestions. We are also grateful to Cambridge University Press for permission to republish their figures for this report.

# CONTENTS

# 1. INTRODUCTION

## 1.1 Grasslands and their Value to Biodiversity and Ecosystem Services

Grasslands can be classified according to multiple criteria and principles. The extent of human influence is a starting point and concerns all grassland types. The terms in use in Latvia are described in Rūsiņa et al (2017) as: natural grasslands (maintained through natural processes such as regular flooding and grazing by wild animals); semi-natural grasslands (where the species composition is influenced by human activity such as gathering hay and livestock grazing); improved grasslands (created and maintained by human intervention and the use of agro-technical soil amendment, drainage, seeding); and temporary grasslands (sown swards maintained for less than five years as part of a crop rotation cycle). The nuances of these categories and shifting species composition due to farmland abandonment and other changes in management are described by Rūsiņa and colleagues.

'Cultivated grassland' is a term that is frequently used in the literature and is assumed here to have the same meaning as 'improved grassland'. Terms 'Low-input', 'no-input' and 'permanent' grassland are used in the literature on grazing systems and likely include – even if not entirely analogous to – semi-natural grasslands. Especially, "permanent' grassland is a broader term than semi-natural grassland and encompass all grasslands not ploughed at least for several years.

The biodiversity and ecosystem services value of unimproved grasslands in particular is considerable. With the majority of farmland biodiversity found in such habitats, semi-natural grasslands (alongside grazed woodlands) are typically considered High Nature Value (HNV) farmland[3] in the European Union (EU) (Collins and Beaufoy, 2012). They are recognized for providing regulating, provisioning and cultural ecosystem services (Peciña et al, 2019; Rūsiņa et al, 2017). These habitats, for example, host the majority of EU farmland carbon; provide water catchment services; provide habitat for crop pollinators and regulate nutrients and reduce soil erosion; are a source of agricultural goods; and contribute to culture, social identity, tourism and more (Peciña et al, 2019; Rūsiņa et al, 2017; Collins and Beaufoy, 2012).

© Kristaps Kalns/GrassLIFE

**Grasslands provide a wide range of ecosystem services**

In most European countries, semi-natural grasslands and grazed woodlands have declined and are threatened by inappropriate management ranging from substantial land use change (for example, afforestation) to intensified use or abandonment (Oppermann et al, 2012). The sustainable management and restoration of these habitats across the EU's Member States (MS) is supported by the Rural Development Programme (through so-called agri-environment-climate measures and non-productive investments, i.e. purely environmental improvements) and other (including national) funding sources. However, high nature value farming such as that conducted on semi- natural grasslands and grazed woodlands is disadvantaged throughout the EU due to conflicting objectives in the Common Agricultural Policy (CAP), which directs most financial resources towards production systems that degrade common environmental resources (Pe'er et al, 2017; Asociación Trashumancia y Naturaleza and WWF/ Adena España, 2018).

[3] Defined by Anderson et al (2003) as 'areas in Europe where agriculture is a major (usually the dominant) land use and where that agriculture supports, or is associated with, either a high species and habitat diversity or the presence of species of European conservation concern, or both'.

## 1.2 Grassland Products as Value-Added Agriculture

The term 'value-added agriculture' has traditionally referred to processing of raw products, but it may also describe mechanisms for increasing producer revenue by creating closer connections between producer and consumer in the supply chain and to enhancing product value through a products' identity characteristics that may not be physically seen (Lu and Dudensing, 2015). Examples of the former include farm-based sales to consumers and local foods initiatives. This is also referred to as 'values-based supply chains' (UC 2017; Hooks et al, 2017). Identity characteristics result from production methods, such as organic farming, that may have environmental, social, or animal welfare benefits or that enhance the quality of the product (Lu and Dudensing, 2015; Ernst and Woods, 2011). In this report, the potential environmental, social, ethical (animal welfare) and quality benefits that may result from the methods of production and sales of grassland products are referred to as 'embedded values' or the 'added value' of the grassland products. These concepts are briefly introduced below, with Figure 1.1 illustrating the difference between traditional added value based on capturing value later on in the supply chain compared to producers gaining benefit from the intrinsic value of the product due to its identity characteristics. Figure 1.1 shows that these different types of added value are not mutually exclusive. More in-depth discussion on added value is found in Part III: Framework for Assessing Potential Added Value in Grassland Products.

Although semi-natural grasslands were traditionally created and maintained through human economic activity, changes in agricultural practices have diminished their importance for fodder production and reduced the number of people working on farms. In many cases, there are neither sufficient incentives nor enough hands available to carry out the traditional, labour-intensive practices under which semi-natural grasslands developed. The biodiversity and ecosystem services which such grasslands support and yield can be viewed as 'public goods' – environmental benefits that accrue to society as a whole. In their

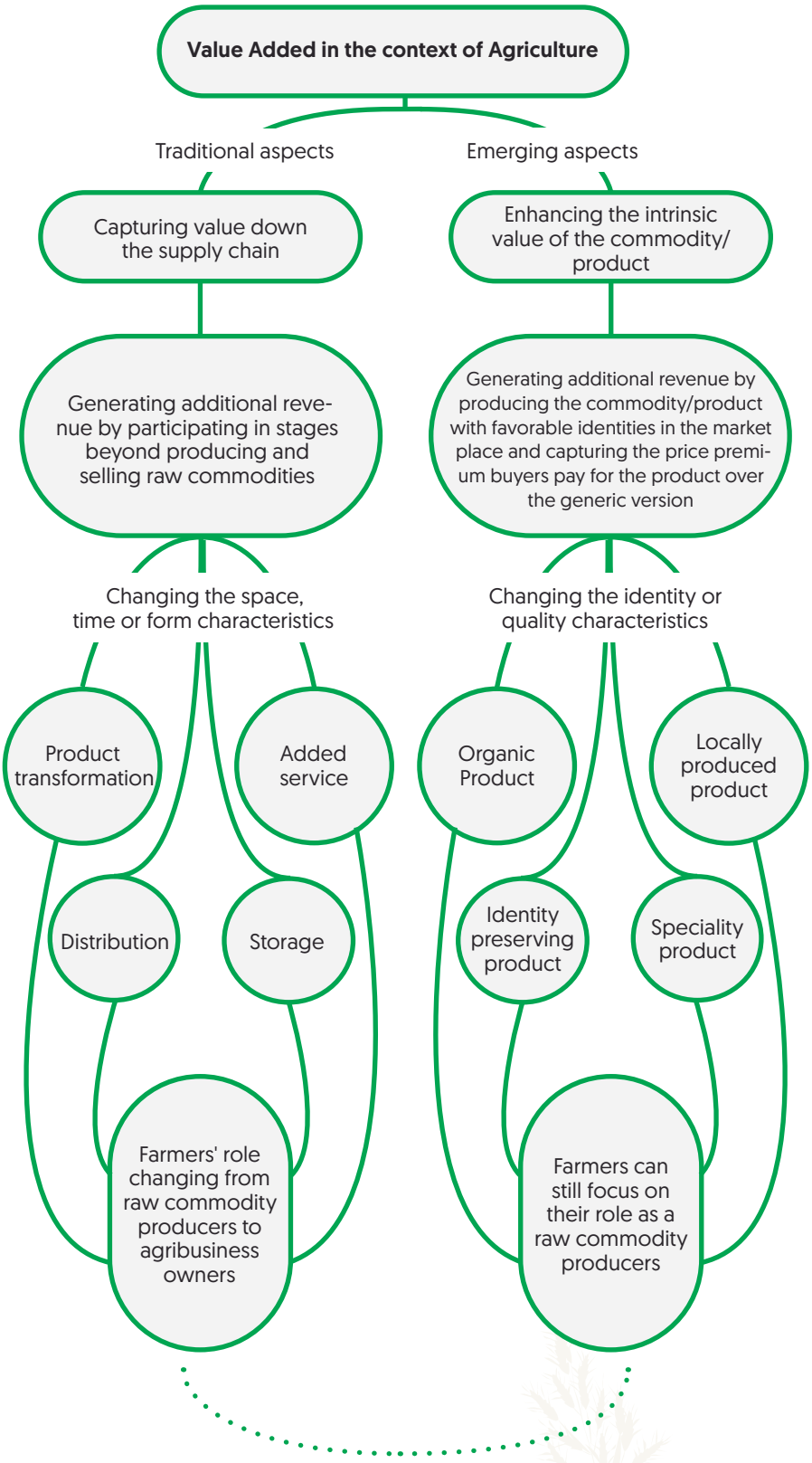



Figure 1.1 Traditional and emerging aspects of value-added agriculture, where traditional aspects refer to capturing value later in the supply chain and emerging aspects refers to product differentiation based on 'intrinsic value' (source: Lu, Dudensing, Ernst and Wood in Lu and Dudensing, 2011).

handbook for Harnessing Markets for Biodiversity, the OECD states:

> "Since certain services are not divisible from others, by coupling a non-marketable good or service (e.g. existence of a species) with a more marketable biodiversity good or service, pure public goods may be preserved without relying on direct private or government provision. Private/public partnerships may work best in these cases." (OECD, 2003 p. 8)

For the added value of such grassland products to be recognized, they must be differentiated in the market through targeted information. When conservation and other 'intangible' goods are coupled to marketable commodities, consumers can 'buy in' to conservation. Honey produced on semi- natural grasslands is an excellent example; the product may be marketed with a strong narrative about the conservation efforts and benefits. Indeed, in cases where conservation is the primary aim, the honey as a product may be secondary to the management actions undertaken. Here, and as implied in the description of emerging aspects of value-added agriculture in Figure 1.1, communication is important in differentiating the product and justifying the higher price. In such cases, consumers understand that they are paying not only for the honey, but for the conservation efforts and outcomes the product represents.

'Commodification' is the transformation of goods, services, ideas, etc. into products which have economic value and can be traded. Products and services can be marketed by coupling a tangible product (for example, meat, honey, wool, or dairy) with values and images the consumer may wish to support. Such embedded added values (or intrinsic value, as in Figure 1.1) can include reduced harm to the environment and improved biodiversity conservation, social values such as livelihoods and supporting cultural heritage, and animal welfare. Product differentiation may be as simple as the producers communicating product value directly totheir customers (e.g. in on-farm shops and in local markets) or as complex as sophisticated marketing and/or participation in certification schemes that assure and relay the values embedded in the products. This study presents a range of real-world case studies that illustrate the ways in which added value is both developed and coupled to marketable products.

© GrassLIFE

**Grasslands support agriculture by providing habitat for pollinators**

The potential nutritional benefits and high quality of semi-natural grassland products can be important for their successful marketing. Sensory qualities, such as texture, odour, aroma and taste are also important indicators of product quality (Stypinski, 2011). This study reviews the current state of knowledge on the potential quality differences between grassland and non-grassland produced products.

There is an ongoing challenge to supporting Europe's semi-natural and low-input grassland systems[4]. Knickel and Maréchal (2018) state:

> "In general, we found that the provision of public goods and ecosystem services from farmland and forests is stimulated by policy interventions, planning and regulations that encourage and support the engagement of the private sector, and of civil society, in joint actions."

[4] See 3.4 'Grassland' – a Note on Terms.

Rural entrepreneurism based on new markets for goods and services is essential to maintaining existing semi-natural grasslands and restoring sustainable agricultural production on abandoned lands. Innovation is necessary: "'Good food' is a fluid concept that is constantly being socially negotiated" write Joosse and Hracs (2015). The choices behind consumer 'food curation' are complex and based on a combination of routine and reflexivity (Joosse and Hracs, 2015). The role of supermarkets as curators is also relevant in terms of their approach to consumer choice and the sustainability of food products – namely, whether they promote or limit products according to embedded environmental, social or ethical values (cf. Fischer and Röös, 2018).

The social and environmental 'embeddedness' of the food system is important to some consumers, particularly those participating in alternative food networks (Morris and Kirwan, 2011). 'Embeddedness' implies a place within a set context and in relationship with other elements – where the social relationships between producer and consumer, as well as their ecological commitments, are fundamental to the functioning of the food network (cf. Morris and Kirwan, 2011). Artisanal and traditional farm products, as well as farm-based tourism and the direct sale of farm products, are short-supply chains where the values embedded in the products can be made explicit to consumers. Furthermore, the European Union and many member states have committed to supporting local foodstuffs through local food strategies (COM 2013 866 final; for example, the Finnish Ministry of Agriculture and Forestry, 2013). Wholesale markets remain relevant, as not all farmers are able or willing to market products themselves, nor are all markets or consumers accessible to farmers directly. Renting et al (2003) assert that spatial embeddedness is more about communication of 'value-laden information' than about the geographical distance between producer and consumer. Certification and product traceability are ways in which products sold wholesale and for processing may be differentiated on the market. This study reviews several certification programmes and examples of traceability as case studies.

© Kristaps Kalns, *GrassLIFE*

**Grasslands serve as a habitat for a diversity of insects**

# 2. AIMS OF THE STUDY

This study is part of the EU-funded project, 'GrassLIFE: Restoring EU priority grasslands and promoting their multiple use' (LIFE16NAT/LV/262). GrassLIFE aims to improve the conservation status of five EU priority grasslands (6120*, 6210*, 6230*, 6270* and 6530*[5]) in Latvia that are fragmented and in need of urgent action for restoration. Because these habitats are dependent on sufficient and appropriate management, GrassLIFE seeks ways in which the sustainable management of grasslands can be made more economically viable and better contribute to rural livelihoods and farm income. The aim of this report is to provide information that can be used to improve the economic aspects of sustainable grassland use in Latvia and beyond.

**The study has three parts which reflect its aims:**

**I.** Conduct a literature review so as to: scope semi-natural grassland-related products with high added value in terms of their biodiversity and quality; identify the corresponding availability of scientific data and literature in English; and determine shortfalls.

**II.** Document, based on the literature review, an array of case studies of semi-natural grassland products from within and beyond the Boreal biogeographical region that illustrate the ways in which they are differentiated on the market and their claims (for example, health or environmental).

**III.** Present a framework for the assessment of quality and the added value of semi-natural grassland-based products in order to assist with identifying, quantifying and comparing the: i) potential differences with non-grassland or cultivated[6] grassland-products; and ii) the potential values, including non-tangible social and environmental goods and services (e.g. ecosystem services), embedded in grassland-based products.

[5] * indicates a priority habitat as listed in ANNEX 1 of EU Habitats Directive

[6] 'Cultivated grasslands' include improved and temporary sown grasslands, see 3.4 'Grassland' – a Note on Terms.

# 3. MATERIALS AND METHODS

The study consists of three parts as described in aims. The product categories (and products) assessed for this study include meat, dairy, honey, grass products, as well as wild medicinal plants. Additionally, two textile examples are included as case studies (Figure 3.1).

**Product categories and how business and differentiation are addressed in each part of the report**

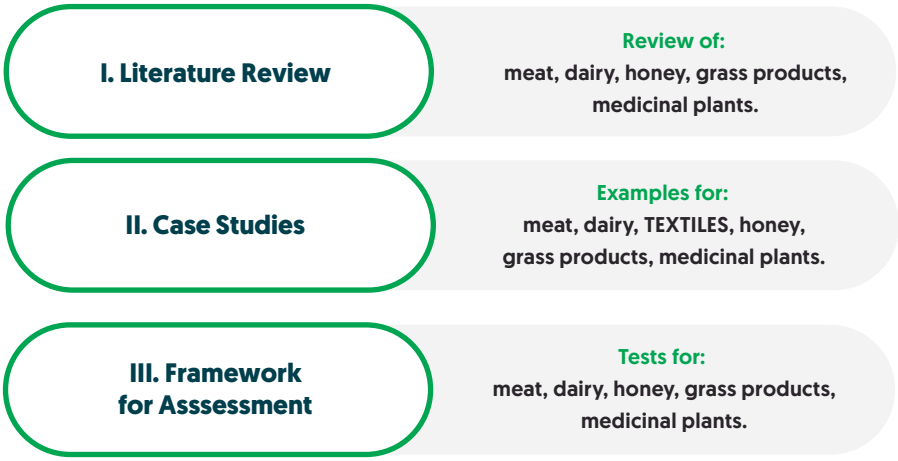



Figure 3.1 Illustrates the aspects of business and grassland product differentiation addressed in each part of the report, as well as the product categories addressed. Textiles are included in the case studies (Part II of the report) but not in the literature review (Part I) or tests for products (Part III).

## 3.1 Literature Review and Product Categories

The literature review began with a search of key and compound words in the article search tool of the Helka Library Database[7], which follows the indexing conventions of ExLibris' Primo Central[8] (see Table 3.1). The starting point was "grassland*" OR "semi-natural grassland*" with and without "Latvia*". Searches continued using "semi-natural grassland*" AND [product category*], as well as "semi-natural grassland*" AND [countries or regions*]. "Grassland*" AND the aforementioned search categories were also explored in some cases (for example in medicinal plants and bioenergy).

Table 3.1 Categories of key and compound words used in a search of articles concerning semi-natural grassland-related products.

| | |
|---|---|
| **Primary search terms** | "grassland*", "semi-natural grassland*" |
| **Country or regional search terms** | "Boreal*", "Denmark*", "Estonia*", "Finland*", "Latvia*", "Lithuania*", "Norway*", "Sweden*", "Northern Europe*" |
| **Product category search terms** | "meat*", "dairy*", "honey*", "wild medicinal plant*", "medicinal plant*", "wool*", "agri-tour*", "grass product*", "thatch*", "reed*", "energy*", "bioenergy*", "biogas*" |
| **Added and embedded values** | "added value*", "embedded value*" "social value*", "nutrition*", "qualit*" "environmental value*" "ecosystem service*" |

[7] HELKA is the joint database of the University of Helsinki library and the National Library of Finland. https://helka.finna.fi

[8] ExLibris' Primo Central https://knowledge.exlibrisgroup.com/Primo/Content_Corner/Product_Documentation/Primo_Central_Indexing

These search parameters provided a starting point, initially yielding a very high number of results (for example, "grassland*" OR "semi-natural grassland*" resulted in 323,801 hits). Adding secondary terms helped narrow the results to more manageable numbers of higher relevance (for example, "grassland" OR "semi-natural grassland" AND "Latvia" yielded 1103 hits; "semi-natural grassland*" AND "Latvia*" realised 75). Table 3.2 is an example of the results derived from the product search.

Table 3.2 Example of search parameters and results for "semi-natural grassland" AND "[product categories]" using the Helka Library Database.

| "semi-natural grasslands*" AND "search term*" | Results |
|---|---|
| meat | 264 |
| beef | 273 |
| dairy | 450 |
| honey | 116 |
| bioenergy | 182 |
| medicinal | 67 |
| Ecosystem services | 705 |

All articles identified by the initial search (grassland* OR semi-natural grassland* AND Latvia*) were reviewed by title and abstract, with relevant articles downloaded (typically search results returned irrelevant articles concerned with ecology, mapping and inventorying of semi-natural grasslands, land use change and land use history, and policy, and were thus disregarded). Titles were also reviewed when completing secondary searches, with promising articles downloaded. The so-called snowball method was also used, whereby relevant references from reviewed articles were further explored. Because the preceding searches yielded substantial literature for semi-natural grasslands, products and marketing, new search terms for added values were tested on an ad hoc basis, using variants of the terms listed in Table 3.1, with the snowball method being used to identify further relevant literature that may have been missed in prior searches.

In determining the relevance of the scientific literature, the following qualities were considered:

**1.** Language: written in English.

**2.** Latvian specificity, including: the Boreal biogeographical region; neighbouring countries; post-Soviet countries or a European Union scope. The search was expanded beyond these contexts where data was limited for example, regarding honey.

**3.** Grassland products, wherein the article must include either: a semi-natural agricultural product component; evidence of the value of semi-natural grasslands (for product coupling); marketing measures relevant for semi-natural grassland-based products; or tests that can be used to compare and validate semi-natural grassland-based products. Examples from non-differentiated grasslands were included in some cases.

Grey literature was also reviewed based on prior source knowledge using the above search parameters and the snowball method. In some cases, non-English sources were examined for keywords alongside trade magazines and specific journals (e.g. Grassland Science in Europe; le Lait for dairy-related products; Apidologie for honey, etc.). Due to time constraints, the literature review is representative of the range of data available as opposed to being exhaustive.

A thematic database was created in MS Excel reflecting the literature gathered per product group (i.e. meat, dairy, honey and grass products as well as wild medicinal plants) together with additional categories for grassland, wool, social (mainly tourism-related), rewilding (as an alternative form of land use), communications and marketing (including predominantly grey literature). For the scientific articles, the aims, results, and tests used were recorded, and each arti-

cle was documented for its relevance to the following areas of interest: ecosystem services/biodiversity; social values/social capital; and methods for testing. The database was refined using an iterative process to reflect the range of data available on semi-natural grassland products. Popular literature, for example, from projects, was also recorded in the database.

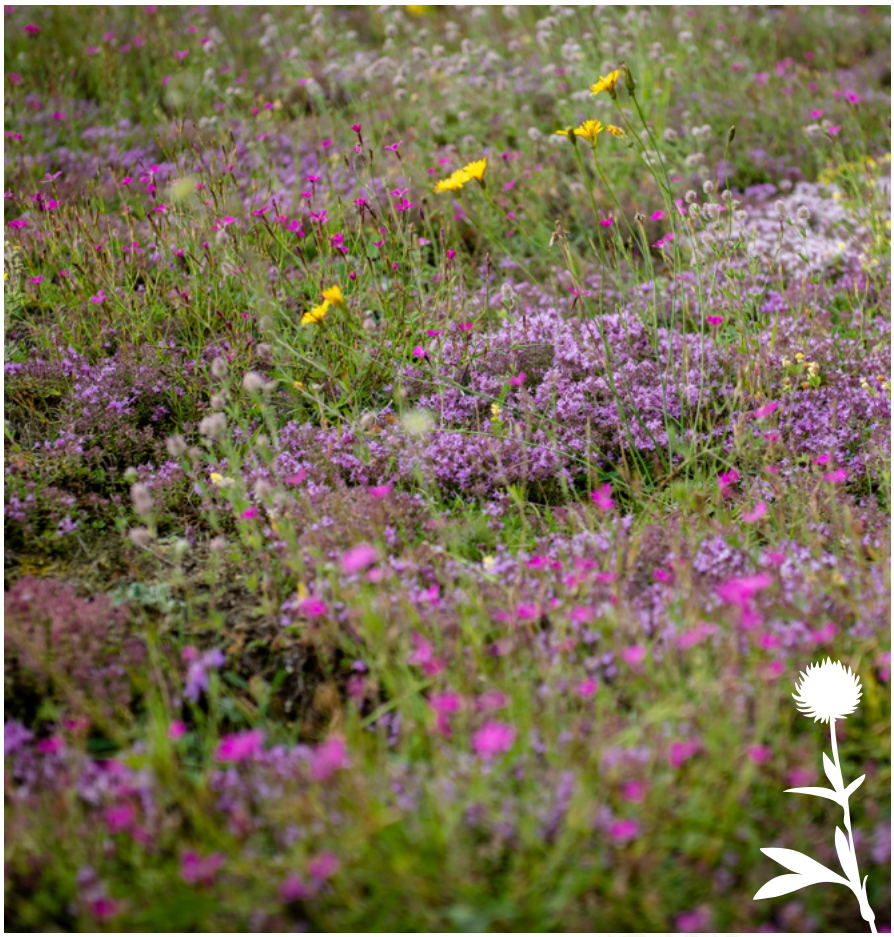
A spreadsheet was also created for ongoing and completed projects relevant to GrassLIFE's objectives, vis-a-vis grasslands, biodiversity and business, that appeared while conducting the literature review. This includes basic information about the project (name, website, and period of implementation, country involved and the funder) and its relevance to GrassLIFE. A selection of relevant projects (not exhaustive) is presented in ANNEX 1.

The results of the literature review are presented according to the five product categories in focus: meat, dairy, honey and grass-based products as well as those medicinal. Each section is accompanied by a sub-section at the start and end entitled Highlights and Conclusions, respectively.

Following these five sections, a common set of conclusions and recommendations closes Part I, reflecting on scientific knowledge shortfalls, consensus, and disagreement.

## 3.2 Case Studies

The examples elaborated as case studies within Part II of this report are based on the results of the scoping study and prior knowledge of semi-natural grassland products. The selected cases examine their unique values and certification (where applicable), as well as provide lessons and inspiration as to how grassland products can be developed and marketed. Most of the case studies fit the five product groups, with meat and dairy examples merged as they are often part of the same case. Additionally, a few individual farms are highlighted because of their particular contributions to semi- natural grassland product development. The examples cite their sources, which are referred to at their end, as well as personal communications. Twenty case studies from eight countries are presented, including some which are concurrently realised in multiple countries.



© Kristaps Kalns, GrassLIFE

## 3.3 Tests and Framework to Assess the Quality of Semi-natural Grassland Products

Various tests and practices that can be used to assess the quality of semi-natural and grassland products and distinguish them from non-grass products were identified during the literature review and are presented, together with an framework for identifying added values of grassland products, in Part III of the study. Further information on how to test product quality and their added value was sought in the scientific and grey literature for the five case study product groups. The suggested tests and their associated references help to illustrate a range of possible next steps when developing semi-natural and grassland products in the Latvian and Boreal contexts. Undertaking any of these would contribute to reducing knowledge gaps regarding the potential embedded values of semi-natural grassland products and contribute to the scientific literature that is currently: geographically limited (for example, regarding the influence of semi-natural grassland types on milk quality); confined to just a few species (for example, concerning wild medicinal plants); or little differentiated between products derived from improved versus semi-natural grasslands.

The framework for assessing added value of grassland products, presented in Part III, was developed for this report and draws on concepts of value-added agriculture and values-based production chains, as well as the bundling of multiple benefits and the coupling of non-tangible ecosystem goods and services with marketable products.

Kristaps Kalns, GrassLIFE

## 3.4 'Grassland' – a Note on Terms

For clarity, this report mainly uses the terms defined in Introduction 1.1 (natural-, semi-natural-, improved-, and temporary grasslands) to refer to the different types of grasslands. However, some allowances must be made for variations in the literature. Thus, other terms common in the literature on grazing systems and animal products are also used here. In the absence of any qualifier, the terms 'grass', 'grass-fed', and 'grazing' are in contrast to conventional grain or concentrate-based fodder. 'Cultivated grassland' is frequently used in the literature and is assumed here to have the same meaning as 'improved grassland'. 'Low-input', 'no-input' and 'permanent' grassland are used in the literature on grazing systems and likely include – even if not entirely analogous to – semi-natural grasslands.

# Semi–natural grassland–related products: scoping of the literature

I

Part I of the report presents the results of the scoping of the literature for the five semi-natural grassland products: meat, dairy, honey, grass products, and medicinal plants. While the focus is on products of semi-natural grassland origin, cultivated grasslands and non-differentiated grasslands are also included, for example where there is insufficient data for semi-natural grasslands alone.

# 4. Meat

- **There are measurable differences in the composition and quality of meat based on animals' diets.**
- **Scientifically supported health claims significant have strong potential to aid marketing of meat and dairy products from grass–fed livestock.**
- **Meat derived from livestock farmed on semi-natural grasslands is more likely to grade lower by conventional meat industry standards, but farmers can overcome this prejudice through alternative market chains that emphasize other values over, for instance, size.**
- **Soil carbon is under-researched, leading to assertions that meat derived from grass-fed livestock has a higher 'climate footprint' than that which is grain-fed.**
- **Mob grazing' – intensive, short rotational grazing – potentially contributes to climate mitigation and offers other positive ecosystem service qualities, compared to both continuous grazing and non-grazing systems.**
- **Consumer preferences regarding taste, texture and cooking qualities may have to be developed through different means (for example, promotional and educational efforts), if consumers are unused to the qualities of meat derived from grass-fed livestock.**

## 4.1 Planetary Boundaries

The benefits, or synergies, of beef produced on semi-natural grasslands concern the environment (especially biodiversity), food security and consumer requirements, while the drawbacks include low animal productivity, carcass quality, labour productivity, greenhouse gas emissions and a dependence on agri-environment schemes for profitability (Bedoin and Kristensen, 2013; Fischer and Röös, 2018). Using a 'planetary boundaries'[9] approach (cf. Rockström et al, 2009) and considering a culturally acceptable and nutritionally adequate diet, Röös et al (2016) estimate that Sweden could cut beef consumption by more than half without any threat to pasture diversity or human health, if the remaining beef production is based on semi-natural grasslands.

Kristaps Kalns, GrassLIFE

**Mobile grazing approach is an innovative multi-benefit grassland management tool applied by GrassLIFE project and Latvian Fund for Nature**

[9] A so-called 'safe operating space for humanity' within environmental limits. Examples of the nine planetary boundaries include biophysical conditions such as ocean acidification, climate change, and chemical pollution, and land system change.

## 4.2 Grazing Systems and 'Global Warming Potential'

A review of the literature for a study on the climate impact of Norwegian meat and dairy found substantial challenges in comparing life cycle assessments for the products due to the differences in the study parameters, including the system boundaries (what is included and what is left out of the calculations) and the methods used for accounting for co-products like meat and dairy (Van Oort and Andrew, 2016). For the most part, life cycle assessments of grass-based production systems have not taken non-fodder ecosystem services into account (de Vries et al, 2015). Reviews of those assessments point towards higher climate impacts of grass-based production systems compared to those which are grain or concentrate-based (Nijdam et al, 2012; de Vries et al, 2015; Van Oort and Andrew, 2016). For example, de Vries et al found the 'global warming potential' to be higher in roughage-based systems (grass and non-grass systems including maize and straw as feed) compared to concentrate-based systems. This was due in part to the faster growth rate of calves and shorter finishing time, as well as lower methane output, of concentrate-based production. For semi-natural grasslands specifically, the review notes that other studies have found the global warming potential to be higher in low-productive and unimproved grasslands compared to intensive grain-based systems (de Vries et al, 2015). These findings are in concurrence with Nijdam et al, namely that extensive rather than intensive ruminant farming has a higher carbon footprint. However, both the Nijdam and the de Vries reviews acknowledge that their conclusions are based on studies that mainly exclude the carbon sequestration potential of grasslands or assume a steady state of soil carbon. Previous studies are also based on one management system – continuous grazing (Stanley et al, 2018).

The importance of including soil carbon in these calculations is significant: in a study on climate change and the carbon balance of European grasslands, Chang et al (2016) found that decreased grazing pressure throughout Europe has inadvertently enhanced soil carbon sequestration. Van Oort and Andrew (2016) also note that the carbon sequestration potential of grazing lands is highly dependent upon soil type and land use history. McAuliffe et al (2018) present a different perspective based on the nutrition value of the different production systems and assert that when the global warming potential implications for sheep and cattle raised on grass is measured by the omega-3 (fatty acid) content produced (measurement of so-called functional units), the results are the opposite to the conclusions of the above studies.

© Talu Toidab

**Products from lamb and beef from Muhu Liha in Estonia**

Mob grazing – intensive, short rotational grazing – may reduce the global warming potential of grazing-based systems relative to both continuous grazing and feed lot finishing systems, whilst providing greater benefits in terms of biodiversity. In a five-year life cycle assessment study of beef cattle in the United States, Stanley et al (2018) found that 'adaptive multi-paddock' grazing has the potential to contribute to climate change mitigation through offsetting greenhouse gas emissions by increasing soil carbon sequestration. Because the system is more intensive compared to continuous grazing, animals reach slaughter weight faster, resulting in lower methane emissions per kilogram of meat. A further benefit of mob grazing is that it is more uniform or complete, which tends to benefit biodiversity (Reed et al, 2019a&b). Other potential benefits of the grazing system are improved recovery time and increased

water retention (Pasture for Life, 2018a). For an example on mob grazing, see the Savory Institute's Land to market Ecological Outcome Verified case study in Section 10.

## 4.3 Nutritional Differences

Meat from Grass-fed Versus Grain or Concentrate-fed Livestock

There is evidence of increased nutritional value in meat products derived from grass-fed animals and further improvement arising from pasturing on semi-natural grasslands compared to improved grasslands (Daley et al, 2010). In a comparison of seven meat production systems, McAuliffe and colleagues (2018) identified beef from forage-fed cattle as having the highest nutrient score. The effect of animal diet on lipid profiles and ratios is significant (McAuliffe et al, 2018; Daley et al, 2010; DeSmet et al, 2004), with species-rich grassland resulting in elevated concentrations of omega-3 fatty acids (Coulon et al, 2004; Fraser et al, 2009).

In their review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef, Daley and colleagues (2010) note that, "research spanning three decades suggests that grass-based diets can significantly improve the fatty acid (FA) composition and antioxidant content of beef, albeit with variable impacts on overall palatability". Later research supports these findings. For example, McAfee and colleagues (2011) found increases in plasma and platelet concentrations of n-3 long chain polyunsaturated fatty acids among test subjects (namely, 38 consumers who were assigned a diet of either grass-fed or concentrate-fed meat portions over a period of four weeks) consuming grass-fed meat. In terms of animal muscle composition, the total fat content was higher in the concentrate-fed animals compared with meat from grass-fed animals (ibid).

*Meat from Semi-natural Versus Improved Grasslands*

Comparing the effects of grazing on improved versus semi-natural grassland has shown that pasture type also affects fatty acid composition of meat (McAuliffe et al, 2018; Fraser et al, 2009). In a controlled trial, Fraser et al found a greater proportion of all the nutritionally important long chain n–3 polyunsaturated fatty acids in meat from cattle grazed on semi-natural grassland compared to those on improved permanent pastures. They conclude, however, that the differences in fatty acid composition were, overall, relatively small. The authors further note that the ratio of beneficial polyunsaturated fatty acids in all the grass-fed beef samples was about two times higher than the British beef average. Fraser and colleagues also found that the loin steaks from cattle grazed on semi-natural grasslands had significantly more vitamin E than those from improved permanent pastures, possibly resulting from either a greater proportion of α-tocopherol or other antioxidants in the sward.

© Kristaps Kalns, GrassLIFE

**GrassLIFE farmers manage semi–natural meadows and produce high quality products from them**

## 4.4 Health, Hygiene, and Consumer Appeal

The United States-based journal, Consumer Reports, tested the bacteria loads within 300 samples of ground beef purchased in stores across the country (Rock, 2015). It found that 18 percent of beef from conventionally raised cattle (finished in feed lots) contained superbugs – bacteria resistant to antibiotics. In contrast, the value for grass-fed beef was 9 percent (Rock, 2015). "We know that sustainable methods are better for the environment and more humane to animals. But our tests also show that these methods can produce ground beef that poses fewer public health risks," stated Urvashi Rangan, Executive Director of the Center for Food Safety and Sustainability at Consumer Reports (Rock, 2015).

Based on the overall health implications of meat from grass-fed versus non grass-fed livestock, McAfee et al (2011) concluded that the former would have greater consumer appeal and added market value. The authors suggest that consumption of red meat from grass-fed animals may "contribute to raising the overall long chain n–3 polyunsaturated fatty acids intake closer to the recommended intake of 450 milligrams per day without a change being made to dietary habits, which in turn would be beneficial for cardiovascular health". Their study was based on the meat consumption habits of Irish consumers.

The biochemical differences between meat derived from grass and grain-fed livestock affect the aroma and flavour of the meat in various ways. In respect to palatability, consumers tend to prefer the flavours they are most used to (Daley et al, 2010). Observations of sensory difference include descriptions such as a 'green' odour in grass-fed beef versus a 'soapy' odour in grain-fed (Lorenz et al, 2002). Pasture type – the difference between rough grazing on semi-natural pasture versus improved grasslands – has also been shown to affect meat colour and stability (Daley et al, 2010; Fraser et al, 2009).

Quality is a relative concept that is approached differently in the conventional meat industry compared to alternative food supply chains, with the latter more willing to overlook quantity in favour of other values (Bedoin and Kristensen, 2013). In some cases, farmers consider semi-natural grasslands as being beneficial to meat and dairy quality (Bedoin and Kristensen, 2013; French 2017). There is evidence that unimproved and conservation-status semi-natural grasslands contain plants with medicinal properties, and farmers and graziers identified some of these plants as being beneficial to their livestock in that they control intestinal parasites (French, 2017; Provenza and Villalba, 2010; Scehovic, 1990, cited in Dumont et al, 2013). Thus, natural pasture grazing or living 'naturally' may also mean that animals are less frequently exposed to antibiotics and other medicines. However, carcass quality from animals under semi-natural grazing regimes has been shown to grade lower than that of animals on improved grasslands, with lower carcass weight an important factor (Fraser et al, 2009; Bedoin and Kristensen, 2013). However, Bedoin and Kristensen determined that there were no negative impacts on carcass quality for cattle herds feeding on semi- natural grasslands up to 45 percent of the time. This finding could be particularly relevant in northern climates, where animals are unable to graze year-round and receive supplementary and preserved feeds such as silage, hay, grains, and concentrates.

Trained taste panels have found that the sensory characteristics of flavour and tenderness of grass- fed beef are less palatable than those of grain-fed beef (Daley et al, 2010). Fraser and colleagues (2009) report that, despite carcass quality scoring lower, their trained taste panel found no major taste differences between beef derived from semi-natural grasslands and that raised on improved permanent grassland. In a simulated retail display, Fraser and colleagues observed that steaks from the semi-natural grassland-grazed animals started with a lower chroma (colour) compared to those from animals grazed on permanent pasture, but that the steaks from the permanent pasture-grazed animals deteriorated faster. Alternative distribution such as direct sales from farms to consumers, especially regarding meat derived from heritage breeds that predominantly graze semi-natural grasslands, can overcome the prejudice associated with the smaller carcass size (Bedoin and Kristensen, 2013).

## 4.5 Conclusions

Meat production is the primary agricultural use of semi-natural grasslands in Northern Europe. Grass-based diets positively impact the nutritional profile of the meat, particularly in regard to fatty acid composition and anti-oxidant properties, but not necessarily the palatability or grading at slaughter. The environmental impact of meat derived from semi-natural grasslands continues to be controversial due to the trade-offs inherent in habitat management by grazing animals on the one hand and the greenhouse gas-related emissions of ruminants on the other. There is increasing research on the carbon sequestration capacity of semi-natural and other grasslands. However, despite its great importance for both climate mitigation as well as for the future of grassland management and grassland-based animal production, it is an understudied topic.

# 5. DAIRY

- **It is generally established that diet affects milk composition and the quality of dairy products. Sward composition and pasturing, for instance, may affect flavour, texture, colour, and nutritional profile.**
- **Grass in the diet positively affects the above-mentioned qualities compared to little or no grass. For example, butter is more spreadable and has a higher nutritional profile when the milking cows consume grass.**
- **There is evidence that the proportion of long-chain polyunsaturated fatty acids is higher in fat from highland dairy products compared to lowland products.**
- **There are substantial gaps in scientific knowledge regarding the effects of the botanical composition of grass swards on the sensory qualities of dairy products.**
- **Due to the soil carbon sequestration in grasslands, increasing grass intake of dairy livestock reduces the carbon footprint of milk..**
- **A higher proportion of grassland in the dairy system reduces biodiversity damage on organic farms.**
- **The suitability of different dairy cattle breeds to semi-natural grassland is understudied.**

## 5.1 Influence of Forage and Pasturing on Milk and Dairy Product Quality

Bijttebier and colleagues (2017) observe that most studies classifying farms according to production intensity have not specifically studied the dairy sector, and that data on differences in milk quality based on semi-natural grasslands versus sown grasslands or concentrated feed is limited.

It is generally established that fodder affects the qualities of milk and dairy products (Sickel et al, 2016; Stypinski, 2011; La Terra et al, 2010; Couvreur et al, 2006; Martin et al, 2005; Coulon et al, 2004; Agabriel et al, 2004; Bugaud et al, 2001b). For example, both milk and meat derived from grasslands, particularly from botanically diverse pastures, have higher concentrations of fatty acids and antioxidants which are favourable to human health (Stypinski, 2011). Milk from the highlands has a higher percentage of long chain polyunsaturated fatty acids compared to lowland products (Martin et al, 2005). Carotenoids are found in higher concentrations in milk produced through grass- based diets, and the sensory value of this is considered positive or negative depending upon consumer preference (Calderón et al, 2006). Nutraceuticals increase in milk as the percentage of native grass in the animals' diet increases, and this may result in increased protection against inflammatory events (La Terra et al, 2010). In a study of Alpine summer grazing in Norway, Sickel and colleagues (2016) found that herbs were the only plant group positively linked to milk yield and could indicate high forage quality.

GrassLIFE

**Milk derived from grasslands that are botanically diverse have higher concentrations of essential fatty acids and antioxidants**

The sensory quality of dairy products is influenced by the chemical and microbiological characteristics of the raw milk (Martin et al, 2005; Agabriel et al, 2004). Maintaining the milk's original character is important for cheeses produced under the 'protected designation of origin' (PDO) label and pasture qualities are a predominant consideration among cheesemakers producing in areas using this designation (Martin et al, 2005, Bugaud et al, 2001a).

Several studies in France have addressed various aspects of pasturing on the quality of dairy products produced with cow's milk. In their study, Martin and colleagues provide a visual representation of the sensory characteristics of cheeses according to the botanical composition of grass. The cheeses assayed are Abondance, Beaufort, Etivaz (a Gruyére-type cheese) and St. Nectaire. The botanical composition of the pastures influenced the sensory properties of cheeses. For example, Poaceae-rich pastures (grasses) resulted in cheese that was more pungent and firm, while the dicotyledon-rich pastures in a dry environment produced cheese that was more fruity and toasted (bread crust) in flavour (Martin et al, 2005).

Studies by Bugaud et al (2001a,b,c) compared the impact of mountain grazing to valley grazing on the composition of cow's milk and those properties relevant to cheese-making. Although the studies identified differences in the milk which affect cheese characteristics, for example fatty acid and terpene composition, they were uncertain of the causes (Bugaud et al, 2001a). Those effects could be due to the botanical composition of forage and bioactive secondary metabolites, mobility and energy expended by the animals while grazing, and altitude in the case of mountain grazing (see Table 5.1; Falchero et al, 2010; Bugaud et al, 2001a&b; Coulon et al, 1998). The consequences of walking long distances or in hilly pastures have been observed for dairy cows, including lower milk yield and a higher somatic cell count – the latter of which can negatively affect the price of milk (Coulon et al, 1998). Despite these documented differences, and the strong views of cheesemakers regarding the cheese-making qualities of milk under different conditions, sensory panellists were unable to differentiate milk from different grasslands in experiments carried out in France (Stypinski, 2011). Couvreur and colleagues (2006) investigated the qualities of butter produced with varying proportions of grass in cows' diets and found that the addition of fresh grass in place of maize silage linearly increased the rheological and nutritional properties of butter, such as easing the spreadability (a result of modifications to the fatty acid profile) and decreasing perceptions of rancid odour (likely due to the decreased lipolysis of milk fat). Hurtaud and colleagues (2007) found that the nature of preserved forage also affects organoleptic characteristics of butter. These sensory and nutritional properties are particularly relevant in regard to criticism of butter's nutritional profile and spreadability compared with margarines and also suggest that butter from cows with access to fresh grass could be considered of higher quality than butter from cows with no or very limited access to fresh grass (Hurtaud et al, 2007).

Reviews of grazing and forage on dairy product quality have been conducted by Dumont et al (2013), Martin et al (2005) and Coulon et al (2004). Martin et al state:

> "Several recent experiments have shown a significant effect of grass botanical composition on cheese texture and flavour. These effects are due to the presence in milk of specific molecules directly introduced by feeding (carotenes, terpenes) or produced by the animals (plasmin, fatty acids) under the effect of specific diets."

Those reviews report several findings from the literature regarding the quality of milk derived from grasslands, including:

- Higher beneficial fatty acid content (conjugated linoleic acids and omega-3 fatty acids) in milk from cows and goats grazed on mountain pasture (Chillard et al, 2007) could be a result of the abundance and diversity of dicotyledonous plants that reduce ruminant biohydrogenation;

- During the cheese ripening stage, terpenes may indirectly modify cheese qualities by modifying the microbial ecosystem, although this link needs more testing (see Martin et al, 2005);
- Besides terpenes, other plant compounds (aldehydes, esters, sulphur compounds) present in grazed plant species can be transferred to cheese (Carpino et al, 2004b);
- Organoleptic characteristics of cheese are affected by the botanical composition of grasslands which, in turn, affects flavour and texture (Bugaud et al, 2001c; Bosset et al, 1999);
- The profile of polyphenol-compounds in semi-natural pastures is closely linked to sward diversity (Reynaud et al, 2010), with phenolic compounds offering antioxidant properties (Farruggia et al, 2008), while "milk phenolics seem particularly interesting as they are present in significant amounts and could contain original nutritionally valuable molecules" (Dumont et al, 2013 citing Setchell et al, 2002);
- Alpine ranges provide fodder with higher levels of a-tocopherol (vitamin E) compared to lowland cultivated pastures (Sickel et al, 2012), while numerous studies show that the addition of fresh grasses from diversified pastures adds yellow colouring to cheeses (see Martin et al, 2005 for a complete list) and imparts floral and herbaceous flavours (Carpino et al, 2004a);
- Preserving grass as silage, in comparison with hay, has no major effect on cheese's sensory characteristics, except on colour, with the cheese being yellower with grass silage;
- Compared to grass (hay or silage), feeding dairy cattle with maize silage leads to whiter and firmer cheeses and butter and sometimes to differences in flavour;
- There are major differences in the sensory characteristics of cheeses made with milk produced by cows on winter diets (based on hay and grass silage) compared with those turned out to pasture in the spring (see Martin et al, 2005 for a complete list).

Table 5.1 A selection of studies from France (by INRA, the Institut national de la recherche agronomique or French National Institute for Agricultural Research) on the influence of pasturing and forage type on dairy quality.

| Study description (reference) | Findings |
|---|---|
| Effect of extreme walking conditions for dairy cows on milk yields (Coulon et al, 1998b) | • Cows that walked daily ate less hay and produced less milk;<br>• The fat and protein content of milk was higher for those cows that walked daily;<br>• Walking induced a rise in body temperature and in plasma non-esterified fatty acids;<br>• The somatic cell count was higher in cows that walked daily and was most marked on the first day and in cows that initially had some minor or major pathogen;<br>• On the first day of walking, the plasma glucose, lactic acid, and cortisol contents of milk were significantly higher while pH, bovine serum albumin and immunoglobulin G1 contents were significantly lower. |
| Alpine pasture influence on milk characteristics (Bugaud et al, 2001a) | • Plasmin activity and the concentration of long-chain polyunsaturated fatty acids in milks produced from mountain pasture grazing were significantly higher than in milks from valley pastures;<br>• Milk's terpene composition was linked to the terpene composition of pastures: milks from the pastures rich in dicotyledons contained a greater quantity and a wider variety of terpenes than milks from those pastures rich in Gramineae;<br>• The content of calcium and phosphorus in milk does not seem to be influenced by the type of pasture. |

| | |
|---|---|
| Relationship between Abondance cheese texture, its composition and that of milk from different types of pastures (Bugaud et al, 2001b) | • Abondance cheeses derived from milk produced from mountain pastures exhibited different rheological properties from those produced with milk from valley pastures: they were less elastic and less deformable;<br>• The cheese's rheological characteristics were mainly linked to the proportion of 18- carbon unsaturated fatty acids, which was higher in mountain milks, and to its proteolysis;<br>• Plasmin activity, higher in mountain milks, could enhance primary proteolysis in the corresponding cheeses;<br>• Differences in sensory texture, which were greater between mountain cheeses than between valley cheeses, were attributed to variations in moisture and salt content. These differences could be linked to the cheesemaking process and also to the characteristics of milks, such as their pH value and acidifying ability. |
| Alpine pasture influence on milk characteristics (Bugaud et al, 2001a) | • Plasmin activity and the concentration of long-chain polyunsaturated fatty acids in milks produced from mountain pasture grazing were significantly higher than in milks from valley pastures;<br>• Milk's terpene composition was linked to the terpene composition of pastures: milks from the pastures rich in dicotyledons contained a greater quantity and a wider variety of terpenes than milks from those pastures rich in Gramineae;<br>• The content of calcium and phosphorus in milk does not seem to be influenced by the type of pasture. |
| Effect of different types of pastures on Abondance cheese's flavour and composition (Bugaud et al, 2001c) | • Cheeses manufactured from milk produced from mountain pastures were deemed to have qualities described as: 'fruity', 'animal', 'boiled milk' and 'hazelnut' and to be less pungent and 'propionic acid' than cheeses made from milk produced from valley pastures;<br>• Different pastures are at least partly attributable to the presence of protein-based volatile compounds in Abondance cheeses;<br>• The valley cheeses had a greater variety of flavours than the mountain cheeses;<br>• Cheeses from gramineae-rich pastures had the most intense 'cooked cabbage' odours, related to the greater amounts of sulphur compounds;<br>• Terpenes, which are more abundant in cheeses produced from dicotyledon-rich pastures, did not contribute directly to cheese aroma;<br>• The differences in flavour between the cheese manufactured by the three surveyed producers were of the same magnitude as those observed between different pastures used by a single producer. |
| Effect of dairy production systems (extensive vs. intensive) on the sensory characteristics of Cantal cheeses (Agabriel et al, 2004) | • Cantal cheeses made from the more extensive farms were more elastic and slightly less bitter and pungent;<br>• Differences between the cheeses derived from the extensive grass-based systems versus the more intensively managed higher production systems were most noticeable among those made in the winter or spring and most significant after 13 weeks of ripening. |
| Effect of grassland maturity stage and grazing management on carotenoids in sward and cow's milk (Calderón et al, 2006) | • Carotenoid concentrations in sward were not affected by grazing management and were only slightly affected by the stage of herbage maturity;<br>• A significant decrease in ß-carotene concentration in milk was observed throughout the course of the grasslands' first growth stage, whereas it increased during the early regrowth stage. |
| Relationship between the proportion of fresh grass on milk fatty acid composition and butter properties (Couvreur et al, 2006) | • Milk yield linearly increased with the proportion of fresh grass in the diet, while fat yield remained unchanged, thus, increasing the proportion of fresh grass in the diet induced a linear decrease in fat content;<br>• Milk fat globule size decreased when the proportion of grass reached 30 percent in the diet;<br>• Increasing the proportion of fresh grass in the diet induced a linear increase in unsaturated fatty acid percentages, at the expense of saturated fatty acids;<br>• These modifications in fatty acid composition resulted in linear decreases in melting temperature and solid fat content in butter fat and linear improvement in butter nutritional content. |

## 5.2 Semi-natural Grasslands and Dairy Breeds

Few studies have been performed that compare old and modern dairy breeds with regard to their adaptation to semi-natural pastures (Bele et al, 2015). Coulon and colleagues (2004) state that, due to variations in fat-protein ratio in milk, breed can influence the texture of cheese. However, large differences have also been observed within the same breed (ibid). Studies on goat cheese from as early as the 1960s and 1970s by Norwegian researchers demonstrated that the traditional 'goaty' flavour desired by consumers of Northern European goat cheese is a result of hereditary qualities and linked to animal breed (see Coulon et al, 2004).

There is some evidence that older or heritage breeds are better suited to production based on semi- natural grasslands compared with modern breeds, but Bele and colleagues' (2015) comparative study from Norway also shows that it is difficult to separate environmental and genetic effects. The same study also found that the older breed voluntarily selected semi-natural pasture, whereas the modern breed selected a greater variety of habitat, including areas with more shrub or overgrowth, and was more selective in grazing grasses. This selectivity could support the notion that older breeds are better 'landscape managers' that graze more uniformly. In another study from Norway, Sæther and colleagues (2006) found differences in fodder preference that showed better adaptability among older breeds for semi-natural grazing. The SOLID project (see Textbox 5.1) notes that 'adapted breeds' exhibit specific strengths such as fewer health and metabolic disorders under low intensity production conditions in certain situations (Scollan et al, 2017 citing Horn et al, 2013).

Textbox 5.1

**IN FOCUS: the SOLID project for Sustainable Organic and Low-input Dairying (2011–2016)**

**Semi-natural grassland-based dairy production is a type of low-input production. The five-year (2011–16) Sustainable Organic and Low Input Dairying (SOLID) project, funded by the European Commission, examined the viability of organic and low-input dairy farming. The authors used external input costs per grazing livestock unit to consider the production curve of high, medium and low input dairy farms.**

**SOLID was conducted across seven EU countries with the aim to: a) provide tools to improve the technical performance of dairy production; b) improve the economic competitiveness of organic and low-input dairy farms; and c) maximise the delivery of environmental goods from the sector and to enhance farm biodiversity. Although the case study farms undoubtedly include some that rely on semi-natural grasslands, the focus is on low-impact grass-based systems versus higher impact grain-based systems. Thus, semi-natural grasslands are not specifically differentiated in SOLID's research.**

**The SOLID project's relevance to GrassLIFE is its teaching materials and research on low-input dairy, as well as its research on consumers and marketing.**
**The project's main conclusions are as follows:**

- Environment: A higher proportion of grassland in the dairy system reduces biodiversity damage and increases carbon sequestration (Scollan et al, 2017). SOLID recommends including more grass in the feed rations of dairy cattle to reduce the environmental footprint of milk.
- Farm competitiveness: SOLID found that low-input dairy farms are diverse and will need country and context-specific solutions. Low-input farms perform relatively well and are less vulnerable to input price shocks from outside the farm (Scollan et al, 2017).
- Consumer viewpoint: SOLID found that consumers favour a 'more natural' process and, out of three innovation choices, ranked 'prolonged maternal feeding' as the most important, followed by agroforestry and, lastly, alternative protein sources (other than soy) for animal feed http://farmadvice.solidairy.eu/how-to-meet-the-consumer. The latter was the most favoured by farmers but poorly understood by consumers. Implementation of consumer-favoured innovations, however, is hampered by a lack of consumer support (i.e. willingness-to-pay) for price premiums beyond organic farming (Scollan et al, 2017).
- Recommendations: SOLID recommends adopting policy measures that support the development of tailor-made business plans, establishment of price premiums and improvement in the supply of home-grown proteins and the use of relevant by-products.

## 5.3 Semi-natural Grassland and Dairy's Environmental Impact

Research on semi-natural grassland-based dairy production and environmental impact is limited compared with that on meat production, especially concerning Northern Europe. This is most likely because semi-natural grasslands are less often used for dairy production. However, the environmental concerns are similar. Grassland-based dairy production reduces the carbon footprint of dairy products (Peterson et al, 2013). However, the use of improved grasslands for dairy production can lead to a variety of environmental concerns, such as when peat lands are drained for dairy grasslands (cf. Deru et al, 2018). The case of grassland-based milk from the Thise Dairy (see the corresponding case study within Section 10) and the SOLID project (see Textbox 5.1) are two interesting examples where positive environmental impacts arise from extensive grass-based dairy production compared to concentrate-based intensive production.

## 5.4 Conclusions

The research reviewed here is almost exclusively focused on dairy products derived from cattle. The nutritional benefits of those produced on grasslands are similar to the benefits of grassland-produced meat products, including the greater prevalence of long-chain polyunsaturated fatty acids compared to those derived from concentrate or maize silage-fed animals. Even relatively small percentages of grass in the overall diet are shown to provide benefits in terms of the nutrition profile and other qualities. Studies on the quality of dairy products in relation to pasture types have been mainly carried out in areas with the protected designation of origin (PDO) label. Thus, research gaps exist in all aspects of dairy production on semi-natural grasslands. The French and other Alpine studies, in particular, provide a good model for studies of semi-natural grasslands and dairy quality in other locales. The comparative studies reviewed here also provide potential models for studying the effects of different semi-natural grassland forage types on meat quality.

Pixabay

**Milk derived from grasslands that are botanically diverse have higher concentrations of essential fatty acids and antioxidants**

# 6. HONEY

- **It is generally established that the composition of honey is substantially influenced by the flora from which bees forage.**
- **Analyses of the pollen and volatile components of honey can provide a 'fingerprint' of its origin.**
- **Darker honey may indicate higher mineral content.**
- **There are very few studies specifically focused on grassland honey.**
- **A variety of techniques are available to differentiate the floral origins of honey.**
- **Recent studies from Estonia, Finland and Lithuania provide examples of pollen analysis.**
- **Substantial knowledge gaps exist in the evaluation of honey and other apicultural products.**

## 6.1 Honey and Other Bee Products

Honey is associated with medicinal properties, including but not limited to: anti-bacterial, hepatoprotective, hypoglycemic, antihypertensive, gastroprotective, anti-fungal, anti-inflammatory and antioxidant effects (Soares et al, 2017; Grembecka and Szefer 2013; Baltrušaitytė et al, 2007). The composition, mainly water and sugars, varies according to factors such as its botanical origin, geographic source, soil type, season, as well as processing and storage conditions (Berriel 2018; Soares et al, 2017). The health effects of honey are strongly associated with chemical composition and its floral origin (Grembecka and Szefer, 2013). There are shortfalls in knowledge regarding the medicinal effects and their origins. For example, the anti-bacterial properties of honey are not completely understood, though there is evidence that at least some are derived from flora (Baltrušaitytė et al, 2007). Macro and microelement levels are significantly influenced by the extent of processing (Grembecka and Szefer, 2013).

Honey may be classified by either its floral composition or geographic origin. Europe has 23 honeys with protected designation of origin (PDO) certification and eight with protected geographical identification (PGI) labels (Soares et al, 2017). A Polish-Lithuanian honey is the only PDO/PGI- labelled honey from a Boreal country and the first transnational product from a protected designation of origin (Soares et al, 2017; EC, 2012).


GrassLIFE

**Analyses of the pollen of honey can provide a 'fingerprint' of its origin**

Other bee products include: bee pollen, beebread (a fermented mixture of pollen and honey used to feed larvae), propolis (resinous mixture bees make to seal hives), royal jelly (a mixture secreted by honey bees and used to feed larvae, especially potential queen bee larvae), honeycomb and beeswax (Evans, 2015). The majority of reviewed publications tend to focus on honey composition, with a lesser number on the chemical composition of propolis, and very few on beebread or royal jelly (Isidorov et al, 2009).

## 6.2 Identifying Botanical Origins and Composition of Honey

Nearly all semi-natural grassland-related articles with reference to 'bees' or 'honey' refer to wild pollinator populations and their traits, and to the ecosystem services provided by wild pollinators. Broadening the search to honey more generally, there is substantial literature on the floral origins of honey (see the following for copious references: Oroian and Ropciuc, 2019; Berriel 2018; Corbella and Cozzolino, 2006; Van Der Ohe et al, 2004) but these studies are mainly restricted to botanical or geographical origin and, to a lesser degree, to identifying adulterants and pollutants (Berriel 2018; Soares et al, 2017; Bilandžić, 2011). Studies of honey according to production system (such as grasslands) are sparse (Berriel, 2018).

© Kristaps Kalns, GrassLIFE

**The composition of honey is substantially influenced by the flora from which bees forage**

A key aim in differentiating honey is to assure that it is from the origin as stated on the label and that it is unadulterated. Some types of honey can be distinguished by one characteristic compound (Kaškoniene et al, 2008) but, because honey is multivariate, there is a risk of misrepresentation if characterisation is conducted using only single variables (Corbella and Cozzolino, 2006). Multivariate analysis of the food sample matrix enables classification without needing to measure all the constituent components of the honey (Berriel, 2018; Grembecka and Szefer, 2012; Corbella and Cozzelino, 2006; Serrano et al, 2004). A table summarizing recent studies on the recognition of the geographical and botanical origins of honey using multivariate data analysis and machine learning is available in Maoine et al (2019).

Melissopalynology is the study of pollen contained within honey (Von der Ohe et al, 2004) and is the most common method used to determine its botanical origin (Puusepp and Koff, 2014). Honey contains pollen grains that provide a good fingerprint of the environment from which the honey was collected, and pollen analysis can be useful in determining the geographical and botanical origin of honey, even if sensory and physico-chemical analyses are also needed to correctly identify botanical origin (Von der Ohe et al, 2004). Thus, melissopalynology is the quickest, most reliable, and least expensive way of determining a honey's floral contents and geographical origin (Bryant, 2018; Puusepp and Koff, 2014). The extraction of pollen, while not difficult, requires a high level of skill and the appropriate equipment and laboratory for analysis (Bryant, 2018; Cuevas-Glory et al, 2007). The existence of a large variety of pollen recovery techniques is due in part to there being only a limited amount of pollen in honey, while any loss can create problems in classifying the nectar sources and geographic origin (Bryant, 2018).

The International Commission for Bee Botany's (ICBB) Methods of Melissopalynology (1978) elaborates methods for: determining the geographical and botanical origin of honey; gathering information on contamination and fermentation; measuring the amount of sediment in honey; identifying the number of plant elements; and preparing reference slides from plants (Louveaux et al, 1978). Generally, honey may be considered monofloral when the pollen from a single species exceeds 45 percent of its total pollen content (Louveaux et al, 1978). The ICBB methods were updated and harmonized and are described in Von der Ohe et al (2004). The production and trading parameters of honey within the EU are set in Directive 2001/110/EC and were amended in 2014/63/EU, although the Directive does not define monofloral honey (Thrasyvoulou et al, 2018). Thus, many countries have set their own parameters for monfloral honey,

and these may be either over or under the ICBB's 45 percent threshold (see Table 1 within Thrasyvoulou et al, 2018 for examples from different countries). In Latvia, for example, the National Food Quality Scheme Requirements for Honey and Beekeeping Products (Annex 7 of Regulation 461/2014) sets the following minimum pollen thresholds for monofloral honeys: heather - 40 percent; buckwheat - 25 percent; lime/linden - 17 percent; rapeseed - 70 percent; and all other monofloral honeys - 45 percent of pollen from one flora.

Corbella and Cozzelino (2006) list the following techniques as having been used to determine honey authenticity and botanical origin: determination of aromatic compounds and flavonoids, amino acids and sugars by high performance liquid chromatography (HPLC); detection of aroma compounds through gas chromatography-mass spectrometry (GC-MS); determination of anions and cations using ion chromatography (IC) and mineral content; determination of chemical characteristics and contamination using spectroscopic techniques such as mid-infrared (MIR) and Raman spectroscopy; and authentication via pollen identification and counts.

The isolation and detection techniques for volatiles in honey include: Likens–Nickerson simultaneous steam distillation extraction; dynamic headspace extraction; ultrasound-assisted extraction; hydro-distillation; solvent extraction; and solid phase microextraction (Kaškoniene et al, 2008). Over 400 different compounds originating from different floral types have been identified in the volatile flavour fraction of honey (Kaškoniene et al, 2008).

## 6.3 Baltic and Nordic Honeys

Puusepp and Koff (2014) note that melissopalynological studies of honey from Estonia, Latvia, Lithuania, and Finland are rare, and the existing studies are very limited in scope. Estonian honey is mainly polyfloral (Puusepp and Koff, 2014), while Finnish honeys are primarily mono or polyfloral depending on region (Salonen et al, 2009). Lapiņa (2016) states that the analysis of honey pollen in Latvia had not been previously carried out and reports that the analysis of botanical content and organoleptic qualities identified 72 plant species in honey samples collected during 2008-2014, with the most common pollen coming from clover, osiers (Eurasian willow trees), fruit trees and rapeseed. The full report on honey diversity in Latvia is available in Latvian, with an abstract in English. In Lithuania, Baltrušaitytė and colleagues (2007) found that the bioactive properties of honey produced in the country had not previously been studied, and Čeksterytė and colleagues (2013) identified multiple monofloral honeys from Lithuanian protected areas. In a study of the chemical composition of beebread from different parts of the Baltic region (Latvia, Poland and Russia), Isidorov and colleagues (2008) identified around 100 compounds and found both consistencies and differences across samples (see Table 6.1). Merckoll and colleagues (2009) investigated the wound treatment properties of polyfloral Norwegian forest honey in comparison to commercially available for purpose MedihoneyTM from New Zealand.

Table 6.1 A selection of studies on the composition and qualities of honey from the Boreal biogeographical region.

| Study description (reference) | Findings |
|---|---|
| Pollen analyses of honey from Estonia (Puusepp and Koff 2014) | • The pollen content of 325 honey samples from Estonia were analysed.<br>• An average of 400 pollen grains were counted in each sample.<br>• Estonian honey is typically polyfloral, with an average of 13 taxa per sample.<br>• The concentration of pollen grains varied from 100-700,000 per gram of honey.<br>• Estonian honey is chararacterised by a high percentage of Salix, Brassicaceae and<br>• Rosacea. Trifolium, Calluna, Apiaceae, Fabaceae, Asteraceae, Poaceae, Fagopyrum esculentum and Frangula alnus were also present. |
| Pollen analyses of honey from Finland (Salonen et al, 2007) | • The pollen content of 734 Finnish honey samples from the years 2000-2007 were analysed and compared to pollen content from 1960–2007.<br>• The average number of grains counted within each sample was 415, with a total of 116 pollen types identified.<br>• Samples contained an average of 27 pollen types, with the main occurrences of melliferous types (i.e. in more than 90 percent of the samples) being Trifolium repens, Rubus species, Salix species, Brassicaceae and Apiacea and non- melliferous plants Filipendula species and Poaeceae (occurring in 92 and 86 percent of honey samples, respectively). Betula species and Pinus species were found in 45 and 44 percent of samples, respectively.<br>• Among the counted melliferous plant pollen grains, 95 percent belonged to the 12 most numerous pollen types, while 63 percent of non-melliferous pollen grains were from Filipendula species. |
| Pollen diversity in honey from Lithuania's protected landscapes (Čeksterytė et al, 2013). | • The pollen diversity of 17 honey samples from eight protected landscapes in Lithuania was tested.<br>• Several monofloral honeys were identified, with the following dominant species being noted: Malus domestica, Carum carvi, Trifolium repens, Tilia cordata, Fagopyrum esculentum, Salix species, Frangula alnus, Onobrychis, and Brassica napus.<br>• Polyfloral honey was identified at some sites, and pollen content varied according to the time of year the honey was collected (spring, summer and autumn). |
| Antibacterial activity of honey and beebread (Baltrušaitytė et al, 2007) | • The antibiotic properties of 34 honey and four beebread samples from Lithuania were tested.<br>• Honeys with similar botanical composition had different anti-microbial activity – a result the authors attributed to metabolism products of bee origin present in the honey.<br>• Honey and beebread can help control food pathogens when used in food formulations. |
| Volatile compounds of various Lithuanian honeys and beebread (Kaškoniene et al, 2008) | • Volatile compounds, some of which may be indicators of honey origin, were analysed for 13 unifloral and 2 polyfloral Lithuanian honeys.<br>• In total, 93 compounds in honey and 32 compounds in beebread were identified.<br>• There was high variation in composition among the samples.<br>• Benzaldehyde and benzenacetaldehyde were the only compounds found in all 15 honey samples. Dimethyl sulphide, pentanenitrile, benzylnitrile were identified in 14 honeys; isobutane, octanoic and nonanoic acids in 13 samples; furfural, linalool and nonanal in 12 samples; octanal, lilac aldehyde C, hotrienol and decanal in 11 samples; and 2-methylbutanenitrile in 10 honey volatile fractions.<br>• The highest variety of volatile compounds was found in unifloral caraway and rape honeys and in polyfloral honeys.<br>• The concentration of volatiles decreased after three months storage. |

| | |
|---|---|
| Chemical composition of beebread (Isidorov et al, 2008) | • The chemical composition of five samples of beebread from Poland, Russia, and Latvia was tested using gas chromatographic-mass spectrometry.<br>• More than 200 compounds were extracted using three successive extraction techniques with different polarities (non-polar n-hexane, slightly polar diethyl ether, and polar methanol).<br>• The most compounds (92) were identified by methanol extraction.<br>• The methanol extract results were similar across all samples, bar the low presence of free amino acids in one. Ether extracts had much more varied composition across samples.<br>• Large quantities of aliphatic acids and digestible carbohydrates were identified.<br>• Free aminoacid content was dependent upon pre-market processing.<br>• Phenol compounds with antioxidant properties were also found. |
| Effects of honey on 'planktonic' and biofilm- embedded chronic wound bacteria (Merckoll et al, 2009) | • Norwegian forest honey was compared to MedihoneyTM from New Zealand.<br>• Norwegian bactericidal effects were slightly lower than those of MedihoneyTM, but both honeys were bactericidal against all the strains of bacteria even at very low doses.<br>• The tested Norwegian forest honey, composition unknown, shows promise in reducing incidences of MRSA (Methicillin-resistant Staphylococcus aureus) and antibiotic resistance while providing effective wound care.<br>• More research is needed on the qualities in honey that produce biocidal effects. |

## 6.4 Honey Studies from Beyond Northern Europe

Scoping of the literature on honey identified a range of topics and ways in which honey is researched. The following studies from outside Northern Europe provide examples of research that could be undertaken to identify the potential added value of natural and semi-natural grassland honeys.

Honey may be considered a bioindicator of pollution, and Bilandžić et al (2011; 2014) and others have reported on the detection of major and trace element levels in honey. The average calcium, copper and lead levels, for instance, in Croatian multifloral honey (from orchards) were much higher than those reported in other European countries, while other trace elements were similar to recent studies elsewhere (Bilandžić et al, 2014).

In Ireland, 131 samples of honey were collected between 2013 and 2015 and compared with eight international honeys – acacia honeys from Romania and Kenya, as well as manuka honeys – and the literature on honey composition (Kavanagh et al, 2019). Overall, Irish honeys had similar total phenolic content typical to European honeys, but differences were observed for monofloral heather honey, which had the highest phenolic content of all of the honeys tested. The relationship between total phenolic content and anti-microbial and antioxidant effects are documented in scientific literature, but the authors recommend that Irish heather honey be examined for their potential health benefits (Kavanagh et al, 2019).

A Canadian study analysed the pollen content of honey sourced from four site types: apple orchards, blueberry fields, cranberry bogs, and fallow fields (Colwell et al, 2017). The pollen's nutritional value and pesticide diversity was found to be high in honey at the apple and blueberry sites and low at the cranberry and fallow sites. Pollen hazard quotients (i.e. pesticides) were also found to be negatively correlated to the number of flower taxa detected in flora surveys (Colwell et al, 2017).

The macro and microelements and toxic metals of several monofloral-, polyfloral-, and artificial honeys, propolis and bee pollen from Poland and Italy were tested and reviewed in relation to the existing literature on honey composition (Grembecka and Szefer, 2013). Their findings include that: macro and micro elements were significantly influenced by the technological processing of products and by geographic origin; darker honeys had higher mineral content than light coloured honeys; and factor and cluster analyses were reliable tools in differenti-

ating honey according to mineral composition.

The influence of soil substrate (limestone or gypsum soils) on monofloral thyme honey was tested using 70 samples collected from the Alcarria region of Spain (González-Porto et al, 2016). Despite similar pollen content, variations in the physicochemical, antioxidant and sensorial characteristics were identified and attributed to the soil type in the hives' settlement area (González-Porto et al, 2016).

Uruguay provides a rare case of research explicitly looking at grassland-produced honey (Berriel, 2018; Corbella and Cozzolino, 2005). Moisture, pH, and electrical conductivity explained floral origin and were successfully used to classify over 80 percent of samples belonging to the foraging habitat categories of pasture, Citrus spp. and Baccharis spp. (Corbella and Cozzolino, 2007). Berriel (2018) attempted to differentiate grassland honey in a study of grassland, native forest and commercial eucalyptus honeys in Uruguay, but the analysis was only able to differentiate the monofloral eucalyptus honey from the wild-sourced honeys. The polyfloral and native forest honeys could not be reliably differentiated from each other with the applied variables (pH, free acidity, lactic acid content, moisture, total sugar content, and honey and extracted protein 13C isotopic composition). When the polyfloral honeys were grouped (grassland and native forest), the variables responsible for the greatest differentiation were: 13C honey, °Brix, and moisture (Berriel, 2018).

Pixabay

**Analyses of the pollen of honey can provide a 'fingerprint' of its origin**

## 6.5 Marketing of Honey

High quality, unadulterated honey is readily available in the Nordic and Baltic countries, and honey production is frequently an on-farm cottage industry. However, honey production is limited to only a few months of the year due to the cold climate, which raises costs compared to regions with a longer production period.

The marketing spectrum and the market potential for European Boreal region honey can be illustrated by real world examples. Natural sourced, so-called 'forest honey' from Estonia, Finland, and Norway show how the added value from the production environment can be made explicit in marketing of honey and could provide a model for promoting natural and semi-natural grassland honeys. The examples in Table 6.2 below emphasise product purity and the health benefits.

Although the Estonian and Finnish examples below have webpages in English, the Finnish example is aimed toward the Asian market, where there is greater fear (and risk) of adulterated products. This honey is priced as a luxury health item.

GrassLIFE

Table 6.2 'Forest honey' marketing and pricing.

| Product | Main marketing points and cost |
|---|---|
| **Example 1:** 'Creamy Forest Honey'. Asten Honey, Estonia<br><br>**Packaging:** 500 gram glass jars<br>**Cost:** retail: 500 grams = EUR 4.00 + taxes. | ● "One of the most beautiful and loved places in Pärnu County." "Far from city pollution." "Bees predominantly harvest in naturally clean forests."<br>● "Naturally wild honey is intensively dark in colour and features the pure and strong taste. The forest may surprise you with various honey types – forest honey, heather honey."<br><br>Wholesale: circa EUR 4.50per kilogram + taxes |
| **Example 2: '**Premium Raw Honey'. Hikiän Honey, Finland<br><br>**Packaging:** 300 gram violet glass<br>**Cost:** Retail: 300 grams = EUR 148.00 | ● "Wild nature, millions of flowers and pure Scandinavian air creates the perfect environment to produce delicious honey."<br>● "Unheated and untreated directly from the beehives." "... tested yearly for its HMF [Hydroxymethylfurfural] levels. Latest tests show HMF levels of 3,8 mg/kg which is exceptionally good." |

Individual examples of high value honey and bee products abound in the Boreal region, although they are not always marketed as such. In Finland, Häntälän Notkot Honey, from the Häntälä dale (Häntälän notkot) in southwest Finland, is an example of a high nature value farming product derived from a traditional rural biotope. In Estonia, Muhu Mesi (see the case study in Part II: Section 12) produces honey from the island's alvars (limestone plains with sparse grassland vegetation). Both examples represent products from Natura 2000 sites. In Norway, Kjartans Honning (see the case study in Part II: Section 12) produces multiple types of raw honey, including from heather, as well as other bee product based items, such as beauty products and gummy bears. In Lithuania, beekeepers producing honey in national parks, nature reserves and other protected landscapes are able to use a quality mark exclusive to their honey (Čeksterytė et al, 2013).

## 6.6 Conclusions

Overall, there are substantial shortfalls in both knowledge and in identification of honey from particular production systems. However, existing studies provide reference points for identifying the potential added value of natural and semi-natural grassland honeys and honey products. Microelements and pollen diversity may be tested using a variety of techniques, but all techniques have drawbacks or challenges related, for example, to the time involved, expertise needed to carry out the analysis, or the precision and reliability of results due to working with volatile compounds and the small (and variable) amounts of pollen within the honey. Increasingly sophisticated analysis is being applied to differentiating honey. 'Forest honey' provides examples of how natural and semi- natural grassland-produced honey could be marketed.

# 7. GRASS PRODUCTS

- **Non-fodder alternatives for grassland biomass are particularly relevant for areas where fodder quality is low or grazing is not feasible due to abandonment or other causes.**
- **Biofuel and hay pellets for pets rank among the alternative uses, while reed has been used for thatching, building, paper making, arts and crafts.**
- **Biofuel production can complement semi-natural grassland conservation, especially in areas where farming has been abandoned or the nutritional value of the grass is low.**
- **The biofuel potential across different grassland types varies significantly, however, many Natura 2000 sites have substantial biofuel feedstock potential.**
- **The effective use of grassland biomass as fuel requires technical solutions, some of which are already being implemented.**

## 7.1 Non-fodder Uses for Grassland Biomass

Abandonment and insufficient grazing pressure tend to result in plant community development that is unfavourable for fodder production (Donnison and Fraser, 2016; Dumont et al, 2013). Biofuel production is a potential use of grasslands and could be a realistic alternative to grassland conservation in areas where there is insufficient livestock for grazing or where the fodder quality is too poor for raising animals. Another alternative use for hay with low nutritional value is as food for animals with moderate needs, such as some heritage breeds with relatively low-production, horses with low level exercise regimes, and pets such as rabbits (see the case study within Section 13 on Baltic Unique Solutions' hay pellets for pets).

© Kristaps Kalns, GrassLIFE

**The most common use of grasslands is as fodder for grazing animals**

Common reed (Phragmites australis) is used as thatching for roofing in countries throughout Europe, and demand is expected to continue to rise in several countries (Wichmann and Köbbing, 2015). Although reed is also imported from Asia, there are European thatching companies that provide both reed and thatching services (cf. OÜ Transar EF). Reed has also been used in Europe for insulation, paper production, woven mats, handicrafts and arts, and can be pressed together to make panels (Wichmann and Köbbing, 2015; Kask, 2013; Parts et al, 2011; Häkkinen, 2007; Tuomela, 2007). Reed can be used with very minimal processing for thatching, but other building uses require additional processing (Laizans, 2013). Wichmann and Köbbing offer an overview on reed use in Europe and reed import and export by country. The joint Central Baltic INTERREG project also produced the 'Guidebook of Reed Business' (Kask, 2013), which details the uses of reed for building, energy, crafts, as well as business practice related to reed management.

## 7.2 Bioenergy – a Grassland 'Ecosystem Service of the Future'

Textbox 7.1

**IN FOCUS: The 'Integrated Generation of Solid Fuel and Biogas from Biomass' (IFBB) process for bioenergy production**

**Joseph and colleagues (2018) describe promising progress in overcoming the technical challenges of using semi-natural grassland biomass in bioenergy production using a process called the "Integrated Generation of Solid Fuel and Biogas from Biomass" or IFBB. The process was tested using typical semi-natural grassland biomass from 11 areas across Europe. The test took place at the commercial-scale IFBB plant, the only one of its kind, in Baden Baden, Germany, with results being compared with those of prototype-scale plants.**

**The process mixes ensiled grassland biomass with water to create a mash that can be separated into solid fuel for combustion and a press liquid (pressé) for anaerobic digestion. Prior studies at the laboratory and prototype levels have shown improvement in output across the board: solid fuel was shown to have lower concentrations of several unwanted elements and more favourable qualities regarding ash, while the pressé was found to be a suitable substrate for biogas production. Additionally, the energy conversion efficiency was between 44.7 and 52.9 percent – values many times the level obtainable with untreated biomass.**

**In conclusion, the authors noted that the up-scaled IFBB process confirmed the laboratory and prototype results and state, "using green residual biomass from grasslands and landscape management with IFBB technology generates an energy carrier which: i) does not conflict with other biomass uses, ii) mitigates CO2 emissions, and iii) helps to preserve landscape diversity."**

The EU targets for renewable energy are set out in the directive on the promotion of the use of energy from renewable sources (2009/28/EC). Bioenergy may be a grassland 'ecosystem service of the future' (French, 2019). The EU aims for renewable energy to account for 20 percent of the total energy consumption by 2020 (Directive 2009/28/EC). Along with the targets for renewable energy source use, the EU provided its member states with sustainability guidelines with the express aim of mitigating climate change by reducing greenhouse gases and avoiding the negative effects on biodiversity, freshwater availability and other ecosystem services (Pedroli et al, 2013). In a multi- country study, Pedroli and colleagues warn that bioenergy harvesting could put pressure on high nature value farmlands. However, well-planned biomass harvesting could have the added value of improving habitat and of utilising a waste product for energy production (Donnisson and Fraser, 2016; Pedroli et al, 2013). Van Meerbeek and colleagues (2016) determined that Natura 2000 sites contain vast biomass-for-energy potential, even under conditions where management actions would be designed to avoid any negative impacts and sustain the conservation values of each habitat type.

Baltic Unique Solutions

**Grass Pellets by Baltic Unique Solutions**

In a review of bioenergy production as a means of maintaining grasslands, Donnisson and Fraser (2016) note that conservation sites are increasingly managed through the late season cutting of In a review of bioenergy production as

a means of maintaining grasslands, Donnisson and Fraser (2016) note that conservation sites are increasingly managed through the late season cutting of biomass, rather than through grazing or haying for fodder collection. In cases where habitat management is the primary motivation for action on sites no longer under active agriculture, the material frequently becomes a waste product that is often discarded because the nutritional value as fodder is too low for farm animals (Donnisson and Fraser, 2016). Restoration management in which excess biomass of low palatability is removed for energy production has the potential to improve the grazing quality of the grassland through the removal of invasive and non-desired competitive species and to stimulate the growth of the desired species (Donnisson and Fraser, 2016; Jalli et al, 2013). Such complementarity, or at least avoidance of competition with food and feed production, is an essential aspect of grassland-produced energy biomass 'additionality' (Joseph et al, 2018; Pehme et al, 2017; Donnisson and Fraser, 2016).

In terms of bioenergy production, there is high variability in the potential output depending on the different habitat types, with wet areas achieving higher biomass yields per area compared to drier grasslands. In Estonia, floodplain meadows were measured as having an output of 5.7 tons of dry mass per hectare, compared to 2.5 tons and 1.6 tons for mesic meadows and wooded meadows respectively (Heinsoo et al, 2010). However, Heinsoo and colleagues, also identified over fourfold differences in biomass yield in different sites of the same meadow type. The energy potential of various grassland types has been explored in multiple Northern European countries (Paarup Meyer et al, 2015; Kask, 2013; Prochnow et al, 2009; Seppälä et al, 2009) and is probably the best-studied aspect of grassland biomass for biofuel.

Studies have shown that bioenergy produced from grassland biomass can help in meeting carbon dioxide emission and renewable energy targets (Donnisson and Fraser, 2016). This is particularly the case where current energy use is based on 'dirty' energy such as oil-shale and coal (Pehme et al, 2017). However, the use of semi-natural grassland biomass for bioenergy faces technical challenges, including the presence of harmful elements in the biomass. A key challenge of bioenergy crops is the emission of harmful gases such as carbon dioxide and nitrous oxide (French 2019; Donnisson and Fraser, 2016). Grassland biomass may be used in energy production either as a feedstock for combustion or anaerobic digestion but, in its original form, it is not favourable for either (Joseph et al, 2018). By itself, its lignin content is too high to function as a substrate for biogas production (Joseph et al, 2018). As a solid fuel, grassland biomass ash is challenging due to its fusibility and accumulation in systems that were not designed for high ash content, while the biomass contains harmful elements such as nitrogen, sulphur and chlorine, which are emitted and also corrosive to the machinery used in the energy production (Joseph et al, 2018; Kask and Kask, 2013).

Research and development is responding to the challenges of efficiently extracting energy from grassland biomass in an environmentally sound way. For example, a study of the 'Integrated Generation of Solid Fuel and Biogas from Biomass' process (IFBB process, see Textbox 7.1), used in Baden Baden, Germany, illustrates some of the newest and most substantial tests conducted on the use of semi-natural grassland biomass in bioenergy production. Similarly, technical research conducted in Norway on common reed has shown that 'steam explosion' of reed biomass increases methane yield under certain conditions (Lizasoain et al, 2016). In Estonia, the Lihula Boiler Plant (see the case study within Part II: Section 13) provides an example of grassland biomass being used for producing bioenergy in a way designed to promote the conservation of semi-natural grasslands in a national park.

Regarding biogas production, Pehme and colleagues (2017) conducted a life cycle assessment of manure-based biogas with grass from improved grasslands and abandoned alluvial semi-natural grasslands as the substrate. They found that co-digestion with the grass from semi-natural grasslands showed substantial environmental benefits over mono-digestion, including the potential to reduce global warming and phosphorus-eutrophication compared to the semi-natural grassland biomass that was

not being harvested. That said, the nitrogen-related impacts of acidification and N-eutrophication would require mitigation so as to minimise impact (Pehme et al, 2017).

The biofuel potential of reed has also been studied (Kask, 2013). Kask and Kask (2013) note that there are only a few experimental results regarding biogas and bioethanol production, but that studies carried out in Portugal, Hungary and Estonia have shown that bioethanol production with native reed as feedstock is viable. The key environmental benefit of harvesting is improvement of habitat for bird species that favour open shorelines and reduction in the nutrient loading of waterways (Kask, 2013). There are considerable energetic differences between summer and winter reed, with the green summer reed having much lower energy potential, although it is also more suitable than winter reed for biogas production (Kask and Kask, 2013). The winter harvesting of reed minimises the environmental impact, especially on bird species, but also removes fewer nutrients from the shoreline (Kask and Kask, 2013). The excess sludge from energy production can be used as fertilizer (Jalli et al, 2013).

The transportation and storage of grassland biomass is a challenge in energy production. As distance from the source increases, denser baling, pelleting or briquetting is required (Kask and Kask, 2013). Pehme and colleagues (2017), however, cite numerous studies that transport distance and harvest yield variations have only a low net environmental impact in regard to biogas production. Kask and Kask note that seasonality, lack of entrepreneurs in the industry, and lack of harvesting machinery are obstacles to the use of reed as an energy source. For these reasons, they envision that the material is more suitable to small-scale energy plants, where waste reed from construction could also be used as a fuel.


Baltic Unique Solutions

**In addition to fodder for livestock, grassland biomass can be used for energy and processed into fodder and treats for rabbits, horses and other herbivorous pets**

## 7.3 Conclusions

There are a variety of existing and potential uses for grass from semi-natural grasslands and reedbeds, but the most wide-reaching is as biofuel, which is also complementary to other uses because excess materials (waste) can also be used as fuel. Limited research has examined the potential of semi-natural grasslands in biofuel production from the perspective of potential feedstock quantity, energetic value, and those harmful components inherent in the raw feedstock. Overcoming the technical challenges to produce clean energy is a developing field. The logistical challenges, particularly transportation and storage, mean that grass biomass may be best suited to small and medium-scale energy plants near the biomass source. Other grass uses include reed for thatch, where there appears to be market opportunity for the increased production of high-quality thatch for roofing, although price and competition for quality from non-European countries may prove a particular challenge.

# 8. WILD MEDICINAL PLANTS

- **Raw material from plant species of grassland origin are used for a variety of cosmetic and medicinal purposes.**
- **At least 27 of the 400 wild plant species in Europe that are used for food, medicine and cosmetic purposes are near threatened or endangered.**
- **Globally, the greatest driver of decline of wild-harvested medicinal species is wild harvesting;**
- **The International Union for Conservation of Nature (IUCN) recommends the use of certification programmes to ensure the sustainability of wild harvesting.**
- **The effective use of grassland biomass as fuel requires technical solutions, some of which are already being implemented.**
- **Significant knowledge gaps exist on the potential differences in the composition of grassland-collected and cultivated herbs. However, variations in chemical composition and bioactivity between wild species and domesticated cultivatars of some medicinal herbs have been identified.**

## 8.1 Context for Wild Medicinals

Historically, Europeans collected herbs from grasslands for medicinal, cosmetic, and food-related use, and some of those practices continue today (Pardo-de Santayana et al, 2015). Local and slow food movements have brought a resurgence in the use and marketing of wild foods in recent years (Łuczaj et al, 2012). The International Union for Conservation of Nature refers to plants used for human consumption or for cosmetic or medicinal purposes as medicinal (Allen et al, 2014). It cites wild plant collection, the loss of habitat, and livestock farming as the current top threats to Europe's wild medicinal plants (Allen et al, 2014). The IUCN assessed 400 plants native to continental Europe with known medicinal properties and found that 27 are near threatened or endangered and that there was too little data to draw conclusions for 25 species. (Allen et al). Because some medicinal plants are characterized by poor seed germination, slow growth or sensitivity to cultivation practices, wild collection remains more viable than cultivation (Catană et al, 2018; Misra, 2009; Schippmann et al, 2006). Wild medicinals are also favoured for cultural reasons in some cases (Schippmann et al, 2006).

Historical ethnobotanical collections notwithstanding, there appears to be more research and more use of medicinal and aromatic plants of grassland origin from Southern and Eastern Europe compared to Northern Europe (Pardo-de Santayana et al, 2015; Quave et al, 2012; Misra, 2009). The probable reasons are the prevalence of medicinal and aromatic plant species compared to Northern Europe (cf. Allen et al, 2014) and the sustained knowledge of wildcrafting and wild plant use in these regions (Pardo-de Santayana et al, 2015; Łuczaj et al, 2012).

Martins Cirulis / Institute for Environmental Solutions

**Common Milkwort (*Polygala vulgaris*) helps for fever and arthritis.**

## 8.2 Bioprospecting and Genetic Material

Bioprospecting is defined by the United Nations Development Fund as the "systematic search for biochemical and genetic information in nature in order to develop commercially-valuable products for pharmaceutical, agricultural, cosmetic and other applications" (UNDP, 2016). A cornerstone of fair bioprospecting is so-called 'access and benefit sharing' through sharing fairly and equitably the benefits arising from the utilisation of genetic resources (Sava Sand and Antofie, 2018; UNDP, 2016). Access and benefit sharing can take many forms, such as royalties, joint ventures, capacity building, etc. (UNDP, 2016). Fair access and benefit sharing in bioprospecting is addressed through the Nagoya Protocol (to the Convention on Biological Diversity) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The corresponding rules adopted by EU Regulation 511/2014 on access and benefit sharing apply to the research and development of novel ingredients, new essential oils and volatile compounds, the characterisation of the biochemical properties of plant parts, efficacy studies, and comparing varieties to identify compounds in ingredients (UEBT, 2017).

In addition to wild collection, grassland species provide genetic resources for products via cultivated species and stem cell technology (Catană et al, 2018; Misra, 2009; Schippmann et al, 2006). The potential of plants as sources of novel compounds was investigated in the EU-funded project, 'AgroCos: From Biodiversity to Chemodiversity: Novel Plant Produced Compounds with Agrochemical and Cosmetic Interest', carried out between 2010 and 2014 (National and Kaposdistrian University of Athens, 2014; Annex 1). AgroCos's research focused on plants in biodiversity hotspots in the Mediterranean, Latin America and Africa, and had considerable scope – nearly 2000 plant species were collected as part of the project (Euronews, 2014). The project collaborated with Korres S. A. Natural Products in Greece to develop plant-derived compounds with antioxidant, UV radiation protection, and whitening effects (National and Kaposdistrian University of Athens, 2014). In terms of scope, no comparable project or research has been conducted on the grassland species of Northern Europe. The Latvian natural cosmetics company, MÁDARA (see the MÁDARA case study in Part II: Section 14), uses plant stem cell technology to bolster the sun protection factor of some of its products (Mádara 2017; personal communication 1/2019). Korres and MÁDARA are examples of two companies that rely on the diversity of genetic plant material through wildcrafting and research to develop new products (Korres undated; MÁDARA undated).


Thomas Laursen

**Wildfooding Gin produced in Denmark contains a long list of ingredients, gathered in nature, and meadow plants among them – such as juniper, mugwort, wild carrot, angelica, meadowsweet, watermint, rowan and lingonberry.**

## 8.3 Sustainable Wild-harvesting

When wildcrafted and cultivated medicinal and aromatic plants are both available commercially, traders may prefer the wildcrafted product due to its lower cost (Guzelmeric et al, 2017; Misra, 2009). Their trade is largely unmonitored and practices for gathering high-demand species are frequently unsustainable (Misra, 2009). The Sustainability Principles for Wild Plant Protection (WWF Hungary et al, undated) provide a guide to responsible collection. A list of European and international guidelines and standards is provided by Hamilton (2005). The International Union for Conservation of Nature recommends adhering to the FairWild Standard (fairwild.org) and its certification schemes for sustainable wild-harvesting in order to halt the negative impacts of overharvesting and other unsustainable practices (Allen et al, 2014). CITES and FairWild currently certify sustainably harvested wild medicinal and aromatic plants from around the world. There are no certified suppliers in Northern Europe, but both Poland and Hungary supply wild-harvested species, many of which are found in semi-natural grassland or grazed woodland (for lists of species, see the FairWild case study in Part II: Section 14). With nearly 50 herbs listed among their offerings, Wildfooding in Denmark is an example of a company that supplies wild harvested foods – including grassland species – to top restaurants in Scandinavia. For a list of its herbs, see the Wildfooding case study in Part II: Section 14. The 'Sustainable Herbal Harvest in Bulgaria' public awareness campaign and Life project is an example of action that can be undertaken with stakeholders and the public at large to improve the sustainability of wild harvesting of herbs.

In addition to the species lists provided by Wildfooding and FairWild, Pardo-de-Santayana and colleagues (2016) identify the following medicinal plants as common and abundant wild species that are widely distributed in Europe: greater celandine (Chelidonium majus), common hawthorn (Crataegus monogyna Jacq.), horsetail (Equisetum arvense) and other species of the genus, perforate St. John's wort (Hypericum perforatum), common mallow (Malva sylvestris), white horehound (Marrubium vulgare), pennyroyal (Mentha pulegium), broadleaf plantain (Plantago major), ribwort plantain (P. lanceolate) and other species of the genus, oregano (Origanum vulgare), elder (Sambucus nigra), stinging nettle (Urtica dioica) and common thyme (Thymus vulgaris).

Juris Ross

**Grasslands provide a wide range of high quality products**

Sustainable harvesting practices should apply to both common and endangered grassland species alike. Arnica montana and eyebright (Euphrasia officinalis) are examples of species of European conservation concern (for some regions) that have commercial value and are wildcrafted from semi- natural grasslands. The natural cosmetics and naturaopathic medicine company, Weleda AG, purchases Arnica collected from semi-natural grassland in the mountains of Romania and eyebright from Rhineland-Palatinate in southwest Germany (Weleda, 2019a and b; see Part II: Section 14 Weleda AG: Mountain Grassland-sourced Sustainable Arnica montana). The use of dandelion (Taraxacum officinalis) flowers in Estonia for dandelion syrup and meadowsweet flowers (Filipendula ulmaria) for cordials in Sweden are examples of common grassland species that are used at home and in sustainable commercial production (Łuczaj et al, 2012).

## 8.4 Quality of Wild Harvested versus Cultivated Medicinal Plants

The beneficial effects of many phyto (herbal) medicines are based on the synergistic or additive effects of the compounds found in the plants (Misra 2009; Schippmann et al, 2006). The consistency of the medicinal quality is a concern in phytomedicines, and environmental effects may be a significant factor in variations seen in phytomedicinal content (Misra, 2009). Geographical and climatic conditions are also known to affect the composition of essential oils derived from medicinal plants (Mohammadhosseini et al, 2017). Furthermore, variations in chemical composition and the bioactivity of wild and commercial cultivars of medicinal herbs have been identified. For example, Dias and colleagues (2013) studied the bioactivity of wild and commercial yarrow (Achillea millefolium) and found that their samples of commercial yarrow yielded higher values for fat, saturated fatty acids, proteins, ash, energy value, sugars and flavonoids compared to the wild sample. Concurrently, their sample of wild yarrow contained higher levels of carbohydrates, organic acids, unsaturated fatty acids, tocopherols and phenolic acids (Dias et al, 2013). The authors note that the results were heterogeneous in terms of bioactivity and that further studies should be conducted to identify the specific compounds responsible for the bioactivity of the samples (ibid).

Misra (2009) states that both the Highgrove programme at the University of Westminster in the UK and Weleda found a loss of efficacy in cultivated stock compared to wild stock. Highlighting the importance of genetic diversity in nature, Weleda overcame their initial challenges of Arnica cultivation through a further search for wild varieties that better adapted to conditions of cultivation (Misra, 2009). In a more recent study of the transfer of wild Arnica montana to cultivated conditions, Sava Sand (2015) found no difference in volatile oil extracts of wild and domesticated varieties.

## 8.5 Herbicide and Pesticide-free Grassland Production

An important added value potentially present in semi-natural grassland-derived herbs is high quality products free from agri-chemical residues. This is especially the case for herbs sourced from Natura 2000 sites and other protected areas, where the use of agri-chemicals is forbidden.

However, plant protection residues have been found in herbs growing in their natural habitat near winter crop fields in, for example, Poland (Malinowska and Jankowski, 2015). Therefore, products with a trustworthy certificate of origin may be less contaminated than other products on the market.

## 8.6 Conclusions

Grassland-harvested medicinal plants can provide social and conservation benefits, but they can also be subject to overharvesting that results in the degradation of grassland environments and negative consequences for those dependent upon the ecosystem services and the livelihoods provided by those habitats. There are substantial shortfalls in the knowledge on potential efficacy differences between wild and cultivated herbs. The available studies provide a starting point regarding the results, as well as examples of tests that can be carried out to identify the potential differences between grassland-sourced and cultivated herbs.

# 9. CONCLUSIONS AND RECOMMENDATIONS FOR PART I

Part I of this study reviewed the literature of five grassland product categories – meat, dairy, and honey, as well as grass and wild medicinal products – with the aim of identifying the availability of scientific data and literature about grassland-derived products to determine gaps, consensus, and disagreement relevant to developing semi-natural grassland products and differentiating those products in the market.
The findings show that there is opportunity for development in production, entrepreneurship, and marketing with emphasis on the added value inherent to semi-natural grassland products in all five categories. Based on the findings, the following observations and suggestions are made:

- The higher nutritional profile of beef derived from grass-fed cattle is well-established, especially in regard to the type and percentages of fatty acids. This foundation should be used for promoting such meat in the market and to fine-tune labelling or other tools to differentiate meat based on the percentage of semi-natural grassland grass in the diet. There is potential to differentiate, according to its composition, meat derived from semi-natural grasslands to that from improved grasslands.

- The findings on dairy composition are similar to those of meat. Alpine studies provide an encouraging foundation for further exploring the effects of semi-natural grasslands, including their different types, on milk quality and dairy products.

- A challenge for both the meat and dairy sectors is the conflict between the consumption of animal products, especially those derived from ruminants, and the push for a climate- friendly diet. Research and development should be undertaken on: i) understanding and quantifying grassland soil carbon potential; ii) better understanding the potential trade-offs and synergies with biodiversity and ecosystem services provided by ruminants in grassland management versus the potential disservices of greenhouse gases produced by those same ruminants; and iii) envisioning and promoting 'less but better' meat and dairy production based on grasslands.

- Further development and use of reliable tests of compositional differences for meat and dairy, so that product quality and origin can be verified, could reduce fraud and increase consumer confidence.

- For the most part, natural and semi-natural grassland-produced honey has not been studied as such. Thus, studies of honey composition, its medicinal properties, and the identification of compounds or a profile that can be used in the differentiation and verification of grassland-sourced honey are all timely ways to contribute to its development and could serve as important contributions to the overall knowledge of honeys.

- The examples of the highlighted 'forest honeys' from Boreal countries provide reference as to how natural and semi-natural grassland-sourced honey could be marketed in ways that highlight the added value of the honey and other bee products.

- Biofuel has been suggested as a grassland 'ecosystem service of the future'. Overcoming technical challenges to produce clean energy is a developing field and should be watched closely for new developments.

- The potential for biofuel feedstock from grasslands should be assessed and local criteria for sustainable biofuel harvesting from grasslands should be created in anticipation of grassland biomass being used as biofuel.

- A variety of markets exist for wild harvested herbs and, in many cases, supply is insufficient to meet demand. Local capacity to supply these markets should be explored.

- Potential differences in the efficacy of wild-collected versus cultivated herbs have been evaluated in very few cases, but these provide a model for conducting further studies on different species.

# Semi–natural grassland–based products: case studies

II

This section presents twenty case studies as examples of value-added agriculture involving sustainably produced grassland products. The cases highlight how embedded added values (environmental, social, animal welfare, and quality) are produced and made visible to consumers. Thus, the cases represent more than just a reference to a product; they describe the wide range of possibilities for grassland biodiversity conservation and business products. They include individual enterprises and collectives, national and multinational product sourcing, as well as certification programmes. Along with social and technological innovations, market creation and development are also highlighted.

The collection of cases is arranged according to the main product types: meat and dairy, textiles, honey and grass products as well as wild medicinal plants. Meat and dairy production are frequently coupled production or present in the same cases and are thus combined in this section. One case, Savory Ecological Outcome Verified Certification, spans all products from grazing animals. The format of the case presentations varies slightly according to the case type and information available. However, each case starts with 'In a nutshell', where key information about the case is presented. This is followed by a description of the case, either specific assertions related to the added value of the products or activities or a summary of the added value, and resources for further information. The case studies are based on publicly available information (Resources), including the homepages for the cases, as well as personal communications. Information presented without citation is from the respective organisation's homepage, listed in 'in a nutshell', at the time of writing.

# 10. Meat and dairy

## Fjällbete AB: Community-oriented Regenerative Agriculture

**Where:** **Åre Municipality in Jämtland, Sweden Case**
**Summary:** **A community-oriented 'association company' for regenerative agriculture and local capital**
**Organisation/Company:** **Fjällbete AB (Jörgen Andersson)**
**Online** **(in Swedish only)**

## Description

Fjällbete AB is an organisation based on a unique model of 'regenerative agriculture and local capital'. It was founded in 2002 in Åre, Sweden as an 'economic association' with the aim of strengthening the local economy through closer ties between producers and the consumers, as well as financiers and entrepreneurs. In 2016, Fjällbete became a limited liability company, Fjällbete AB. Because the company provides opportunity for local investments in entrepreneurs, it refers to itself as an 'association company'. To date, nearly 200 investors have contributed SEK 2.4 million to its development. Fjällbete farm is Swedish organic standards certified (KRAV).


Fjällbete

**Fjällbete, animals interacting at the restaurant**

Fjällbete's focus is on the grazing of semi-natural mountain grasslands within a holistic management framework that was developed by Allan Savory (see the corresponding case study within this section below). In keeping with the principles of regenerative agriculture, Fjällbete supports activities that sustain and develop soil fertility through grazing.

The main agricultural activity it supports is grass-fed sheep in a mountain environment. About 10 tons of lamb meat is produced annually, and this income forms the backbone of the operation so that social projects and innovations can be undertaken. Additionally, Fjällbete has facilitated a small herd of grass-fed 'mountain cows,' which are only milked during the grazing season when fodder is plentiful and of high nutritional quality. Leather and wool-production are also supported by Fjällbete. Further, Fjällbete also hosts a 'mountain living' school for children and young people with special needs. The organisation teaches regenerative agriculture and also serves as the Savory Institute Knowledge Hub for the Nordic and Baltic countries.

## Community Financing

Fjällbete was cited in 'Local Dollars, Local Sense' (Shuman, 2012) as an example of an organisation supporting community investment. Shuman notes that,

> "everyone from modest farmers to wealthy venture capitalists in the region can now invest in sheep, their sheds, their grazing land, and machinery for processing their wool and meat. People can buy shares of these capital assets and then trade

them with one another. Because a land embankment defining the edge of a sheep-grazing area is called a vallen in Swedish, the locals joke that this is their Vall Street."

With shared sustainability values among the companies, Fjällbete's member deposits and loans have been supplemented by Ecobank and JAK (the 'Land Labour Capital') Bank (Conaty and Lewis 2010). In a Fjällbete financing and sales initiative called 'Milk is thicker than water', villagers could contribute to financing local producers by paying a premium on milk. In this case, eight local retailerswithin the food chain, ICA, provided their customers the option of paying approximately. EUR 0.1 € extra per litre of milk, which created funds that Fjällbete distributed to the ten local dairy farms. The European Network for Rural Development (ENRD, 2013) identifies the added value of Fjällbete:

"Allowing cows to make milk of grass is good for the environment, health and the economy."
"When policy and market fails, people here in Western Jämtland intervene so that cows remain!"

Fjällbete publicizes its activities and products on their website. Examples include milk subscriptions during the summer, mountain pasture lamb boxes (available at ICA grocery stores), and My Laghum – a local trade in locally-produced vegetables.

## Specific Assertions

The added value of the Fjällbete model is in both its approach to regenerative agriculture as well as in its community orientation, which is aimed at supporting the local economy through business and community involvement. Grassland production sustains the initiative. Fjällbete asserts:

| Added Value | Statement |
|---|---|
| Biodiversity and ecosystem services | "The purpose of [using] the mountain pasture is to try and show ways towards regenerative agriculture" |
| Health | "We will be a spearhead for regenerative agriculture, where we improve the environment while we produce healthy food at a low price" |
| Rural community | "We shall be a spearhead for public funding that enables participation and co-responsibility in the management of land and animals"<br>"At Fjällbete [mountain living school], children and young people with special needs can also stay for shorter or longer periods" |

## Resources


Conaty, P. and Lewis, M., 2010. JAK Bank: Liberating community finance from the ball and chain of compound interest. Making Waves. 20(3)50–57.
Retrieved from community-wealth.org/sites/clone.community-wealth.org/files/downloads/paper-conati-lewis.pdf [accessed 22.2.2019].
European Network for Rural Development, 2013. 17th NRN Meeting, 14–15.3.2013. Åre, Sweden.
Retrieved from enrd.ec.europa.eu/sites/enrd/files/enrd- static/app_templates/enrd_assets/pdf/17thNRNMeeting/FieldVisit17thNRN_SE3.pdf
Fjällbete, 2019a. Retrieved from fjallbete.se [accessed 22.2.2019]. Hansdotter, S., 2017. Bachelor thesis: An assessment of possibilities and limitations for an application of Sigill's climate-certification on the organization "Fjällbete". Mid Sweden University. 23pp.
Retrieved from diva-portal.org/smash/get/diva2:1184596/FULLTEXT01.pdf [accessed 22.2.2019].
Shuman, M.H., 2012. Local Dollars, Local Sense: How to Shift your Money from Wall Street to Main Street and Achieve Real Prosperity. Chelsea Green Publishing, Vermont. 249pp.

# Liivimaa Lihaveis: Government-certified Organic Beef

**Where:** Estonia
**Summary:** Estonia Case Summary: Certification – government-certified organic beef production
**Organisation/Company:** MTÜ Liivimaa Lihaveis
**Online**

## Description

Liivimaa Lihaveis was started in 2010 by ten farmers and now boasts approximately 50 members with an interest in organic production and grassland conservation through grazing. The initiative has received financing from the EU and the Republic of Estonia. The organisation emphasises the multiple values of high-quality products, grassland conservation and animal well-being and also advocates for sustainable agricultural policies. Liivimaa Lihaveis states that their common desire is, "to grow happy cattle in their inherent environment – strolling around the great grasslands.

The organisation has two brands of environmentally-friendly meat: grassland-produced Liivimaa Meat and its wild game label, Liivimaa Wild. The Estonian-language website provides product descriptions and lists over 70 points of purchase. The EU project website provides contact information for purchasing (for example, for export), as well as videos and other promotional materials. MTÜ Liivimaa Lihaveis products are produced at Liivimaa Lihasaaduste Wabrik OÜ/Nordic Meats.

## The Certification Scheme

The organic production for Liivimaa Lihaveis is guaranteed through certification by MTÜ Liivimaa Lihaveis, a non-profit organisation. The rules of the certification scheme are presented by Liivimaa Lihaveis (undated). Liivimaa Lihaveis operates a quality-oriented scheme that is based on the grazing of Angus, Hereford, and Simmental cattle breeds on organically-certified farms. In order to better assure the safety of the people working with the cattle, the scheme specifically favours naturally- polled (hornless) animals. Among its certification criteria are the following:

- Animals must be pastured on grassland during the grazing season. At least 50 percent of the grazing land must be natural, semi-natural or permanent grassland. In the winter period, animals must be able to move freely (and have access to the outdoors) and be provided a dry and clean place to sleep, water and enough hay and silage for every separated age group. Animals may be fed organic grain and protein feeds of domestic origin, but these must not exceed 30 percent of their daily total dry matter intake.
- Slaughter requirements are 24 months age for bulls and under 30 months old for heifers and oxen. Quality standards require that the carcass weight is between 250 and 300 kilograms, the conformation class should be O and R, and their fat classification between 1 and 4[10].
- All producers of organic grass-fed beef who fulfil MTÜ Liivimaa Lihaveis' requirements can participate after completing an application. MTÜ's board will verify that the scheme's requirements have been fulfilled and, if so, lists them among its participants. Various certification checks are carried out at farm level and at the slaughterhouse to ensure compliance and quality.
- Product traceability is embedded in the processing chain. MTÜ Liivimaa Lihaveis monitors the grass- fed cattle which have been sold, outsources the slaughtering and butchering services, and assigns batch numbers to the carcasses, which are packaged, marked and stored.

[10] See European Commission's Annex IV: Union scales for the classification of carcasses referred to in article 10 full text [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1308&from=EN] or summary [https://ec.europa.eu/agriculture/sites/agriculture/files/market-observatory/meat/beef/doc/methodology-carcase- remainders_en.pdf] [accessed 26.7.2019]

## Specific Assertions

Unless otherwise cited, the statements below are from the certification programme's rules (Liivimaa Lihaveis, undated), as listed on the website. Although specific citations are not provided in the rules, the assertions are well supported by the organisation's literature.

| Added Value | Statement |
|---|---|
| Health | "Grass-fed beef is healthy: it contains conjugated linoleic acid (CLA), vitamin E and betacarotene, and has an optimal ratio of omega-6 to omega-3 fatty acids. At the same time, the value of all these indicators from the point of view of human nutrition is at a better level than that of grain-fed beef." |
| Quality | "Our cattle only eats grass and if its diet consists of tens of different spices, we can be sure that this variety can also be met in the taste of the meat. Cattle that has been grown on the diverse grasslands of Estonia most certainly has the best and the strongest tasting meat. Furthermore, grass-fed beef has the best health and dietary qualities that our food can have." |
| Carbon sequestration | "The raising of grass-fed beef cattle is ecologically sustainable, lacking the carbon footprint that production of beef in factory farms has." |
| Biodiversity | "The Baltic area does not have high mountains nor deep lakes, but we do have grasslands more diverse than any rainforests, containing more than 70 species per square meter. So it is our burden to rightfully sustain and cherish these lands." |
| Animal welfare | "Grazing of beef cattle ensures that animal welfare requirements are better fulfilled and the cattle are allowed to act in a way characteristic of the species." |

## Resources


Liivimaa Lihaveis, undated. Rules of 'Production of Grass-fed Beef' food quality scheme.
Retrieved from media.voog.com/0000/0040/1347/files/Kvaliteedikava_en.pdf [accessed 14.3.2019].
nordicmeats.com [accessed 14.3.2019].
grassfedbeef.eu [accessed 14.3.2019].
liivimaalihaveis.ee [accessed 14.3.2019].

# **Naturbeteskött:** Certified Semi-natural Grassland Beef

**Where:** Sweden
**Case Summary:** Meat– certification programme for semi-natural grassland-produced beef
**Organisation/Company:** WWF/Naturbeteskötts föreningen
**Online** (in Swedish)

## Description

'Naturbeteskött', or natural pasture meat (beef) is produced on farms where at least 50 percent of its pasture lands are unfertilized and have not been ploughed for at least 20 years. The cows should graze for the entire grazing period and their winter diets should be roughage-based and exclude imported protein. The natural pasture meat certification is guaranteed by Swedish Seal's (Svensk Sigill) quality assurance IP Sigill.

'Naturbeteskött' was launched in the 1990s through a collaboration between the World Wide Fund for Nature (WWF) and the grocery store chain ICA (ICA, 2013). Their association grew out of a project WWF ran at the end of the 1980s, called 'Naturbetesmarker och Naturbeteskött' or 'Natural pasture and natural pasture meat' (WWF undated). Between 1999 and 2013, ICA contributed financially (WWF, 2015). WWF's partnership with ICA was significant because ICA controls over 50 percent of Sweden's food retail market (Brännström, 2015, as cited in Fischer and Röös, 2018).

In developing the certification, WWF worked together with individual stakeholders and local and regional organisations (WWF, 2015). The resulting logo is a protected trademark, and products are available in a limited number of stores, with ICA selling under the name, 'ICA Selection Swedish Premium Beef'. The Naturbeteskött föreningen non- profit association was developed in 2012 to independently continue WWF's work on semi-natural pasture meat and also serves as a platform for stakeholders. As a result, public procurement in Sweden can now include certified semi-natural pasture meat as a requirement (WWF, 2015).

Svenskt Sigill, conducts the certification for natural pasture beef in Sweden and has certified 'nötkött naturbeteskött' (beef from the natural meadows) of 19 companies.

© Naturbeteskött i Sverige Ideell förening

**The final product from "naturbeteskött" is served at an evening cookout**

## Specific Assertions

The World Wide Fund for Nature promotes natural pasture meat as a 'green product with many added values'. WWF Sweden and Naturbetesköttsföreningen both draw on their extensive experience to make the assertions below:

In their review of 25 years of the project, WWF (2015) cites the following outcomes of the Naturbetesskött certification:

- Semi-natural grassland conservation has increased: "The projects have contributed to approximately 30,000 hectares of biologically valuable natural grazing land [being] restored and resumed."
- Environmental benefits in that, "The projects have created added value for the farmers by restoring the natural pastures."
- Farmer's incomes have improved such that, "During the latest ten-year period, farmers have together increased their revenues by around 700 million SEK thanks to these natural pasture projects."
- Job-creation and entrepreneurial initiative has been fostered, whereby some landowners have become conservation contractors.
- The concept of natural pasture meat is understood by the public and can be requested in public procurement.
- Both public access to pastures and nature tourism have increased as a result of the projects.

| Added Value | Statement |
|---|---|
| Quality and nutrition | "Natural beef meat has a high content of Omega-3 fatty acids which have positive effects on human health. The natural meadow meat also has a high content of antioxidants and vitamin E, which gives a long shelf life." (in Swedish)<br>Meat is of high quality: animals must have been slaughtered a minimum of 2 weeks before sale and meat hung for that period. |
| Biodiversity | "You can eat meat with a good environmental conscience if you choose natural Swedish beef" and "Natural pasture lands are as diverse as the rainforests." (in Swedish)<br>"The rich natural pastures are one of the most important land layers to preserve in order to protect biodiversity in Sweden. They are necessary for pollinating insects and can help counteract the eutrophication of the Baltic Sea." (in Swedish) |
| Carbon sequestration | "Carbon dioxide is stored in the untouched soil Carbon". |
| Cultural | "Natural pasture lands are also our oldest cultural lands, with traces of ancestral cultivation in the form of old stone walls, cultivated rows and pollarded trees". |

## Resources


Brännström, S., 2015. Få aktörer har makten över maten. Svenska Dagbladet. 27.6.2015
Retrieved from svd.se/fa-matkedjor-attvalja-pa/om/makten-over-maten. [Accessed 5.2.2019]
Fischer, K. and Röös, E., 2018. Controlling sustainability in Swedish beef production: outcomes for farmers and the environment. Food Ethics. 2:39–55.
Retrieved from ink.springer.com/content/pdf/10.1007%2Fs41055-018-0027-7.pdf [accessed 5.2.2019]
ICA, 2013. Annual Report 2013 (in Swedish). Retrieved from reports.icagruppen.se/en/ar/2013/sustainability-report/icas-sustainability-work/environment/product-range/ [accessed 5.2.2019]
WWF, undated. Naturbetesmarker: en resurs som måste användas. 20 pp.
Retrieved from wwf.se/source.php?id=1730711 [accessed 5.2.2019]
WWF, 2015. WWFs Naturebetesprojekt: Långsiktiga effecter av 25 års arbete. 60 pp.
Retrieved from wwf.se/source.php?id=1665627 [accessed 5.2.2019]

# **Pasture for Life:** Certified 100 Percent Grassland–produced Meat and Dairy Products

**Where:** UK
**Case Summary:** Meat and dairy– certification for 100% grassland-produced beef, lamb and dairy products
**Organisation/Company:** The Pasture-Fed Livestock Association
**Online**

## Description

'Pasture for Life' is a UK certification programme for meat and dairy products derived from 100 percent grass-fed cattle. It is the initiative of The Pasture-Fed Livestock Association. Farmers, butchers, and dairies can apply for certification and create an online business profile hosted at pastureforlife.org. Dozens of farms in the UK have this certification. Independent inspection for Pasture for Life certification is conducted by ACOURA.

Pasture for Life defines pasture-based meat and dairy products as, "those coming from animals that have eaten nothing but their mother's milk and fresh grass or conserved pasture throughout their lives". The programme considers that their products' certification "represents a distinct method of farming where [the] raising of ruminant livestock is based exclusively upon pasture" (PfL, 2016a).

Pasture for Life

**Pasture for Life certified products are from 100% grass-fed animals**

Certification is based on annual or tri-annual inspection and can be combined with other assurance schemes (for example: Organic, Red Tractor, RSPCA ASSURED, Animal Welfare Approved). Fees are based on one's membership of the Pasture-Fed Livestock Association, inspection/audit fees charged to Organic Farmers and Growers, and a levy on product sales.

The dairy certification concerns UK dairy farms producing milk from cows that are fed exclusively on fresh and conserved grass and pasture.

In 2017, the Pasture-Fed Livestock Association ran a pilot with eight farms (three 'micro dairies' of fewer than 30 cows, two mid-size farms of 30–149 cows, and three large-scale farms with over 350 cows) and found that the grassland-based production costs were lower compared to conventional dairy herds. The pilot study also identified lower milk production (2,433-4,500 litres annual production per cow) compared to conventional farms, but higher farmgate prices (milk prices ranged from 40 pence per litre wholesale for cheese to GBP 3 per litre for direct retail) compared to conventional products (PfL, 2018), compared to the national average farmgate milk prices in 2018-2019 (approximately 20-31 pence per litre as reported by DEFRA, 2019).

## Specific Assertions

The Pasture for Life website includes sections on health, animal welfare, environment, trust, and taste and provides scientific articles to support their claims.

A summary of Pasture For Life's evidence for each of these key added values is presented below.

| Added Value | Statement |
|---|---|
| Quality and nutrition | "Food from animals that are grass-fed is healthier for humans to eat than meat produced from grain-fed cattle and sheep." Pasture for Life makes the following assertions about pasture-fed meat (and milk):<br>● Lower total fat levels;<br>● Higher levels of conjugated linoleic acid (CLA);<br>● Higher vitamin and mineral levels than meat or milk from grain-fed animals; and<br>● Higher levels of Omega-3.<br>Its review of scientific literature for grass-fed ruminants generally supports these assertions (PfL, 2016b) |
| Biodiversity | "The diversity of plant species within grass leys and pasture is one of the most important elements of pasture-based production." (PfL, 2016a)<br><br>Certification standards prohibit soya and encourage the use of legumes and herbs to enhance soil fertility and provide food for insects while avoiding chemical fertilizers. Mob grazing, leys and 'traditional flock sizes' are all mentioned as extensive production elements that promote biodiversity and resilience. Stocking rates must be sustainable and encourage biodiversity, as well as reflect the importance of herbs and other native species within grass swards. Agri-chemical application is to be minimized (Standards, 7.2.1). The standards include further specific recommendations and requirements for full farm biodiversity and grasslands in particular. |
| Carbon sequestration | "New research highlights the environmental benefits of 'mob-grazing' in beef cattle systems for the first time."<br>Pasture for Life refers to a study, conducted at Michigan State University, that compared "short duration, high intensity grassland grazing" (mob grazing or holistically-planned grazing), to beef production on intensive feedlots. The research found lower greenhouse gas emissions and improved soil organic carbon content from grass finishing (PfL, 2018a). |
| Animal welfare | "Compelling scientific research shows animals fed on pasture are less stressed, live longer and are more fertile than those farmed intensively."<br><br>Pasture for Life standards provide indicators of animal health and recommends the AssureWel resource for animal health (Standards 10.2). They promote animal welfare through a ruminant-appropriate diet, mobility, and longer weaning time for calves. |
| Farmer consumer welfare | "Bringing together British farmers committed to producing high quality food in a more natural way." The Pasture-Fed Livestock Association has over 420 members. The site includes a 'where to buy' section, as well as a system by which consumers can trace their meat, via a QR code system called Tracks, down to the individual animal and farm. |

Pasture for Life

**The diversity of plant species within grass leys and pasture is one of the most important elements of pasture-based production**

## Resources


DEFRA 2019. Historical statistics notices on UK milk prices and composition of milk, 2019.
gov.uk/government/statistics/historical-statistic-notices-on-uk-milk-prices-and-composition-of-milk-2019 [accessed 27.7.2019].
PfL, 2016a. Certification standards for ruminant livestock. v. 3.1, 56 pp.
Retrieved from pastureforlife.org/media/2014/03/PFLA-standards.pdf [accessed 22.1.2019].
PfL, 2016b. Research demonstrating the health benefits of Pasture for Life meat.
Retrieved from pastureforlife.org/media/2018/10/PFL-Health-Benefits-at-14-Sept-FINAL.pdf
[accessed 22.1.2019]. PfL, 2018a. New beef systems research includes soil carbon measurements for first time. 5.24.2018.
Retrieved from pastureforlife.org/research/ [accessed 4.2.2019].
PfL, 2018. Pasture for Life milk certification launched. 3.22.2018.
Retrieved from pastureforlife.org/news/pasture-for-life-milk-certification-launched/ [accessed 4.2.2019].

# Ranchising® and Goodmood Highland Ltd:
## A Novel Model for Organic Beef Production

**Where:** **Finland, with Ranchising abroad**
**Case Summary:** **Meat– franchising and marketing food chain model for organic beef production**
**Organisation/Company:** **Goodmood Highland Ltd.**
**Online**

## Description

Ranchising® is a short supply-chain agri-business franchising model based on the application of a range of techniques aiming to realise sustainable farming and contribute to the so-called sharing economy. The 'Ranchising for sustainable farming' model was originally developed by two Finnish farmers with the company Goodmood Highland Ltd. and is currently being further developed with partners for worldwide application. The farm is certified organic under Finnish organic standards (Luomu) (Goodmood Highland Ltd, 2019; Lehto, 2017).

The founders describe Ranchising as "a franchise model which mobilises the benefits of franchising and creates a business model structure which assists farmers to achieve and improve the quality of life in rural areas, profitability of their farming activities, enhancing the welfare of communities and promoting best practices in farming methods, while maintaining the highest standards of food safety, animal husbandry and environmental protection" (Goodmood Highland Ltd., 2019). Ranchising allows would-be farmers to invest in a farm on a franchise basis and access the internal and external support inherent in the franchise model (Russell, 2017).

Goodmood Highland Ltd. (Hyvätuuli Highland OY in Finnish) is a partnership of three farms with direct sales from their farm shop and selected sales points. The farms produce organic beef from semi-natural grasslands and organic hay. Cattle are at least three years old at slaughter. In addition to fresh and frozen beef and sausages, the company has a separately labelled, pre-prepared meat product line designed to aid the consumer who does not have the time (or skill) for proper preparation. The product line includes canned beef and ready ('just add water') stew.

© Kristaps Kalns/GrassLIFE

**Nature friendly grazing approaches are crucially important for development of high quality semi-natural grasslands**

The three farmers describe their integrated Ranchising concept – including their mobile phone app – in a short video (Goodmood Highland Ltd, 2017), where they emphasise the concept's application to any type of production process, the importance of simplicity for producer and consumer, and product traceability. After prerequisites are met, interested parties can enter into a Ranchising contract and begin training and production, with ongoing support from Goodmood Highland Ltd.

The company has taken the Ranchising concept to South Africa with the aim of building capacity among small-scale farmers (Russell, 2017; Ala-Siurua, 2016). In light of food scandals, they have, for example, emphasised how the Ranchising app entitles product traceability:


Goodmood Highland Ltd. participated in the EU-funded project, 'TRADEIT: Traditional food, Entrepreneurship, Innovation and Technology Transfer' (2013 – 2016), where the company promoted the Ranchising platform and partnerships (Lehto, 2017).

## Specific Assertions

The Goodmood Highland/ Ranchising website has sections dedicated to 'production ethics' and 'environmental responsibility'. Among the specific added values described on the website are the benefits of: grazing for biodiversity; crop rotation in organic farming; and free-range living conditions for their animals. Illustrative statements are presented below.

| Added Value | Statement |
|---|---|
| Quality and nutrition | "We feed our animals on hay only'. In this way our animals grow slowly but the meat develops a fine flavour."<br>"Goodmood meat's uniquely tasty, strong flavour is the result of three years of stress- free living."<br>To demonstrate the quality of the meat, Goodmood Highland Ltd. Has published the findings from an analysis of meat composition conducted by Eurofins Scientific Finland OY (2012). (in Finnish) |
| Biodiversity | "Our animals' fodder is based on natural pasture and capacity for hay production. Through natural pasturing, such as on rocky or riparian pasture, we create diverse habitats for many endangered species." (in Finnish) |
| Farmer welfare | "Direct sales give the farmer higher returns, which enables smaller-scale farming to beprofitable for the farmer." (Ranchising, 2015) |

| | |
|---|---|
| Animal welfare | "Our animals live their whole lives free on broad pasture lands... The mother cow's milk goes where it belongs– the calves nurse from their mothers until they are 8-10 months of age."<br>"Cattle are ruminants and, thus, their natural food is hay. Thus, we've made an ethical choice: we feed our animals on hay only". (in Finnish) |
| | "Year-round pasturing assures conditions for animals to realize species-specific behaviour as much as possible for production animals. We assure our animals have food, water and necessary care. The animals themselves develop their own natural hierarchies and care relationships to their off-spring". (in Finnish) |
| Product traceability | The Ranchising mobile app enables product traceability. |

## Resources


Ala-Siurua, M., 2016. Eteläsavolainen pienuuden hulluus tuo toivoa Etelä-Afrikkaan – "Mitä kaikesta koituu, jos meiltäkin katoaa sukupolvien hiljainen osaaminen?" ('What would happen if we too would lose generations of tacit knowledge?') Maaseudun Tulevaisuus. 21.12.2016.
Retrieved from maaseuduntulevaisuus.fi/ihmiset-kulttuuri/etel%C3%A4savolainen-pienuuden-hulluus-tuo-toivoa-etel%C3%A4-afrikkaan-mit%C3%A4-kaikesta-koituu- jos-meilt%C3%A4kin-katoaa-sukupolvien-hiljainen-osaaminen-1.173099 [accessed 15.2.2019].
Goodmood Highland Ltd., 2015. Ranchising (with English subtitles).
Retrieved from youtu.be/4in7OgsvRCg [accessed 15.2.2019].
Goodmood Highland Ltd., 2017.
Retrieved from youtube.com/watch?v=H3HkWF51pEQ&feature=youtu.be [accessed 15.2.2019].
Goodmood Highland Ltd., 2019. Ranchising – Goodmood Highland Ltd.
Retrieved from hyvatuuli.fi/en/ [accessed 15.2.2019].
Russell, S., 2017. Meet a new breed of cowgirl. Business Day Wanted. 3.12.2017.
Retrieved from wantedonline.co.za/travel/rest-of-africa/2017-08-14-meet-a-new-breed-of-cowgirl [accessed 15.2.2019].
Lehto, S., 2017. Future proof farming. 4.7.2017.
Retrieved from tasteofscience.com/articles/1262/future-proof- farming.html [accessed 15.2.2019].

# Saloniemi Cheese Dairy:
## Dairy Products from Finnish Heritage Breeds

**Where:** **Laitila, Finland**
**Case Type:** **Dairy products– milk is from Finnish landraces grazing grasslands**
**Organisation/Company(Owner):** **Riitta and Jouni Saloniemi**
**Online** **(in Finnish)**

## Description

The 'Saloniemi cheese dairy' is a family-owned organic farm and dairy producing over 25 different dairy products from Finnish landrace cattle and goats. The heritage breeds include approximately 120 milking goats and 20 milking cows, as well as Finnhorses.
Saloniemi dairy products include fresh and aged cheeses, a variety of fermented dairy products, clarified butter, raw milk, and toffee candies. All products are 100 percent organic, unhomogenized, and free of additives. In addition to organic certification, products are also certified by the Finnish Organic Association (Luomu), confirming that the animal feed is also of Finnish origin. Products are sold in over 80 stores in 11 provinces in Finland, as well as through direct sale on the farm. The company received the 'Organic Business of the Year' award from the Finnish Organic Association in 2014.

Traci Birge

**Saloniemi Cheese on a shelf in a grocery store in Finland**

## Specific Assertions

The website for Saloniemi Cheese Dairy emphasizes how their products support the maintenance of Finnish heritage breeds and traditional semi-natural habitats. Illustrative statements include:

| Added Value | Statement |
|---|---|
| Conservation and quality | "These animals graze endangered Finnish habitat types [n.b. management of this type is essential for maintaining the habitats] seashore meadows and traditional rural biotopes, adding their own historical hues to the meat and milk". (in Finnish) |
| Animal welfare and conservation of endangered heritage breeds | "Our ingredients are from Finnish heritage breeds – Finncattle, Finngoat, and Finnsheep." "Through processing the milk into cheese, we help in the conservation of these breeds and even encourage producers in breeding for now and the future". (in Finnish)<br>According to Natural Resources Finland, there are approximately 6,000 Finngoats, 15,000 Finnsheep, and 20,000 Finnhorses. Whereas the Western Finncattle population number around 3,000, there are only about 800 Eastern and less than 1,000 Lapland Finncattle. (Natural Resources Finland 2015). Saloniemi mainly has Western Finncattle (Linnainmaa 2017). |

## Resources


http://saloniemenjuustola.fi
Linnainmaa, E., 2017. Katso videolta vuohien iltaruuhka – Kuka tuleekaan viimeksi? 19.7.2017.
Retrieved from maaseuduntulevaisuus.fi/maatalous/katso-videolta-vuohien-iltaruuhka-kuka-tuleekaan-viimeksi-1.198883
Natural Resources Finland, 2015. Eläingeenivarat (Animal gene resources- Finnish only).
Retrieved from portal.mtt.fi/portal/page/portal/www/Tietopaketit/Elaingeenivarat/sailytysohjelmat/nauta [accessed 15.2.2019].

# **Savory Institute:** Land to Market/Ecological Outcome Verified Certification

**Where:** United States-based but active globally
**Case Summary:** Certification – applies to meat, dairy, wool and leather
**Organisation/Company:** Savory Institute
**Online**

## Description

The Savory Institute is a US-registered 501(c)(3) charitable organisation named after its president, Allan Savory, a biologist from Zimbabwe. Savory developed holistic management as a specific framework for grassland restoration, particularly in arid and semi-arid regions. The approach is based on very short, intensive grazing rotations of pasture (so-called 'mob grazing') combined with adaptive management that aims to mimick the natural grazing habits of herds (Savory Institute, 2018; Savory, 1991). In February 2013, Savory attracted substantial attention, both positive and negative, with his TED talk, 'How to fight desertification and reverse climate change' (Nordborg and Röös, 2016; Savory, 2013).

Savory Institute

Inspection for Ecological Outcome Verified certification

## Ecological Outcome Verification

In 2018, the Savory Institute launched the 'Land to Market™' programme as a 'regenerative sourcing solution' that connects conscientious buyers, brands and retailers directly to farms for meat, dairy, wool, and leather. Savory Institute partners with several 'Frontier Founders' to develop Land to Market sourcing. Its 'Ecological Outcome Verification' (EOV)™ certification is the empirical instrument used to qualify participating farms and ranches (Savory Institute, 2018a).

Ecological Outcome Verification is a certification scheme that is designed to help farmers achieve positive ecological impact on their farms through their grassland grazing practices and to inform consumers of these values.

"Land to Market™ helps tell consumers that the products they are purchasing come from livestock where the meat, dairy, wool, or leather are actually coming from companies that are making the land better as a result of how they are being managed." (Savory, 2018b)

Verification is based on context specific indicators where 'leading indicators' are short-term and related to habitat quality, biomass production, species composition, and soil erosion/stability. Short-term verification is accomplished through a scorecard of indicators that is used to determine an 'ecological health index' calibrated to the ecoregion. Additionally, longer-term 'lagging' indicators are used to monitor land regeneration and include canopy cover, biodiversity indicators, water filtration, soil carbon and soil equivalent fixed mass. The institute administers the verification process and trains farmers through a global network of regional hubs. (Savory Institute, 2018a)

## Savory Hubs

The Savory Institute is active in North and South America, Europe, Africa and Asia through accredited hubs, hub candidates and projects. Savory 'accredited professionals' have undertaken institutional training and are accredited to teach and train others in holistic management practice.

Fjällbete (whose slogan is 'Stronger local economy with regenerative agriculture'), based in Sweden (see the earlier case study entitled Fjällbete), is the 'Savory Hub' for the Nordic and Baltic countries (Fjällbete, 2019). Both the UK and Spain also have Savory accredited hubs, and there are candidates in Finland, Denmark, Germany, France and Croatia. Profit-oriented businesses, non-profit organisations, and cooperatives are all eligible to apply for accreditation (Savory Institute, undated).

## Controversy

Allan Savory's method of holistic management for grazing is controversial (Nordborg and Röös, 2016). A key criticism is that it is vague and that the benefits are exaggerated or not based on scientific evidence. Advocates, however, counter that the studies cited have not measured the impact of holistic grazing, and examples from the field ('anecdotes' according to critics) show highly favourable development. In their extensive review of Savory's methods, Nordborg and Röös conclude that holistic grazing, "could be an example of good grazing management but nothing suggests that it is better than other well-managed grazing methods."

Savory's views on grassland capacity for carbon and methane sequestration are the most controversial (e.g. Briske et al, 2013; Nordborg and Röös, 2016). "About two thirds, I would guess, of the world is desertifying... if we do what I am showing you here, we can take enough carbon out of the atmosphere and safely store it in the grassland soils for thousands of years, and if we just do that on about half the world's grasslands that I've shown you, we can take us back to pre-industrial levels, while feeding people."(Allan Savory 2013)

## Resources


Briske, D. D.; Bestelmeyer, B. T.; Brown, J. R.; Fuhlendorf, S. D.; Wayne Polley, H., 2013.
The Savory method cannot green deserts or reverse climate change. Rangelands. 35 (5): 72-74.
Fjällbete, 2019. Retrieved from www.fjällbete.se [accessed 21.2.2019]. Nordborg, M. and Röös, E., 2016.
Holistic management: a critical review of Allan Savory's grazing method. SLU/EPOK Centre for Organic Food and Farming, Chalmers. 45pp.
Retrieved from pub.epsilon.slu.se/14350/1/nordborg_m_roos_e_170628.pdf [accessed 21.2.2019].
Savory, A., 1991. Holistic resource management: a conceptual framework for ecologically sound economic modelling.
Ecological Economics. 3:181–191.
Savory A., 2013. How to fight desertification and reverse climate change. Ted2013.
Retrieved from ted.com/talks/allan_savory_how_to_green_the_world_s_deserts_and_reverse_climate_change/transcript
[accessed 21.2.2019].
Savory Institute, 2018a. Land to Market: World's First Regenerative Sourcing Solution. 29.8.2019
Retrieved from youtube.com/watch?time_continue=48&v=EuvrA8ohSKw [accessed 21.2.2019].
Savory Institute, undated. Holistic planned grazing. savory.global/holistic-management/ [accessed 21.2.2019].
Savory Institute, 2018b. Ecological Outcome Verification (EOV). Version 1.0. 15.8.2018.
Retrieved from savory.global/wp-content/uploads/2018/08/0828_EOVDoc.pdf [accessed 21.2.2019].

# Thise Organic Dairy: GrassMilk as a New Differentiated Product

**Where:** Jutland, Denmark
**Case Summary:** Dairy – organic milk from grass-fed cattle
**Organisation/Company:** Thise Dairy Cooperative (Torsten Wetche)
**Online** (in Danish)

## Description

Thise Dairy is Denmark's second largest dairy (Thise, undated-a). It was founded in 1988 by 'seven eco-idealists' and a 'dairy manager from a small village dairy' on the principle of members' freedom to independently produce high quality organic dairy products (Thise, undated-a). Products are certified by Denmark's organic label (Ø-label).

The company offers a diverse organic dairy product portfolio and, in recent years, has launched several dedicated milks based on specific production qualities, including 'Jersey milk', 'farm milk', 'regional milk', and 'grass milk'.

Thise's grass milk ('graesmaelk' in Danish), was launched in 2017 by one of its founders, Torsten Wetche of Hvanstrup Farm in Himmerland, and is currently offered by a single farm (Thise, undated- b). Wetche crowdfunded for the product and succeeded in DKK 100,000, (approximately 13,000 €) to launch production (Wetche, undated).


Thise Dairy

**Thise's grass-produced milk is an organic and unhomogenized product**

Hvanstrup farm covers approximately 300 hectares and includes meadow, forest, arable and improved grassland. The fifth-generation owners' strategy is based on organic, grass-fed animals for dairy (and eventually meat) products and 'vegetable' (including pseudograins like quinoa) production. Approximately 40 percent of the arable land is in clover grass and 60 percent is cultivated for vegetable crops (Thise, undated-b). The cattle, including the milking cows, graze the semi-natural meadows as well as improved grasslands (Torsten Wetche, personal communication). Under this strategy, their production is based on approximately half the number of dairy cows than would normally be possible on a farm specializing in organic milk production (Thise, undated-b). Thise asserts that this multi-pronged production strategy actually results in the farm producing food in quantities that would serve nearly three times the number of people (3,500) compared to if it were in standard organic dairy production (under which the farm would be able to meet the energy needs of about 1200 people annually) (Thise, undated-b). Torsten states that sales have been positive, although it is difficult to fully gauge demand with only one producer of grass milk (personal communication, 2/2019).

## Specific Assertions

Thise Dairy describes grass milk as more than just a milk, because it illustrates novel approaches to farming. Among its assertions are the following:

| Added Value | Statement |
|---|---|
| Nutrition and composition | "When the cows are not fed with concentrate, the milk yield drops significantly. However, the milk gets a different and nutritionally more interesting fatty acid composition". (in Danish) |
| Animal welfare | In terms of animal welfare, new standards have been developed in the grass milk concept, which include (in Danish):<br>The cows must be on grass in the summer, day and night, for a minimum of 3 months.<br>● Cow and calf join 3–5 days after calving.<br>● The calves must not be placed in single boxes.<br>● The calves must have milk for the first 4 months.<br>● The calves must not be sold until they are 2 months old and they must be reared organically.<br>● Cows and calves are given 40% more space compared to the requirements of the organic set of rules." |
| Climate | "There is no full consensus among the researchers on all aspects of the grass milk climate effect. The assessments depend, among other things, on measuring methods and the starting point for what it is measuring." (in Danish) |

## Resources


Skiv-Her, 2017. Torsten søger støtte til Græsmælk fra "Hvanstrup" (Torsten seeks support for milk from "Hvanstrup"). 6.4.2017.
Retrieved from skive-her.dk/nyheder/mad-og-drikke/torsten-soeger-stoette-til-graes-maelk-fra- hvanstrup.htm [accessed 26.2.2019].
Thise Dairy, undated-a. Thise overgiver sig ALDRIG! (Thise NEVER gives up!).
Main website Retrieved from thise.dk/om/historie/ [accessed 26.2.2019].
Thise Dairy, undated-b. Graesmaelk fra Thise Mejeri (Grass milk from Thise Dairy).
Main website Retrieved from thise.dk/historier/graesmaelk/ [accessed 26.2.2019].
Wetche, T., undated. Græsmælk fra "Hvanstrup" (Grass milk from "Hvanstrup").
Coop Crowdfunding.
Retrieved from crowdfunding.coop.dk/project/24 [accessed 26.2.2019].
Wetche, T., 2019. Personal communication. 27.2.2019.

# **Wild Estates:** Sustainable Landscape Management Accreditation

**Where:** Europe
**Case Summary:** Whole estate – sustainable landscape management accreditation (for estates with hunting and fishing activities)
**Organisation/Company:** The European Landowners Organisation (ELO)
**Online**

## Description

Wild Estates (WE) is a certification label (and de-facto) network especially relevant to estates with hunting activities. Its slogan is 'We act for biodiversity' and the aim is sustainable and active wildlife management that improves biodiversity wherever possible (Wild Estates Charter). The Wild Estates label was conceived in 2005 with input from national authorities and private organisations related to nature conservation and land management. Its secretariat is based in Brussels, and the ex-officio coordinator is The European Landowners Organisation. The organisation works directly with the European Commission in activities related to Wild Estates.

"The WE Label represents a voluntary commitment by land managers to work under the standards of wildlife management and conservation as it can deliver a wide range of social, economic and environmental public benefits. The WE Label communicates cost-effective ways to enhance biodiversity thanks to rigorously tested sustainable land management practices. It helps connect people with the land and its resources by supporting the provision of information and encouraging active engagement with the general public."

All estates are welcome to apply for the Wild Estates label. Application involves signing the WE charter and completing a questionnaire adapted to each biogeographical region. Presence of semi- natural grassland is not necessary to achieve certification, but it is highly relevant and complementary. Wild Estates uses a points-based system to award its label, where 'natural, semi- natural and intensive hunting or fishing grounds' have strong value. Cultural values are also incorporated into the points system.

Hia Sjöblom/Nature and Game Management Trust Finland

**Semi-natural grassland located on a Wild Estates certified farm in Finland**

By October 2018, the Wild Estates label was in use in 19 countries on a total of 330 estates covering 1,616,881 hectares in various biogeographic regions. The estates ranged in size from a few tens of hectares to those covering hundreds of thousands. Certified Wild Estates in the Boreal biogeographical region are found in Finland, Sweden, and Estonia (there are no participating estates in Latvia).

n the UK, the Country Land and Business Association (2014) recommended evaluation of Wild Estates' criteria and certification to ascertain that the purported nature values are, indeed, present on the certified estates (Scottish Land & Estates, 2018). However, there is also evidence of high levels of engagement in nature and biodiversity conservation on its accredited farms (Luonnon- ja Riistanhoitosäätiö, undated; Järki 2016). Wild Estates can serve as a network and information hub for semi-natural grassland farms hosting hunting, fishing and wildlife management activities, and the label can aid in communicating the landowners' commitment to nature.

## Specific Assertions

The main added values indicated by the Wildlife Estates label are biodiversity conservation and rural welfare, as seen in the statements below.

| Added Value | Statement |
|---|---|
| Biodiversity | "Wildlife Estates Label is a network of exemplary estates that voluntarily agreed to adhere to the philosophy of wildlife management and sustainable land use."<br><br>"The Wild Estates Charter includes biodiversity commitments as follows: undertaking active management plan and its monitoring; following the European Charter on Hunting and Biodiversity and the respective Agreement between Birdlife International and FACE; improving biodiversity where possible; and following all applicable laws and codes of practice in environmental legislation". |
| Rural welfare | "Rural estates are crucial in supporting rural economies, which in turn play a significant role in overcoming the world's food, energy and environmental challenges." |

## Resources


Country Land and Business Association (CLA), 2014. European Wildlife Estates Label. 6.11.2014. Retrieved from cla.org.uk/your-area/south-west/swrn-regional-news/european-wildlife-estates-label# [accessed 16.2.2019]

Järki, 2016. Wildlife Estates Label. Newsletter 8.12.2016. Retrieved from jarki.fi/sites/default/files/we_label_newsletter_dec_2016.pdf [accessed 16.2.2019].

Nature and Game Management Trust, Finland, undated. Activities. Retrieved from luontojariista.fi/en/activities [accessed 16.2.2019].

Scottish Land & Estates, 2018. Prestigious Wildlife Estates Scotland accreditation presented to Glenbervie Estate. Scottish Land & Estates, 6.8.2018. Retrieved from scottishlandandestates.co.uk/news/prestigious-wildlife-estates- scotland-accreditation-presented-glenbervie-estate [accessed 16.2.2019].

# 11. TEXTILES

## Hiiu Vill Vaemla Wool Factory: Wool from the Estonian islands

**Where:** Hiiumaa, Estonia
**Case Summary:** Wool- from the Estonian islands
**Organisation/Company:** OÜ Hiiu Vill
**Online**

## Description

Hiiumaa is Estonia's second largest island and has a long history of pasturage on its semi-natural grasslands and wooded meadows (Kaasik et al, 2011). Two of its most important semi-natural grassland-types are alvars and wooded meadows – habitats of exceptional biodiversity value (Talvi and Talvi, 2012). The grasslands suffered from changes in land use (mainly afforestation) during the Soviet period, but European Union agricultural policy facilitated grassland restoration (Kaasik et al, 2011). Hiiumaa, along with the neighbouring islands of Saaremaa and Muhu, is undergoing substantial restoration of its grasslands through the 'LIFE to alvars' project. Through concerted efforts, new farmers have taken up raising sheep and cattle on the islands' grasslands.

The Vaemla Wool Factory on Hiiumaa Island transforms the wool from the three islands' sheep into yarn and knit-wear. The factory has been owned and operated by the Valdma family since 1992 and is operated under the company name Hiiu Vill (Hiiu Wool). Much of the work is done by hand (Põllö, undated). The shop, which houses the original machinery, is one of the last surviving buildings of the Vaemla Manor and was restored by the Valdmas. Vaemla Wool Factory is the legacy of the Estonian SSR Local Industrial Combine wool factory, which operated from the 1950s until 1987 (Hiiu Vill, undated). In addition to selling their wool products, the family also operates a summer café on site. It is the combination of wool commerce and tourism-oriented activities that helps the business stay competitive (Põllö, undated).

Traci Birge

**Spools of wool and old wool machinery at Hiiu Vill. Visitors can see the old wool machinery in action when they visit the on- site shop**

## Added Value

In purchasing the wool locally and operating on the island, Hiiu Vill supports local livelihoods and is a direct link between the islanders' rural culture and valuable grasslands. With its historic buildings and working antique machinery, the wool factory makes a positive contribution to the tourism of Hiiumaa and connects visitors with the semi-natural grasslands through a tangible market product.

## Resources


Hiiu Vill, undated. Retrieved from hiiuvill.ee/wptest/en/about-us/ [accessed 27.2.2019].
Kaasik, A., Sepp, K., Raet, J., Kuusemets, V. 2011. Transformation of rural landscapes in Hiiumaa since 1956 and the consequences to open and half-open semi-natural habitats. Ekológia (Bratislava) 30(2):257–268.
Põllö, H., undated. Vaemla wool factory. Retrieved from hiiumaa.ee/tuletorn/english.php?id=18 [accessed 27.2.2019].
Talvi, T. and Talvi, T., 2012. Semi-Natural Communities: Preservation and Management. Ministry of Agriculture, Viidumäe – Tallinn. 31pp. Retrieved from keskkonnaamet.ee/sites/default/files/maahooldus/poollooduslikud_kooslused_eng.pdf [accessed 27.2.2019]

# **Kering:** Regenerative Sourcing Solutions in Luxury Fashion

**Where:** Global
**Case Summary:** Textiles– Certification under Savory's Ecological Outcome Verification (EOV) for leather and fibre supply chains
**Organisation/Company:** Kering in collaboration with the Savory Institute
**Online**

## Description

Kering manages the development of a series of luxury houses in fashion, leather goods, jewellery and watches, including Gucci, Saint Laurent, and Kering Eyewear, among others. Kering and the Savory Institute (further description of Savory Institute is found in the case study of Savory Ecological Outcome Verified Certification in the Section 10: Meat and Dairy) announced their collaboration in December 2018 and state that their aim is to 'recognize the positive impact regenerative agriculture can have in the fashion industry' (Kering, 2018). Accordingly, Kering has expressed a commitment to supporting and promoting Savory's Ecological Outcome VerificationTM methodology for leather and fibre (e.g. wool and cashmere) sourced from regenerative grazing systems (Kering, 2018; Mitchell, 2018).

© Savory Institute

**Multi-species grazing applied in regenerative agriculture**

In their announcement, Kering states that, "the inclusion of regenerative raw materials is also one of the three key principles to building a circular economy in fashion" (Kering, 2018). Marie-Claire Daveu, Chief Sustainability Officer and Head of International Institutional Affairs at Kering, stated:

> "Regenerative agriculture is a multi-benefit solution which supports Kering's sustainability ambitions to mitigate our environmental impacts and deliver positive outcomes along our supply chain." (Kering 2018).

As part of the collaboration, Kering and Savory plan to identify and develop a network of farms from which Kering can source textile materials. In addition to improving the sustainability profile of its supply chain, Kering notes that verification will allow goods' traceability, which is a key challenge for the fashion industry to overcome. As the Kering partnership is in its initial phases, Savory is in the process of developing capacity for their supply needs (Victoria Keziah, Savory, personal communication, 2/2019).

## Specific Assertions

The Kering-Savory Collaboration aims to improve environmental and social sustainability by supporting value-added agriculture as presented below.

| Added Value | Statement |
|---|---|
| Carbon sequestration | "Regenerative agriculture can protect and reverse this environmental degradation, including restoring healthy soil, which removes CO2 from the atmosphere and acts as a carbon sink for mitigating climate change." (Kering, 2018) |
| Farmer welfare | "Kering will focus on its key sourcing regions and work together with Savory to support farmers pursuing and demonstrating positive ecological outcomes on their land." (Kering, 2018) |

## Resources


Kering, 2018. Kering and Savory Institute collaborate for first verified regenerative sourcing in fashion. 6.12.2018.
Retrieved from www.kering.com/en/news/savory-institute-collaborate-first-verified-regenerative-sourcing-in- fashion [accessed 2.20.2019].
Kering, 2019. A Luxury Group and its houses.
Retrieved from www.kering.com/en/houses/ [accessed 2.20.2019]
Mitchel, K., 2018. Kering forms two new partnerships. 12.12.2018.
Retrieved from www.ecotextile.com/20181212223919/fashion-retail-news/kering-forms-two-new-partnerships.html#jextbox-login- module-0
[accessed 2.20.2019].

# 12. HONEY

## Kjartans Honning: Raw Honey from the Norwegian Nature

**Where:** Østfold, Norway
**Case Summary:** Honey – from natural landscapes
**Organisation/Company:** Kjartan and Marianne H. Dahl
**Online** (in Norwegian)

## Description

The aim of Kjartans Honning (honey) is to produce high quality raw honey without any additives. Håkan Dahl, Kjartans grandfather began with bees on Solhøy Bigård in Trøgstad, Norway in 1938, and Kjartan began participating when he was ten years old. Together, they managed the bees for many decades, up until Kjartan's grandfather passed away at age 99. Today, Kjartan manages 300 hives.

Kjartans honey is differentiated according to the foraging habitat for the bees. In addition to polyfloral forest honey, Kjartans honning also sells wild raspberry honey and honey from heather nectar. All of these honeys are marketed as high quality, raw honey. The heather honey is from the mountains of Norway in Femunden, Trysil and Rendalen, about 300-700 metres above sea level in an area free of cars and other pollution (Marianne H. Dahl, personal communication 14.8.2019). The heather honey is particularly relevant to grassland product differentiation, as heaths are associated with grazing and other management for natural and semi-natural grasslands.

Research on the wound healing properties of Kjartans Honning's forest and heather honey was conducted by Patricia Merckoll, of Ullevål Hospital, and colleagues (Merckoll et al, 2009). The honey was determined to have antibacterial properties and products from this honey could be further developed for medicinal use (ibid).

In addition to honey, Kjartans Honning produces bee product-based skin care products, as well as treats (gummy bears). Kjartans Honning products are sold in a variety of health food stores and grocery chains in Norway, as well as directly from the farm and can also be purchased online.


Kjartans Honning

**Kjartan's Honning from Norway is differentiated according to the foraging habitat for the bees**

## Specific Assertions

The main added value of the Kjartans Honning is health-related:

| Added Value | Statement |
|---|---|
| Natural product | ”Kjartans Lynghonning is a nutritious raw nectar gathered from heather plants in Trysil and Telemark – the honey in this jar is refined and tapped by Kjartan. It is never heated. Kjartans Lynghonning has a distinctive taste and a low GI, which makes it beneficial as a sweetener for people with diabetes. Just like the forest honey, this nectar has been proven for its antibacterial properties.” (Kjartans honning, undated) |
| Health qualities | “By sourcing different plants in the rich, Norwegian forest, we have created a range of healthy and nutritious honeys: Bringebær [raspberry], Skogsplante [polyfloral forest] and Lyng [heather],” says Dahl. “In addition, we have another raw forest plant honey with propolis, which is excellent for exterior application such as on wounds and rashes, so our honey can be beneficial in many ways.”(Opstad, 2019) |
| Health qualities | “Raw honey like this has a number of good properties and contains all 22 amino acids, 27 minerals and 5000 enzymes. Honey is a versatile low-GI substitute for table sugar.” (Kjartans honning, undated) |

## Resources


Kjartans honning. Retrieved from www.kjartanshonning.no (in Norwegian) [accessed 13.8.2019].

Kjartans honing, undated. Kjartans Honning brochure, in English. Provided by Kjartans Honning, 14.8.2019.

Merckoll, P., Øystein Jonassen, T., Vad, M.E., Jeansson, S.L. & Melby, K.K., 2009. Bacteria, biofilm and honey: A study of the effects of honey on ‘planktonic’ and biofilm-embedded chronic wound bacteria. Scandinavian Journal of Infectious Diseases. 41: 341–347.
Retrieved from www.static1.squarespace.com/static/56ade87e60b5e97dc36baab5/t/56c7261b1bbee0becc9a33e2/1455891996964 /Forskning_ Article2009.pdf [accessed 13.8.2019].

Opstad, I. 2019. Natural, raw Norwegian honey – straight from the beekeeper. Scan magazine.
Retrieved from www.scanmagazine.co.uk/kjartans-honning/ [accessed 13.8.2019].

# Muhu Mesi: Island Honey from Natural Landscapes

**Where:** Muhu, Estonia
**Case Summary:** Honey – Island honey from natural landscapes
**Organisation/Company:** Muhu Mesi (Almar Lauge)
**Online** (in Estonian)

## Description

Muhu is the third largest island in Estonia and covers an area of approximately 200 square kilometres. Local honey producer, Muhu Mesi, gathers honey from bees that frequent the sparse grassland vegetation on its alvars, as well as the juniper (Annely Holm, personal communication, 2/2019). The family business owner, Aimar Lauge, started with two hives in 1992 which has now grown to 150 (Muhu Mesi undated). The bee colonies are spread across Muhu Island in a total of 21 locations (Muhu Mesi, undated). The bees are of the BuckfastTM variety, known as a gentle and hardy bee (Buckfast Abby, 2019). In 2005, Muhu Honey was recognized as 'The Best Food for Health in Estonia' and, in 2010, the owner received the Estonian Beekeepers Association's 'Beekeeper of the Year' award (Võer, 2018).

Annely Holm

The honey is mainly sold directly in the village of Hellamaa on Muhu, but is also available in Tallinn (Muhu Mesi, undated).

**Restored alvar grassland in Koguva Muhu island**

## Specific Assertions

Muhu Mesi does not make specific health claims about their honey, but they do emphasise the wide variety of natural plants upon which the honey is based:

| Added Value | Statement |
|---|---|
| Natural product | "There are 746 different types of plants found on Muhu, 395 species in Kesselaiul." "More than 100 different plant pollens have been concurrently found in Muhu honey, indicating that it is indeed sourced from a wide variety of plants." |
| Natural product | "We offer the best Muhu honey. Our bees collect nectar from the clean Muhu nature and make honey that melts in the mouth. What matters is that all of our bees are gentle and happy. It is passed on to the taste properties of the honey." |

## Resources


Buckfast Abby, 2019. Retrieved from buckfast.org.uk/bees-past-and-present [accessed 28.2.2019].
Holm, A., 2019. Personal communication. 28.2.2019.
Muhu mesi undated. Main web page Retrieved from muhumesi.ee
Võer, L.-R., 2018. Aimar ja Rita Lauge – juba kolmandat põlve mesilindudega koos.
(Aimar and Rita Lauge - already the third generation of beekeepers). Maaleht 15.2.2018.
maaleht.delfi.ee/news/maaleht/elu/aimar-ja-rita-lauge-juba-kolmandat-polve-mesilindudega-koos?id=81041397 [accessed 28.2.2019].

# 13. GRASS PRODUCTS

## Baltic Unique Solutions:
## Organic Hay Pellets for Pets

**Where:** Latvia
**Case Summary:** Grass product- organic hay pellets
**Organisation/Company:** Baltic Unique Solutions
**Online**

## Description

Baltic Unique Solutions was founded in 2009 and began manufacturing hay pellets for pets (mainly rodents) in 2010 (Kuris et al, 2015). The company produces a variety of feed pellets based on organic hay from semi-natural grasslands in Latvia. These also include fodder and treats for horses and ponies, as well as for rabbits, guinea pigs, and chinchillas under the name 'Nicety' (Nicety, 2015). The company advertises that all ingredients are 100 percent organic and of high quality. The company has certification in Latvia that guarantees the organic quality of their factory's products. The product is convenient for the consumer in that it is easy to transport and store.

The basic hay pellets for horses are 100 percent semi-natural grassland-sourced, while the main ingredient of the rodent feed pellets is polyphyte meadow hay (Nicety, 2015). The different formulae are prepared based on animals' nutritional requirements according to type, age and so on (Kuris, et al). Specialized machinery is used for cutting, milling and packaging the pellets. The production line, including a new production plant, was further developed with the aid of the European Structural and Investment Funds (Baltic Unique Solutions/Berzins, undated).


Baltic Unique Solutions

**Hay pellets for horses are 100% sourced from semi-natural meadows**

Since 2011, Baltic Unique Solutions has supplied the biggest pet shop in Latvia – Dino Zoo. The company has exhibited the product at international exhibitions and exports its products to Russia and Italy, for example (Baltic Unique Solutions/Berzins, undated).

The pellets are an important innovation for certified organic semi-natural grasslands because their added value is made visible to consumers. They also ensure that feed which is otherwise unsuitable for modern agriculture's farm animals can be used for pets (Herzon et al, 2018). Hay that is unsuitable for fodder production can also be used as bedding or made into fuel pellets, while the ash can be used as fertilizer (Herzon et al, 2018; Kuris et al, 2015).

## Specific Assertions

Baltic Unique Solutions emphasizes the naturalness of their hay products, as follows:

| Added Value | Statement |
|---|---|
| Animal welfare and nutrition | Hay pellets for horses are suitable for: "Providing all the benefits of summer grass, all year round. Manufactured exclusively from organically farmed meadow hay of the highest quality. Does not contain colorants, preservatives and GMOs. Low in starch. High fibre content. Natural minerals and vitamins. Can be used dry or soaked." |
| Transparency | "All parties including farmers and producers involved in [the] animal feed production process are regularly monitored and re-certified at least once a year". |

## Resources


Baltic Unique Solutions/Priede, M., undated. Production of Hay Pellets.
Retrieved from grassservice.balticgrasslands.eu/content/uploads/2014/10/15_Grass-pellets-forage_M.Priede.pdf [accessed 18.2.2019].

Herzon, I., Birge, T., Koivuranta, R., Keinänen, M., 2018. Innovations for High Nature Value farming systems. In Herzon, I. Package of educational materials on High Nature Value farmland topic. Deliverable D.3.18 of the HNV-Link project, Grant agreement no. 696391, University of Helsinki.
Retrieved from hnvlink.eu/download/education/HNV-LinkRoleforInnovationsinHighNatureValue-farmingsystems.pptx.pdf [accessed 18.2.2019].

Kuris, M., Remmelgas, L., Prižavoite, D., Bojārs, E., Ruskule, A., Fammler, H., Navickas, K., 2015. Viable grassland management – experience, challenges and opportunities. Baltic Environmental Forum. 35 pp. Retrieved from vivagrass.eu/grasslands/best-practice/ [accessed 18.2.2019].

Nicety, 2015. About Company.
Retrieved from www.nicety.lv/?page_id=160&lang=en [accessed 18.2.2019].

# OÜ Lihula Soojus Lihula Boiler Plant's Energy from Seashore Meadows

**Where:** Lihula, Estonia
**Case Type:** Bioenergy – Common reed and hay from seashores used for energy
**Organisation/Company:** OÜ Lihula Soojus
**Online**

## Description

After years of feasibility and scoping studies, the Lihula Boiler Plant, which previously used shale oil for combustion, was rebuilt to a utilize biomass from grasslands as biofuel. The reconstruction was undertaken with a co-financing loan from Iceland, Liechtenstein and Norway (EEA Grants – Norway Grants 2008). The boiler plant has used hay and reed from the Matsalu National Park as the main fuel for heating the District of Lihula since 2010, with the new plant decreasing the CO2 and SO2 emissions by 98 percent (Kask and Kask, 2013). Shale oil now is kept only as a reserve, in case of emergency or maintenance (Levo, undated). The new boiler is a Danstoker biomass boiler with 1.8 megawatt capacity and has an annual energy production of 4.2 gigawatt hours (Kask and Kask, 2013). In 2013, the plant used about 1,000 tons of hay or reed and about 200 tons of wood chips (Kask and Kask, 2013).

Lihula Parish encompasses an area of 384 square kilometres and has a population of just under 3,000. The Lihula Soojus company, which manages the heating plant, is owned by Lihula Rural District. Matsalu National Park, founded in 1957, is an important conservation area that covers nearly 500 km2 and encompasses waterways, wetlands and woodlands. Collectively, Matsalu has nearly 1,000 hectares of reedbeds, floodplains and coastal meadows. Its reedbeds are also harvested for thatching material. (Kask and Kask, 2014)

## Added Values

By using the grassland biomass in the Lihula Boiler Plant, the region was able to respond to several environmental concerns simultaneously. First, it found a way to care for the semi-natural grasslands of the Matsalu National Park, since the meadows have to be mown every year. Second, the use of local, renewable energy sources reduced the inherent pressure of increasing fossil fuel prices. Third,

© Avo Kiisk

**Liihula Soojus Boiler Plant utilizes biomass from grasslands as biofuel**

the environment is cleaner through the reduction in CO2 and SO2 emissions. Finally, the co-financing helped realise the much-needed economic and technical support to make the project feasible (Levo, undated). The new boiler plant is also able to utilise the reed material that is left over from thatch production – a waste product that formerly had to be disposed of other ways (Kask and Kask, 2014).

By 2014, only meadow hay was being used for heat production, with the mowing and baling of the hay supported with agri-environment payment of EUR 120/ha (Kask and Kask, 2014). Mowing of reedbeds is not a supported activity (ibid).

## Resources


Kask, L. and Kask, Ü., 2014. Energy production from biomass of Matsalu Natural Park, Estonia.
Tallinna Tehnikaülikool 5-6.11.2014.
Retrieved from http://grassservice.balticgrasslands.eu/content/uploads/2014/10/12_Maatsalu-nature- park_L.Kask 1.pdf [accessed 1.3.2019].
Kask, Ü. and Kask, L., 2013. Reed as a renewable energy source, equipment and technologies for using reed in energy industry. pp. 55–75. IN: Kask, Ü. (Ed.) 2013. Guidebook of reed business. COFREEN – Reed for bioenergy and construction. 107pp.
Retrieved from https://www.ymparisto.fi/download/noname/%7BCCDBCAB8-A4B6-400B-BF6F-4F1D04CCD126%7D/120479 [accessed 3.3.2019].
Kosk, K., 2016. Lihula ja Haapsalu katlamaja saavad KIKilt üle poole miljoni euro (Lihula and Haapsalu boiler plant will receive over half a million euros from the Environmental Investment Center (EIC) Foundation). Lääne Elu 8.26.2016
Retrieved from https://online.le.ee/2016/08/26/lihula-ja-haapsalu-saavad-kikilt-ule-poole-miljoni/ [accessed 1.3.2019].
Paluoja, S., 2017. Pärnu Postimees: Lihula katlamajas läheb ahju hein (Pärnu Postimees: In the Lihula boiler house, the hay goes). Liula Teataja 5.1.2017.
Retrieved from https://lihulateataja.ee/majandus/parnu-postimees-lihula-katlamajas-laheb-ahju-hein/ [accessed 1.3.2019].
EEA Grants - Norway Grants, 2008. Biofuels to cut air pollution in Lihula, Estonia.
Retrieved from https://eeagrants.org/News/2012/Biofuels-to-cut-air-pollution-in-Lihula-Estonia [accessed 1.3.2019].

# 14. WILD MEDICINAL PLANTS

## FairWild Foundation:
## Certified Wild-harvested Ingredients and Wildcrafted Products

**Where:** Multi-country/global
**Case Summary:** Certification – for sustainable and fair trade in wild harvested ingredients
**Organisation/Company:** FairWild Foundation
**Online**

## Description

The FairWild Standard was established in 2008 to promote the sustainable use of wild-collected plants, fungi and lichen and their ingredients. The foundation works with partners worldwide to improve conservation and assure the livelihoods of rural people involved in wildcrafting. FairWild certification is available for wildcrafted products, their processed ingredients, and the finished products themselves. Third party inspection is carried out by FairWild-approved control bodies.

The FairWild Standard was created based on prior experience as well as stakeholder consultation. It also builds on the outcomes of an earlier initiative; the International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants. The FairWild Standard is used as the basis of a certification scheme, which provides a way to communicate throughout the value chain that wildcrafted ingredients are sustainably harvested. Eugeniusz Sidoruk, of the Polish wild herb supplier, Runo Sp. z. o.o. (see the case study below entitled Runo Sp. z. o.o.: Wildcrafting Herbs Sustainably), states that the certification brings new opportunities by adding value, opening up new markets and attracting new customers (Runo Sp. z o.o., 2013). Conservation organisations such as the International Union for Conservation of Nature recommend the FairWild Standard and its certification scheme for sustainable wild- harvesting as a means to halt the negative impacts of wild harvesting (Allen et al, 2014).

FAIRWILD® is a legally registered trademark and can only be used in accordance with the foundation's labelling rules, and upon payment of a licensing fee, which is based on product turnover. Certified FairWild products containing a minimum of 20 percent FairWild-certified ingredients may use the word FAIRWILD® in the product name. If the product contains less than 20 percent FairWild-certified ingredients, the FAIRWILD® mark may be placed on the side or back panel of the product.

The majority of FairWild products that are already on the market are herbal teas. Currently, there are no certified FairWild suppliers in the Boreal biogeographical region. However, FairWild-certified medicinal and aromatic plants, many from semi-natural grasslands, are available from suppliers in Poland and Hungary (see Table 14.1 below).

Bryony Morgan/ FairWild Foundation 2013

**Bazyl Panasiuk demonstrates the collection of dandelion root Taraxacum officinale from meadows that form the collection sites of Runo sp. z o.o., Poland**

Table 14.1 Wild-harvested commercial medicinal and aromatic plant species with FairWild certification, available in Poland and Hungary (adapted from the FairWild Foundation, 2018a).

| Scientific Name | Common Name and Plant Part | Pharmacopoeial Name |
|---|---|---|
| *Achillea millefolium* | Yarrow flowering tops | Millefolii herba (flower and leaf) |
| *Arctium lappa* | Burdock root | Arctii radix or Bardanae radix (root) |
| *Filipendula ulmaria* | Meadowsweet herb | Filipendulae ulmariae herba |
| *Gallium aparine* | EU: Clivers herb; USA: Cleavers herb | Galii aparinis herba (herb) |
| *Hypericum perforatum* | St. John's Wort flowering tops | Hyperici herba (herb) |
| *Juniperus communis* | Juniper cone berry | Juniperi pseudo-fructus (ripe cone berry) |
| *Rubus idaeus* | Raspberry leaf | Rubi idaei folium (leaf) |
| *Sambucus nigra* | EU: Elder flower, fruit<br>USA: European elder flower, fruit | Sambuci flos (flower) Sambuci fructus (fruit) |
| *Taraxacum officinale* | Dandelion leaf; root | Taraxaci officinalis folium (leaf); Taraxaci officinalis radix (root) |
| *Tilia cordata* | EU: Lime flower; USA: Linden flower | Tiliae flos (flower) |
| *Tilia platyphyllos* | EU: Lime flower; USA: Linden flower | Tiliae flos (flower) |
| *Urtica dioica* | EU: Nettle leaf; root; USA: Stinging nettle leaf; root | Urticae folium (leaf) Urticae radix (root) |

In addition to the species listed above, the FairWild Foundation identifies the following medicinal and aromatic species found in Northern Europe as either available from its certified sources or as species that could become certified given sufficient demand: bilberry (Vaccinium myrtillus), comfrey (Symphytum officinale), cowslip (Primula elatior/Primula veris), horsetail (Equisetum arvense), lady's mantle (Alchemilla vulgaris), everlasting flower (Helichrysum arenarium), and motherwort (Leonurus cardiaca).

In November 2018, the FairWild Foundation launched a 'matchmaking' initiative, intended to support entry into the certification scheme. For instance, they publish 'expressions of interest' for producers to better identify demand (FairWild, 2018b). For buyers, conversely, the FairWild Foundation posts lists of suppliers and products that are already available.

The FairWild Foundation also provides support to stakeholders to implement the FairWild Standard. In April 2019, FairWild held its first 'FairWild Forum' in Budapest, Hungary, for professionals with a technical background in sustainable wild collection.

## Specific Assertions

FairWild emphasizes both the ecological and social values of their standard, as follows:

| Added Value | Statement |
|---|---|
| Sustainable management | "The FairWild Standard assesses the harvest and trade of wild plants, fungi and lichen against various ecological, social and economic requirements. Use helps support efforts to ensure resources are managed, harvested and traded sustainably, providing benefits to rural producers." |
| Livelihoods for local communities | The benefit of FairWild certification to companies is to "show and communicate to the end consumers that their products are sourced and produced in a socially and ecologically sound way. Benefits are felt by all those involved right down to the local communities harvesting the wild plants." The FairWild Premium is paid to the collectors / collectors' associations reflecting the efforts made by the collectors and all other actors in the supply chain to arrive at sustainable wild collection, production and sales of the respective final products. It is usually 10% over the individual collector's selling price. It is intended for social development projects in the collectors' communities, and must be responsibly managed in a Social Development Fund. In the first five years of certification, it may also be used to improve the sustainability of collection. |

## Resources


Allen, D., Bilz, M., Leaman, D.J., Miller, R.M., Timoshyna, A. and Window, J., 2014. European Red List of Medicinal Plants. Luxembourg: Publications Office of the European Union.

Runo Sp. z o.o., 2013. FairWild meeting with Runo Company, Poland. Retrieved from https://www.youtube.com/watch?v=ZZXViTRX5_w [accessed 19.2.2019].

FairWild Foundation, 2018a. FairWild Certification Scheme: FairWild-certified ingredients under production. Last updated 24.10.2018. Retrieved from https://www.fairwild.org/species-ingredients [accessed 8.2.2019].

FairWild Foundation, 2018b. FairWild matchmaking project to help producers and buyers connect. 11.2018. Retrieved from https://www.fairwild.org/news/2019/3/6/fairwild-matchmaking-project-to-help-producers-and-buyers-connect [accessed 19.2.2019].

# AS MÁDARA Cosmetics: Organic Skincare Based on Grassland-sourced Ingredients

**Where:** Latvia
**Case Type:** Cosmetics – organic skincare products with grassland species ingredients
**Organisation/Company:** AS MADARA Cosmetics
**Online**

## Description

The Latvian company, AS MADARA Cosmetics, produces skin care products using plant extracts, natural oils, butters and waxes. Sales are international. The company launched on the stock market in 2017 and is listed on the Nasdaq Riga Alternative Market First North Baltic (MÁDARA, 2018). MÁDARA Cosmetics are ECOCERT and COSMOS certified for natural and organic cosmetics.

'MÁDARA' is Latvian for the meadow species Galium, or 'bedstraw', which also serves as the company's logo. The World Wide Fund for Nature highlighted MÁDARA as an example of sustainability in 'Deeper Luxury' by Bendell and Kleanthous (2007), a report on developing a clear vision for a more sustainable luxury industry. MÁDARA products are free from ingredients derived from petroleum, chemical preservatives, parabens and artificial colorants. The company aims for sustainability throughout their production process: paper for packaging is certified by the Forest Stewardship Council and MÁDARA is already experimenting with plant-based packaging to replace plastic (MÁDARA, 2019).

MÁDARA uses ready extracts of grassland species in their products (MÁDARA personal communication, 2019; see table below). Evoking the nature of Latvia and Northern Europe is a substantial component of the company's marketing and brand. Its corporate sustainability report (2018) emphasises the purity of their products and their actions toward environmental and social corporate responsibility throughout the entire production chain, besides its community work.


© MADARA

**MADARA products are made using plant extracts**

Some of the plants used in MÁDARA products include (adapted from the website):

- Yarrow *(Achillea millefolium)*
- Sweet flag *(Acorus calamus)*
- Lady's mantle *(Alchemilla vulgaris)*
- Burdock *(Arctium lappa)*
- Common mugwort *(Artemisia vulgaris)*
- Bur-marigold *(Bidens tripartite)*
- German chamomile *(Chamomilla recutita)*
- Hawthorn *(Cratageus monogyna)*
- Horsetail *(Equisetum arvense)*
- Lady's bedstraw *(Galium verum)*
- Witch hazel *(Hamamelis virginiana)*
- St. John's wort *(Hypericum perofratum)*
- Juniper *(Juniperus communisi)*
- Evening primrose *(Oenothera biennis)*
- Common reed *(Phragmites communis)*
- Plantain *(Plantago major)*

## Specific Assertions

MÁDARA emphasizes both the ecological sustainability of their brand, as well as high quality as follows:

| Added Value | Statement |
|---|---|
| Quality | "Natural ingredients provide better health and environmental safety". (Mádara, 2018 p. 21) MÁDARA emphasizes that their manufacturing processes result in fewer unwanted by- products and contaminants in the final products compared to products based on synthetic raw materials. |
| Environmental Sustainability | "In accordance with ECOCERT/COSMOS standards, MÁDARA only uses raw materials that respect the requirements of the Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES)." (Mádara, 2018 p. 22) |

## Resources


Bendell, J. and Kleanthous A. 2007. Deeper Luxury. WWF. 52pp.
Retrieved from http://assets.wwf.org.uk/downloads/luxury_report.pdf [accessed 19.2.2019].
Mádara, 2018. ESG Environmental Sustainability, Social Responsibility and Corporate Governance Report for 2017.
Retrieved from https://issuu.com/madaracosmetics/docs/2018_esg_report_eng_172x235_webinar?e=31220781/64190813 [accessed 19.2.2019]. Mádara, 2019.
The future is filled in plant-based packaging. 1.2019.
Retrieved from https://www.madaracosmetics.com/en/blog/the-future-is-filled-in-plant-based-packaging-video [accessed 19.2.2019].

# Runo Sp. z o.o.: Wildcrafting Herbs Sustainably

**Where:** Northeastern Poland
**Case Summary:** Herbs supplier – wildcrafting
**Organisation/Company:** Runo Sp. z o.o. (Eugeniusz Sidoruk)
**Online** (with English subtitles)

## Description

Runo Sp. z o.o. is the first, and thus far, only FairWild-certified supplier in Poland. The company specializes in collecting and processing organic herbs, having begun in 1991. The raw materials are collected in ecologically clean areas in northeastern Poland, including the Biolawieza Forest (Runo Sp. z o.o., 2013; Traditional Medicinals, 2019).

In Poland, Runo is tapping into a long tradition of herb collection for their production. At the beginning of the season, Runo organizes with collectors and informs about the company's herbal needs, makes agreements and conducts training. Collectors are mainly older people, and the company is concerned that the number of collectors is declining. In fact, it does not have enough collectors to meet demand (Runo Sp. z o.o.).

Runo purchases wildcrafted dried and fresh herbs at its seasonal collection points. The dried herbs are brought by the collectors in paper bags, whereas fresh herbs may be delivered either loose (in bulk) or in polypropylene bags. Upon delivery, the herbs are weighed and the collectors paid accordingly. The head of the collection point is responsible for paying the collectors for the herbs and informing Runo when it is time to transport herbs to Runo's facility for processing. The dried herbs are stored at the collection point until it is full, but the company picks up the fresh herbs and transports them to its warehouse as soon as they are informed by the collection point. Laboratory checks to ensure quality are conducted at the warehouse before the herbs are sorted into batches to be processed according to customer requirements. The fresh herbs are dried at Runo's facility.


Bryony Morgan/ FairWild Foundation 2013

**A purchase point of Runo Sp. z o.o. – the first, and so far only, FairWild certified supplier of wild medicinal plants in Poland**

All dried herbs are packed into paper sacks and shipped to customers all over the world, according to their requirements. The U.S.-based company, Traditional Medicinals, is an example of one of Runo's bulk buyers. The company purchases the leaves of dandelions and stinging nettles, plus the latter's roots for use in their herbal teas and medicinal products. The products are sold in the United States and Canada. Thanks to its cooperation with Traditional Medicinals, Runo became familiar with the FairWild certification programme (Runo Sp. z o.o. 2013).

Among the certified FairWild species available from Runo Sp. z o.o. are the following (FairWild Foundation, 2019).

| | |
|---|---|
| Yarrow (*Achillea millefolium*) | Rasperry leaf (*Rubus idaeus*) |
| Burdock (*Arctium lappa*) | Elder flower & fruit (*Sambucus nigra*) |
| Meadowsweet (*Filipendula ulmaria*) | Dandelion (*Taraxacum officinale*) |
| Clivers herb (*Gallium aparine*) | Lime (*Linden*) flower (*Tilia cordata* and *Tilia platyphyllos*) |
| Juniper (*Juniperus communisi*) | Stinging nettle (*Urtica dioica*) |

## Specific Assertions

Traditional Medicinals promotes their sourcing of Runo products. The main added values they emphasize are nature conservation and local livelihoods:

| Added Value | Statement |
|---|---|
| Sustainable " management | "Our partnership with the team at Runo Spolka in the nearby town of Hajnowka,Poland has helped us fulfill our mission to only source sustainably harvested herbs, while also keeping the forest meadows vibrant." |
| Livelihoods local for communities | "By holding ourselves and our partners to the FairWild Standard, we can do our part to protect the biodiversity of this special place, while also ensuring a viable livelihood for out collectors." |

## Resources


Runo Sp. z o.o., 2013. FairWild meeting with Runo Company, Poland.
Retrieved from https://www.youtube.com/watch?v=ZZXViTRX5_w [accessed 19.2.2019] Video produced by TV Podlasie, commissioned by Runo Sp. z o.o., Poland.
FairWild Foundation, 2019 Certified ingredients: Available FairWild-certified ingredients by species.
Retrieved from https://www.fairwild.org/certified-ingredients [accessed 28.7.2019].
Traditional Medicinals, 2019. Protecting People and Plants in Poland.
Retrieved from https://www.traditionalmedicinals.com/articles/community/protecting-people-plants-in-poland/ [accessed 28.7.2019].

# Weleda AG: Mountain grassland-sourced sustainable Arnica montana

**Where:** Carpathian Mountains, Romania
**Case Summary:** Medicinal plant: Arnica from mountain grasslands
**Organisation/Company:** Weleda
**Online**

## Description

Arnica montana is a flowering herb with medicinal properties that relieve muscle aches and bruises (Sava Sand, 2015; Nikolova et al, 2013). It also appears in the IUCN Red List of Threatened Species (Allen et al, 2014). There is a substantial commercial market for Arnica flowers, and the flower heads are often wild-collected. Romania is one of the main sources of dried Arnica montana and, in at least some cases, the grassland habitats where Arnica is found are threatened by abandonment and intensification (Michler et al, 2005). Arnica also provides income for local people in marginalized mountain communities. For these reasons, the sustainable harvesting of Arnica in Romania has been the focus of agroecological-based development work as well as scientific research (Darwin Initiative, 2015; Balazsi et al, 2018).

Pixabay

**Arnica montana is a grassland species valued for its medicinal properties**

The natural cosmetics company, Weleda, made a multifaceted effort toward ensuring the sustainability of Arnica stocks for their products (Ellenberger, 1998). Weleda sources dried Arnica from the semi-natural grasslands of the Carpathian Mountains in Romania. The company developed its collection practices in collaboration with the World Wide Fund for Nature and landscape ecologists. They found that Arnica can be sustainably harvested by removing only sections of the above-ground parts of the plants together with only small parts of the rhizomes (Misra, 2009). Weleda states that their wild-sourced Arnica is Fair Trade and sustainably harvested, and that they have worked since 2010 to expand the scope of sustainably harvested Arnica. Weleda purchases only a specific amount of hand-picked flowers each year from areas managed through semi-natural grazing and without the use of fertilizer.

Weleda sources its ingredients under certification from the Union for Ethical BioTrade, which is a non-profit association registered in Switzerland and relies on the slogan, 'sourcing with respect'. Audits are conducted by the union or by qualified certification bodies. Bas Schneiders of Weleda is the president of the union's board in 2019.

## Specific Assertions

Weleda focuses on nature conservation and livelihoods as added values of their wildcrafted mountain meadow arnica:

| Added Value | Statement |
|---|---|
| Conservation | "Since 2010, Weleda has worked to expand sustainable wild collection to other parts of the Carpathians, spreading the idea of sustainable use and protecting more pastureland with its precious biodiversity." Research by Păcurar et al (2018) shows that Arnica montana is a relatively sensitive species adversely affected by changes in land use from traditional practices. |
| Livelihoods for local communities | "Arnica could be the saving grace for local people." Arnica is collected in the Romanian mountains in areas where low level of infrastructure and other livelihood challenges that generally face remote rural regions are present. Weleda provides testimonials and stories from people who rely on Arnica collection for income. |
| Quality | Weleda does not explicitly address quality other than that high standards are used. |

## Resources


Allen, D., Bilz, M., Leaman, D.J., Miller, R.M., Timoshyna, A. and Window, J., 2014. European Red List of Medicinal Plants. Luxembourg: Publications Office of the European Union.

Balazsi, A., Păcurar, F. Mihu-Pintilie, A., Konlod, W., 2018. How do public institutions on nature conservation and agriculture contribute to the conservation of Species-rich hay meadows? International Journal of Conservation Science. 9(3):549–564.

Darwin Initiative, 2015. Conservation of Eastern European medicinal plants: Arnica montana in Romania project reference number 13020. Retrieved from http://www.darwininitiative.org.uk/project/13020/ [accessed 7.2.2019].

Ellenberger, A., 1998. Assuming responsibility for a protected plant: Weleda's endeavour to secure the firm's supply of Arnica montana. In "First international symposium on the conservation of medicinal plants in trade in Europe", pp. 127- 30. TRAFFIC Europe, Kew, UK.
Retrieved from https://portals.iucn.org/library/node/8151 [accessed 7.2.2019].

Michler, B., Rotar, I., Păcurar, F., Stoie, A., 2005. Arnica montana, an endangered species and a traditional medicinal plant: the biodiversity and productivity of its typical grasslands habitats. Grassland Science in Europe. 10:336–339.

Misra, A., 2009. Studies on biochemical and physiological aspects in relation to phyto-medicinal qualities and efficacy of the active ingredients during the handling, cultivation and harvesting of the medicinal plants. Journal of Medicinal Plants Research. Vol. 3(13):1140-1146.
Retrieved from http://www.academicjournals.org/app/webroot/article/article1380528338_Misra.pdf [accessed 8.2.2019].

Nikolova, M., Petrova, M., Zayova, E., Vitkova, A., Evstatieva, L., 2013. Comparative study of in vitro, ex vitro and in vivo grown plants of Arnica montana – polyphenols and free radical scavenging activity. Acta Bot. Croat. 72(1):13–22. Păcurar, F., Balázsi, A., Rotar, I., Vaida, I., Reif, A., Vidican, R., Ruşdea, E., Stoian, V., Sângeorzan, D., 2018. Technologies
used for maintaining oligotrophic grasslands and their biodiversity in a mountain landscape. Romanian Biotechnological Letters. DOI: 10.26327/RBL2018.184.

Sava Sand, C., 2015. Arnica montana L. as a medicinal crop species. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. 15(4):303–308.

Weleda Australia, 2015. Weleda Arnica cultivation https://www.youtube.com/watch?v=B81CFrX5G8k Weleda [accessed 7.2.2019]:
Retrieved from https://www.weleda.com/ingredients/fair-trade-farming/fair-trade-Arnica; https://www.weleda.co.uk/natural-ingredients/fair-trade-farming/Arnica-raw-materials; and https://www.weleda.com/uebt

# **Wildfooding:** From Wildcrafting to Haute Cuisine

**Where:** Denmark
**Case Summary:** Wildcrafting – supplying wild foods, including grassland-collected herbs, to restaurants
**Organisation/Company:** Wildfooding (Thomas Laursen)
**Online**

## Description

Wildfooding is the brainchild of Thomas Laursen, an entrepreneur who forages and hunts wild foods. Through Wildfooding, he supplies top-tier restaurants in Denmark with wild plants, berries, roots, mushrooms etc. Laursen also teaches courses, leads herb collection field trips, and conducts co-cooking events and training courses for restaurants, schools, and others. He has appeared on various Danish television shows. An extensive list of collaborations includes state agencies such as the Danish Ministry of Environment and Food, private enterprises and civil society groups.

Laursen states that it was a chance encounter in 2011 with the deputy head of the famous Noma restaurant that saw him turn his passion for wild food into a living. He also undertakes charity work in Denmark with a view to opening up the world of foraging to people (personal communication, 2/2019). He refers to the field trips he organizes as 'gastro-gathering'. Laursen's book on wildcrafting, 'Vild – Naturen ind I køkkenet,' was published in 2017 and opened up the world of wildcrafting in different biotopes to readers. His newest book, 'Vild mad i køkkenet' (wild food in the kitchen) was published in 2019.

Laursen hunts and forages all types of wild foods, with a full list of herbs, seaweed and mushrooms available on the website. Wildfooding provides a mix of in-season products, with delivery once a week or according to agreement. Pre-orders can also be made in the winter for the upcoming season.

Thomas Laursen

**Wildfooding uses a wide range of grassland species**

The following many grassland species and species families of wild herbs are available from Wildfooding (adapted from the website):

- Yarrow *(Achillea millefolium)*
- Sand leek *(Allium scorodoprasum)*
- Common mugwort *(Artemisia vulgaris)*
- Shepherd's purse *(Capsella bursa-pastoris)*
- Chicory *(Cichorium intybus)*
- Meadowsweet *(Filipendula ulmaria)*
- Hops *(Humulus lupulus)*
- Musk mallow *(Malva moschata)*
- Cicely *(Myrrhis odorata)*
- Wild parsnip *(Pastinaca sativa)*
- Common sorrel *(Rumex acetosa)*
- Dandelion *(Taraxacum)*
- Pennycress *(Thlaspi)*
- Garlic mustard *(Alliaria petiolata)*
- Ramsons *(Allium ursinum)*
- Chamomile *(Matricaria recutita)*
- Watercress *(Nasturtium officinale)*

- Plantain *(Plantago family)*
- Orpine *(Sedum telephium)*
- Viola *(Violaceae)*
- Clover *(Trifolium family)*
- Ground elder *(Aegopodium podagraria)*
- Garden angelica *(Angelica archangelica)*
- Daisy *(Bellis perennis)*
- Cuckooflower *(Cardamine pratensis)*
- Japanese knot weed *(Fallopia japonica)*
- Ground-ivy *(Glechoma hederacea)*
- Red dead-nettle *(Lamium purpureum)*
- Water mint *(Mentha aquatica)*
- Wood sorrel *(Oxalis acetosella)*
- Cow parsley *(Anthriscus sylvestris)*
- Hairy bittercress *(Cardamine hirsuta)*
- Cornflower *(Centaurea cyanus)*
- Lady's bedstraw *(Galium verum)*
- White dead-nettle *(Lamium album)*
- Red sorrel *(Rumex acetosella)*
- Common chickweed *(Stellaria media)*
- Thyme *(Thymus family)*
- Bulrush/Reedmace *(Typha family)*

## Specific Assertions

Wildfooding has a culinary-cultural focus where the added value is in linking people with nature through wild foods.

| Added Value | Statement |
|---|---|
| Biodiversity and ecosystem services | "Vild – Naturen ind I køkkenet's extreme degree of usability is due to the division of the book into the biotypes where you might find wild food: The City, The Hedge, The Forest, The Meadow, The Field, The Beach etc. ... For me, it is key that Laursen so precisely presents the kind of food I want to make, and that the illustrations convey the rustic aesthetics of the simple and the natural, which entices you to get started." Søren Frank, Berlingske |
| Sustainable livelihood | "Today I make my living by supplying some of the best restaurants with a wide variety of wild plants, e.g. mushrooms, berries and seaweed.... What used to be my hobby and lifelong passion is now my way of life." Thomas Laursen |

## Resources

All information retrieved from www.wildfooding.com as well as personal communication with Thomas Laursen, 2.2019.

# Added value of grassland products: Framework and means of assessment

III

## 15. Introduction and aims of part III

'Additionality' refers to the production of some 'extra good' compared to a 'business as usual', or baseline, model (Gillenwater, 2012). 'Value-added agriculture' can refer to the processing of raw products into goods of higher value, but may also describe additionality that occurs through creation of closer connections between producer and consumer and when product value is increased by making visible otherwise hidden characteristics of the product or production process (Lu and Dudensing, 2015). This report is concerned with the latter two definitions, specifically such added values as product quality, as well as social, environmental and animal welfare benefits.

Part I of this report scoped the literature and provided background for ways in which grassland products may have added value. Part II presented real world examples of products and means of developing and differentiating grassland produces with added value. Parts I and II of the report showed that the added value of grassland products may include superior nutritional profiles, benefits to rural livelihoods, support for biodiversity and the environment, and improvements in farm animal welfare. Part III explores how the added value of the grassland products can be identified and promoted to help make grassland -based production more viable in the market.

The aim of Part III is to provide guidance to the Latvian Fund for Nature and others for identifying, developing, and promoting additionality in grassland products. Thus, Part III: i) describes the added values that may be embedded in grassland products, as well as key concepts related to product differentiation and markets (Sections 16 and 17, respectively); ii) presents a framework for identifying added value in grassland-related products (Section 18); and iii) provides examples for each of the five product groups of tests and measurements that could be undertaken to ascertain additionality (Section 19). Finally, the conclusions for Section III are presented (Section 20). The specific research questions answered within Part III are:

- The aim of Part III is to provide guidance to the Latvian Fund for Nature and others for identifying, developing, and promoting additionality in grassland products. Thus, Part III: i) describes the added values that may be embedded in grassland products, as well as key concepts related to product differentiation and markets (Sections 16 and 17, respectively); ii) presents a framework for identifying added value in grassland-related products (Section 18); and iii) provides examples for each of the five product groups of tests and measurements that could be undertaken to ascertain additionality (Section 19). Finally, the conclusions for Section III are presented (Section 20). The specific research questions answered within Part III are:
- What kinds of tests could be conducted to identify potential differences in quality between (semi-)natural grassland-based products and similar products from non-grassland sources or cultivated grasslands?
- What kinds of tests could be conducted to identify and measure potential added value, including non-tangible social and environmental goods (e.g. ecosystem services), embedded within grassland-produced products?
- How can these be compared or measured against similar products from non-grassland sources or cultivated grasslands?

# 16. DEFINING AND IDENTIFYING ADDED VALUE OF GRASSLAND PRODUCTS

The following section describes the key findings and the associated knowledge gaps for the multiple added values that may be embedded in grassland products. These may also be described as non-market goods and services[11] and may be used to differentiate grassland products in the market. The section is not exhaustive, but instead focuses on key issues of relevance to grassland-product development and marketing.

## 16.1 Environmental Value and Ecosystem Services

The environmental value of grasslands may include habitat for species of conservation concern, contributions to ecosystem functioning, and provision of ecosystem services. These concepts are closely linked by interrelationships as, for example, in the contributions of soil and insect biodiversity to nutrient cycling. Goods and services arising from grassland ecosystems are listed in Table 16.1.

Table 16.1 Goods and services provided by grassland ecosystems. Adapted from OECD (2003)

| Goods | Services |
|---|---|
| • Livestock (food, medicinals, hides, fibre)<br>• Drinking and irrigation water<br>• Genetic resources<br>• Cultural resources | • Watershed functions (infiltration, purification, flow control, soil stablisation)<br>• Nutrient cycling<br>• Oxygen production & air purification<br>• Biodiversity maintenance<br>• Soil generation<br>• Carbon sequestration<br>• Human and wildlife habitat provision<br>• Cultural services, e.g. aesthetic & recreational |

The capacity of natural and semi-natural grasslands to provide ecosystem services such as listed in Table 16.1 is relevant for sustainable grassland production. There are many approaches that can be taken to study the ecological benefits produced through management regimes, and these are taken up in the following paragraphs. Two approaches, ecosystem services and 'conservation effect', are particularly relevant concepts for assessing the environmental benefits of semi-natural grassland- based production. Ecosystem services[12] are calculated in a multitude of ways and are an outcome of the habitat and the particular management regime. 'Conservation effect' (Bedoin and Kristensen, 2013) attempts to quantify the semi-natural grassland area 'embedded' in the product. In addition to these approaches, the carbon sequestration potential of grasslands, as well as the impact of conversion to grassland, is particularly relevant from a climate change mitigation point of view and is reviewed in more detail below.

[11] Goods and services that are not directly traded in the markets. See e.g. https://www.greenfacts.org/glossary/mno/non-market-value.htm

[12] The benefits of nature and natural ecosystems to people – see Millennium Ecosystem Assessment or https://www.nature.com/subjects/ecosystem-services

## Biological Control, Pollination and Soil Conservation

The literature on the key ecosystem services of biological control, pollination and soil conservation of Europe's semi-natural habitats (including grasslands) was reviewed by Holland and colleagues (2017) with the objective of summarizing the quantity of evidence and synthesizing it. The comprehensive systematic review (270 publications) found that the majority of publication identified a positive effect of semi-natural grasslands on pollination and pest control. The review identified the following research gaps:

- Geographical under-representation of Eastern and southernmost Europe;
- Lack of studies on crop yield of adjacent arable land, even when authors recommend the use of semi-natural grasslands for pollination or pest control;
- Lack of research on trade-offs and multiple (as opposed to single) ecosystem services; and
- Few studies on other ecosystem services, particularly the role of soil organisms.

Holland and colleagues found that a wide variety of metrics are used for measuring these ecosystem services but that a weakness of the literature is that the metrics, such as yield, that are valued by end users are rarely measured. Their recommendations for policymakers and funders are that they should be prepared to fund longer-term studies and specifically encourage research that includes more end user metric analysis.

## 'Conservation Effect'

A second approach to understanding environmental value of grassland products is the 'conservation effect' Bedoin and Kristensen (2013) calculated this for meat produced predominantly on semi-natural grasslands in Denmark, recording that 1 kilogram of meat (slaughter weight) results in the utilisation (i.e. conservation) of 200-300 square metres of semi-natural grassland. In comparison, on farms where mother cows and calves graze on semi-natural grassland, but young animals are fattened indoors, the corresponding conservation effect was about 9-22 m2 per kilogram of slaughter weight (Bedoin and Kristensen).

Kristaps Kalns / GrassLIFE

**Grasslands are a source for polyfloral honey**

## Carbon Sequestration

Generally, reduced livestock numbers on European grassland over the past years have enhanced the grassland soil carbon stocks because lower stocking rates raise the net biome production through higher litterfall and soil carbon storage (Chang et al, 2016). Soil is the largest carbon sink in terrestrial ecosystems, and the documentation of carbon sequestration capacities is an important part of climate change and agricultural policies (Lugato et al, 2014). The Kyoto Protocol to the United Nations Framework Convention on Climate Change also allows for carbon emissions to be offset through demonstrable carbon sequestration, including through the improved management of agricultural soils (Hagyó and Tóth, 2018). Yet, mapping of organic carbon in soil at the EU level has proved challenging (Lugato et al, 2014). The recent EU-wide study by Hagyó and Tóth found higher levels of organic carbon in soil in Natura 2000 grasslands compared to both Natura 2000 croplands, as well as croplands and grasslands outside the Natura 2000 network. Hagyó and Tóth attribute the higher carbon levels to the extensive management practices occurring inside the Natura 2000 network.

### Conversion to Grassland

Due to the higher organic carbon content of grassland soil compared to other farmlands, grassland is effective for carbon sequestration in agricultural landscapes, and there is large carbon sequestration potential if grassland area is increased (Conant et al, 2001). However, a study that modelled a 5 percent increase based on a policy scenario found the greatest carbon sequestration potential in countries with large arable farms (e.g. France and Germany), but

## 16.2 Animal Welfare: An Added Value of Grassland-based Animal Production

In a general sense, animal welfare relates to animals' physical and emotional health and the freedom to express innate behaviours (Manteca et al, 2012). Interpretation and regulation for animal welfare varies across countries and certification programmes, including organic and animal welfare certification.

Animal welfare is both an ethical and a food safety issue because stress, injuries, and poor animal welfare create risks in the food chain (EFSA, 2018; FVE, 2018). The following paragraphs present key concepts and frameworks in developing and operationalising animal welfare.

Fraser and colleagues (1997) identified three common and overlapping ethical concerns for the quality of life for animals. Animals should:

- Lead natural lives through the development and use of their natural adaptations and abilities;
- Feel well by being free from prolonged and intense fear, pain and other states and by experiencing normal pleasures; and
- Function well, in the sense of satisfactory health, growth and normal functioning of physiological and behavioural systems.

The 'Five Freedoms' principle defined by the UK's Farm Animal Welfare Council in 1997 is widely used as the basis of modern animal welfare legislation and as guidance for veterinary and animal welfare students (e.g. Mellor, 2016; McCulloch, 2013; FAWK, 2009; FVE, 2009). The Five Freedoms (and aligned provisions for actualisation) appear in Table 16.2 below:

© Kristaps Kalns / GrassLIFE

**Social values are deeply embedded in grassland products**

Table 16.2 The 'Five Freedoms' and the corresponding provisions for promoting farm animal welfare, adapted from Mellor (2016).

| Freedom | Aligned Provision for Actualising the Freedom |
|---|---|
| Freedom from hunger and thirst | By providing ready access to fresh water and a diet to maintain full health and vigour |
| Freedom from discomfort | By providing an appropriate environment including shelter and a comfortable resting area |
| Freedom from pain, injury and disease | By prevention or rapid diagnosis and treatment |
| Freedom from fear and distress | By ensuring conditions and treatment which avoid mental suffering |
| Freedom to express normal behaviour | By providing sufficient space, proper facilities and company of the animal's own kind |

The five freedoms represent an ideal by which animal welfare can be measured (Mellor, 2016). At minimum, animals kept by people should be protected from unnecessary suffering, as the first four 'freedom from' freedoms denote (Mellor; McCulloch).

More recently, the concept has been reformulated into the 'Five Domains Model' and a quality of life evaluation in order to take into account not only negative conditions animals may experience but also positive conditions (Mellor, 2016; Green and Mellor, 2011). The 'Quality of Life' scale, presented in Table 16.3, is based on the balance of positives and negatives animals may experience.

Table 16.3 The 'Quality of Life' scale, adapted from Green and Mellor (2011).

| Freedom | Aligned Provision for Actualising the Freedom |
|---|---|
| A good life | The balance of salient positive and negative experiences is strongly positive. Achieved by full compliance with best practice advice well above the minimum requirements of codes of practice or welfare. |
| A life worth living | The balance of salient positive and negative experiences is favourable but less so. Achieved by full compliance with the minimum requirements of code of practice or welfare. |
| Point of balance | The neutral point where salient positive and negative experiences are equally balanced. |
| A life worth avoiding | The balance of salient positive and negative experiences is unfavourable, but can be remedied rapidly by veterinary treatment or a change in husbandry practices. |
| A life not worth living | The balance of salient positive and negative experiences is strongly negative and cannot be remedied rapidly so that euthanasia is the only humane alternative. |

Grazing and natural fodder is associated with animal health and well-being, and good animal husbandry practices on grasslands can meet the Five Freedoms criteria and provide the conditions for 'a good life' for grazing animals. Although it can be argued that some of the conditions or interpretations may be speculative regarding animals' wants and needs (Green and Mellor, 2011), the qualities that make up the conditions of 'a good life' can be found in the various best practice guidelines and animal welfare certifications, some of which have been reviewed in this report (see Part II). Such guidelines and practices should include all stages of the animals' lives and deaths. A further look at the characterisation of animal welfare and review of the positive and negative experiences that make up welfare status in the Five Domains Model (domains are nutrition, environment, health, behaviour, and mental state) is found in Mellor (2016). An analysis of the definitions of the conditions and outcomes of the presence or absence of the Five Freedoms is found in McCulloch (2012).

## 16.3 Social Values

Social values embedded in grassland products are evident in the case studies presented in Part II of this report. Examples include: income for rural and vulnerable populations provided by wild medicinals/herb collection; benefits of direct sales and higher prices for producers; maintenance of rural traditions and vibrant communities through small-scale local industry and sustainable agriculture; and innovation and job creation. Economic resilience and social well-being are the key sustainability dimensions (FAO, 2014) related to social values.


© GrassLIFE

**Grassland products fit the market based on health, naturalness and nutrition**

## 16.4 Health: 'Naturalness' and Nutrition

The measurable compositional differences of meat and dairy products favourable to human nutrition resulting from ruminants' semi-natural grassland grazing and grass-based diets are described in Sections 4 and 5, meat and dairy respectively. The compositional differences of honey (see Section 6) and wild medicinals may also become better established with further research (see Section 8). In addition to nutritional benefit, semi-natural grassland products are favoured for their 'naturalness' and purity, including for being sourced in some cases from protected areas or areas where the use of agri-chemicals is restricted. Assessment of the nutrient value of products, as opposed to focusing only on the units produced, is important to understanding the true environmental and other impacts of production systems (McAuliffe et al, 2018).

# 17. PRODUCT DIFFERENTIATION AND CONSUMER WILLINGNESS TO PAY

The following section describes the key findings and the associated knowledge gaps for the multiple added values that may be embedded in grassland products. These may also be described as non-market goods and services11 and may be used to differentiate grassland products in the market. The section is not exhaustive, but instead focuses on key issues of relevance to grassland-product development and marketing.

## 17.1 Labelling Schemes for Product Differentiation

Unless differentiated in the market, the potential for the producer to achieve a price premium based on the added value of semi-natural grassland products compared to conventionally produced counterparts is lost. Labelling schemes provide consumers with information that is not readily apparent from the product itself and afford producers a means to couple non-tangible values such as animal welfare, biodiversity protection and ecosystem service production to their marketable goods and product brand. Labelling can be viewed as a social movement (Barham, 2002), albeit one that functions inside the neo-liberal marketplace and through employing tools designed to create new markets (cf. Guthman, 2007). Values-based labelling, a response to the unsustainable practices of conventional farming, emphasises process over product and quality, thus effectively making the process part of the product. 'Eco-labels' may stress environmental, social, or ethical values and many combine multiple values (Barham, 2002). Following this, so-called 'beyond organic' labels are a response to the 'conventionalization' of organics via the inclusion of industrialized farming in organic labelling (Lamine and Dawson, 2018).

A unifying feature of eco-labels is that they seek to convey values in registers that are usually considered non-market by economists (Barham, 2002). Definitions of quality that include non- market values embedded in the products provide a means for consumers to link to the production process, although labelling and certification schemes are also contested spaces with questions about who and what are included, governance and transparency, and respective role(s) within the market(s) (Barham, 2002; Mutersbaugh et al, 2005).

© Kristaps Kalns / GrassLIFE

**Hereford cattle in Kalna Rubeni farm in Latvia**

Communicating the agroecological links embedded in semi-natural grassland products (such as artisanal cheeses) to consumers is challenging in long food chains (Lamine and Dawson, 2018). Thus, 'grass-fed' certification is used in conjunction with animal welfare and organic labels to convey to consumers additionality that may not be visible (or included) in primary certification alone (A Green World, 2018; Lamine and Dawson). FairWild, which provides a guarantee that wild plants are sustainably sourced and that individuals and communities receive fair compensation for their labour, incorporates both social and environmental standards into their certification (FairWild Foundation, 2018; see also FairWild in Part II: Section 14). Inadvertent or intentional adulteration of the product with non-target species is an issue of concern with wildcrafting (Guzelmeric et al, 2017). Thus, certification for wildcrafted species can also help ensure that the collectors have sufficient knowledge and the purchaser sufficient control over the harvesting process to assure quality. A selection of certification programmes relevant for grassland products is presented in Table 17.1.

The World Wide Fund for Nature (WWF, 2015) asserts that certification of natural beef is needed to ensure its traceability and credibility for restaurants, consumers and the public sector. In Sweden, municipal public procurement contracts for certified 'natural pasture beef' have existed since at least 2005 and are made possible by a labelling scheme (WWF; see case study in Part II: Section 10). WWF reports strong interest in their certification programme from other countries in the Boreal biogeographical region, as well as from the UK and USA. WWF has also published a manual on natural beef production in Estonian, Latvian and Lithuanian languages. In Finland, the term 'meadow meat' ('niittyliha') has gained considerable recognition among producers and is used in direct sales marketing. However, WWF's efforts toward a set of certification criteria for the Finnish market are still ongoing (WWF, 2014).

Table 17.1 Examples of certification programmes relevant for grassland products.
*indicates that the certification programme is further described within the case studies featured in Part II.

| Certification | Product | Location | Description | Online |
|---|---|---|---|---|
| Liivimaa Lihaveis grassfed beef * | Beef | Estonia | State certified, organic, grass- fed beef; includes beef cattle breeding criteria. | grassfedbeef.eu |
| Pasture for Life * | Meat and dairy | UK | Certified 100 percent grass-fed meat & dairy. Farms, butchers and dairies are eligible to participate. | pastureforlife.org www.pastureforlife.org/certification |
| Natural pasture meat (Naturbetes–kött) * | Beef | Sweden | Specifically includes semi-natural grassland-produced beef. | wwf.se wwf.se/wwfs-arbete/mat-och- jordbruk/hallbart- jordbruk/naturbetesmarker/1730399-naturbeteskott |
| Certified | Meat and dairy | USA & Canada | Includes (but not exclusively) semi-natural grassland- produced meat and dairy | agreenerworld.org agreenerworld.org/certifications/certification-process |
| Exceptional raw material | Any (raw) food products | Sweden | An initiative targeting contact between farmers and chefs to develop Swedish raw material of the highest quality for the food market. | lrf.se lrf.se/politikochpaverkan/marknad-och- mervarden/marknadssamarbeten/exceptionell-ravara |
| Savory's Ecological Outcome Verified (EOV) * | Grassland-based | Multiple countries | EOV certification is based on ecological indicators for sustainable grassland management. | savory.global |
| FairWild * | Wild- harvested ingredients | Multiple countries | FairWild certifies that wild-harvested herbs and other products are collected in an ecologically and socially responsible way | fairwild.org |

## 17.2 Consumer Willingness to Pay

Certification enables product differentiation in the market, but the products also need a consumer market willing to pay premiums for the additionality indicated by the labelling. Values, beliefs and norms have a strong role in consumer motivation for purchasing differentiated food products such as local foods (Feldmann and Hamm, 2015). A willingness to pay higher prices for products with added value can vary across product and consumer groups, according to the added value under consideration, and based on consumer trust in the veracity of the claim.

Organic certification continues to be a powerful tool in product differentiation, with consumers mainly buying organic because they perceive it as more environmentally friendly, healthier, and safer (Akaichi et al, 2019). However, the research by Akaichi and colleagues also shows consumers who may be indifferent to organic are willing to pay for so-called 'conventional-plus' products that represent attributes they find important, such as animal-friendly production. Feldmann and Hamm (2015) identified a negative correlation between willingness to pay and the amount of product consumed – the smaller the amount consumed, the greater the willingness-to-pay. This finding may have particular relevance to ruminant products, where the climate-smart diet suggests that meat and dairy should be consumed in lower quantities and from sustainable sources, such as semi- natural grasslands, where there is clear environmental additionality (Willett et al, 2019).

In the United States, Consumer Reports (2015) found an increased willingness to pay among American consumers for meat labelled with sustainability claims such as, 'no antibiotics' and that consumers feel it is important that their purchasing choices support local farmers, the environment, and animal welfare. In line with these studies, grass-fed ground beef (foreign or domestic) sold in the United States can achieve a premium of 4-5 US dollars over conventionally produced equivalent product (Consumer Reports, 2015, citing USDA figures). In Germany, Profeta and Hamm (2018) found consumer willingness to pay for local animal products produced with local feed. In an example of the variation of the results of willingness to pay studies, the SOLID project found poor consumer willingness to pay among European consumers for added values in dairy unless the product was certified organic (Scollan et al, 2017). However, a German study of conventional dairy products found German consumers had the highest willingness to pay where animal welfare was concerned, followed by biodiversity conservation, supporting small farms and, finally, regional production (Markova-Nenova and Wätzold, 2018). A challenge facing the willingness to pay research is that consumers often overstate their willingness compared to their actions in real life (Feldmann and Hamm, 2015). Examples of tests of consumer views and their willingness to pay are presented in Table 17.2.

Table 17.2 Examples of consumer interest and willingness-to-pay tests that could be adapted for consumer-focused market research for grassland products.

| Research Theme | Test | Literature |
|---|---|---|
| Consumer views of 'good food' and how 'food curation' creates value(s) and shapes food practices | Interviews with food 'curators' – people who work with local food, collective buying groups etc. | joosse, S. and Hracs, B.J. 2015. Curating the quest for 'good food': The practices, spatial dynamics and influence of food-related curation in Sweden. Geoforum 64:205–216. |
| Willingness to pay for ethical attributes of milk | Consumer survey choice experiment on their willingness-to-pay. | Markova-Nenova, N. and Wätzold, F. 2018. Fair to the cow or fair to the farmer? The preferences of conventional milk buyers for ethical attributes of milk. Land Use Policy 79: 223–239. |

## 17.3 Relocalisation and Alternative Agrifood Networks

Relocalisation, direct sales and short supply food chains are production and sales modes related to consumers' willingness to pay. Relocalisation is a prevailing concept in literature on alternative food systems and focuses mainly on direct producer-consumer relations (Lamine and Dawson, 2018). In support of relocalisation, WWF (2015) recommends supporting and facilitating small-scale producers of 'natural pasture beef' to access public procurement contracts.

Producers are further accessing markets and finding consumer bases willing to pay for product additionality through alternative agrifood networks[13], including: on-farm sales, farmers markets, box schemes, community supported agriculture and more (Volpentesta and Della Gala, 2013). Further, alternative food networks such as these may add value to products with added service, as providing recipes and nutritional information about crops (Ernst and Woods, 2011). Reko (Kärki, 2015) and FoodHub distribution models (Uudenmaan Ruoka, 2019) are examples from Finland of new direct sale formats, based on pre-orders of products and collection at a central distribution point, and have seen strong growth in Finland in recent years. Semi-natural grassland producers participate in both distribution models.
Mobile device services are also being used to shape local food choices and to connect producers and consumers. Volpentesta and Della Gala (2013) identify five major classes of mobile device services in alternative agrifood networks: 1) virtual visit services via interactive virtual farm tours; 2) traceability and product-related information services delivering tailor-made data; 3) geospatial services that facilitate consumers' search for in-season products and ongoing markets; 4) dietary and health services providing agrifood nutritional information and tailored advice; and 5) social networking services, which allow interactive learning experiences through photo uploads and feedback.

© GrassLIFE

**Grassland meat burgers in the farm sale dedicated to meadows in Straupe SlowFood market**

Joosse and Hracs (2015) describe two Swedish examples of mobile device services for local foods: 'Bonde på köpet[14]' (loosely translated as 'farmer included in the bargain') and 'mathantverk[15]' ('food craftmanship' i.e. artisanal food). 'Bonde på köpet' is a free Swedish app that allows the user to scan a product and receive product information with a 'thumbs up' or 'thumbs down' to indicate whether the product is produced by Swedish farmers. Mathantverk is also a free mobile app that helps consumers find farm shops and artisanal food and provides information about both the food items and their producers. Swedish producers of semi-natural grassland products participate in both 'Bonde på köpet' and Mathantverk.

[13] An umbrella term indicating new forms of collaborative development and based on shorter distances between suppliers and consumers. See Volpentesta and Della Gala (2013).

[14] https://www.lrf.se/bpk

[15] https://www.mathantverk.se

# 18. FRAMEWORK FOR IDENTIFYING ADDED VALUE OF GRASSLAND PRODUCTS

There are multiple frameworks and tests that can be useful in identifying added values in grassland- produced products, some of which are presented in Section 19. The criteria for assessing additionalities will necessarily vary according to the individual quality (or value) under consideration, the method of assessment, and the socio-cultural context, including the 'business- as-usual' model against which the product is being evaluated. Although the Food and Agriculture Organization (FAO, 2014) states that the mantra for assessment is to 'measure what matters', they also note that measuring 'what' matters to 'whom' and 'how' is not straightforward. FAO's Sustainability Assessment of Food and Agriculture Systems Guidelines (2014) provides guidance for "assessing the impact of food and agriculture operations on the environment and people". FAO states that the guidelines focus on the evaluation of supply chains and participating enterprises as a whole, rather than the final product, as this is purported to enable a more comprehensive consideration of good governance and social well-being compared to product-focused analyses such as life cycle assessment.

An example of how sustainable grassland production can be evaluated in regard to concurrent environmental and agronomic outcomes is provided by the diagnostic tool used for the French Flowering Meadows Competition. It evaluates and rewards "the best agro-ecological balance found in species-rich grasslands and pastures managed by livestock farmers" (Plantureux, 2014). For nutrition, McAuliffe and colleagues (2018) propose that the end products originating from different farm systems should be treated as separate, competing commodities that should be evaluated under a whole supply chain approach. Regarding animal welfare, added value can be established by gauging the extent to which Green and Mellor's (2011) Quality of Life scale is met.

Kristaps Kalns / GrassLIFE

**Farmers and scientists collaborate in GrassLIFE project, to identify the best assessment approach to semi-natural grasslands**

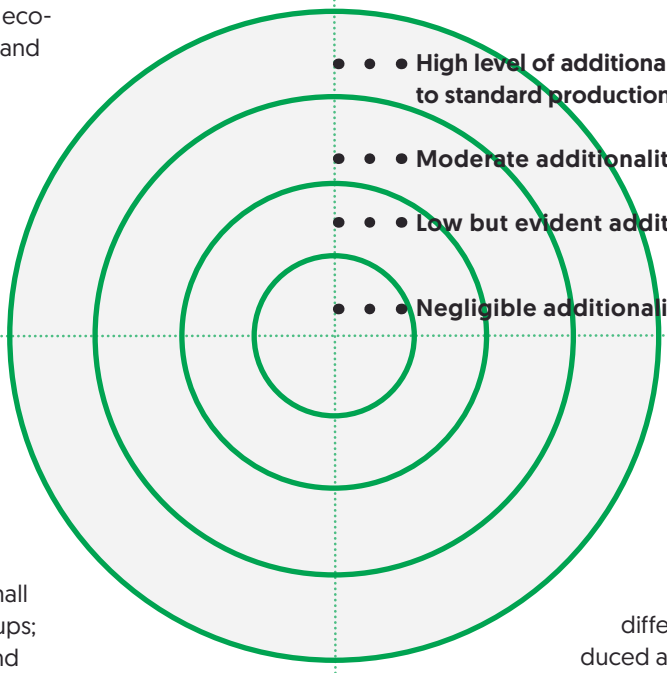
This study proposes that product added value can be represented in a systematic, uniform way regardless of the varied methods used to assess the specific qualities that comprise the value-added agriculture. The framework for such assessment is presented graphically in Figures 18a-c. Each target value can be compared to a reference point (normally a business-as-usual model), where the additionality is assessed as high, moderate, low, or negligible/unchanged from the baseline (see Figure 18a). The same graphical means can also be used to visualise individual criteria or qualities, of which an added value category is composed. For example, environmental additionality can be visualised by rating each of the components, ranging from particular ecosystem services to species of conservation interest, that potentially contribute to the environmental additionality embedded in the product (see Figure 18b). At a microlevel, biodiversity additionality, for example, could be visualised in the same way, with plant, insect, bird, and mammal categories defined and assessed according to the high, moderate, low, negligible/baseline scale.

Figure 18c applies the proposed methodology to wool and knitwear sold by Hiiu Vill Vaemla Wool Factory in Hiiumaa, Estonia (see case study in Part II: Section 11). As the visualisation shows, high environmental and social additionality is present in the products through benefits to biodiversity and to the island community. Some animal welfare benefit may accrue for the sheep grazing the meadows. Health benefit is not particularly relevant for this example.

## Framework for assessing additionality in grassland products: four types of added values

**Biodiversity and environmental benefits**
**Including:**
Biodiversity, ecosystem function, ecosystem services, sustaining grassland systems (abandonment avoided)

**Animal welfare benefits**
**Including:**
5-freedoms; quality of life scale; specific criteria




**Social benefits**
**Including:**
Equitable trade and viability of small farms; income for vulnerable groups; contribution to social cohesion and community wellbeing

**Health benefits**
**Including:**
Compositional differences favourable to health; reduced agri-chemical, pollutant, adulterant, or pathogenic risk. Product traceability may also be included

Figure 18a Framework for assessing grassland products' added values.

# Framework for assessing a single added value category: environmental additionality

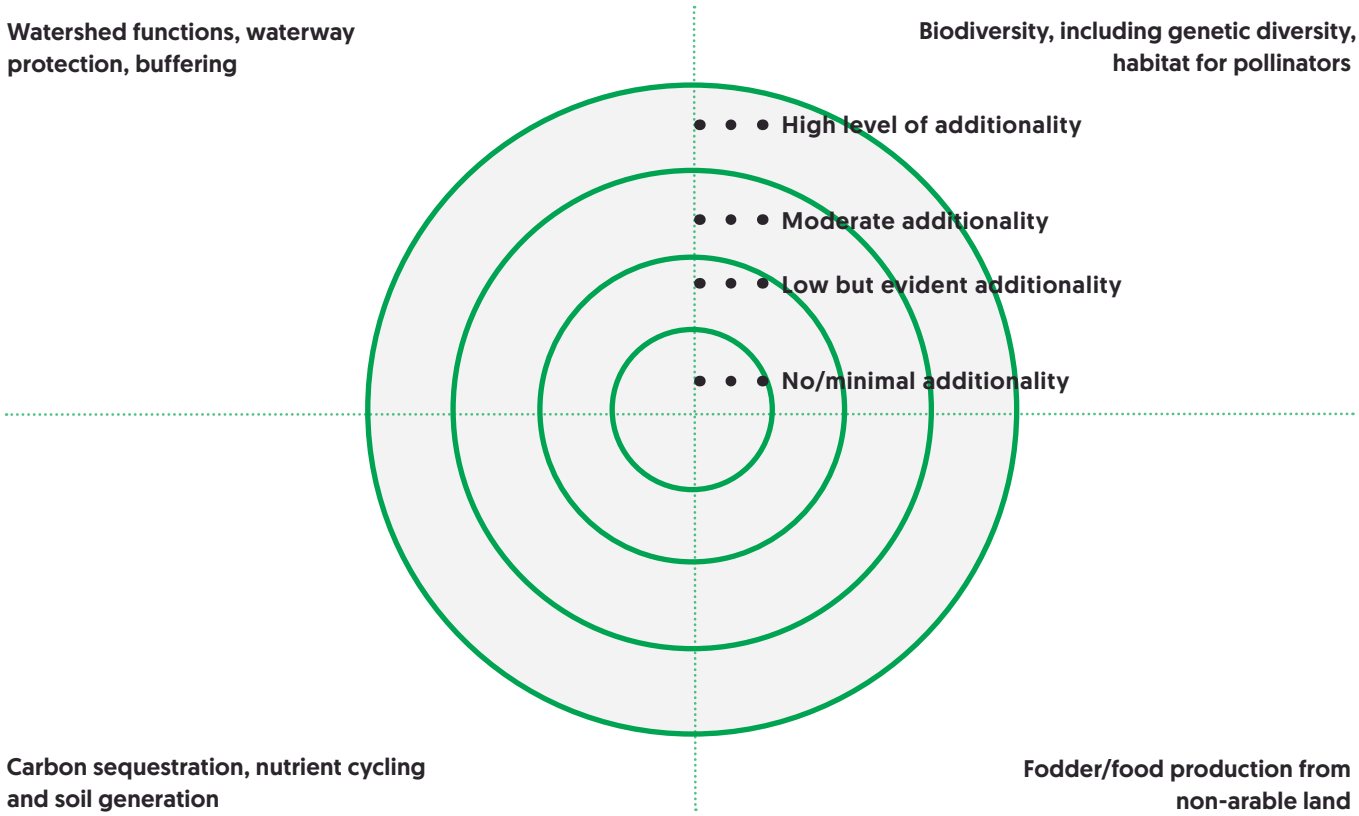



Figure 18b Framework for assessing a single added value category, with the example of environmental additionality.

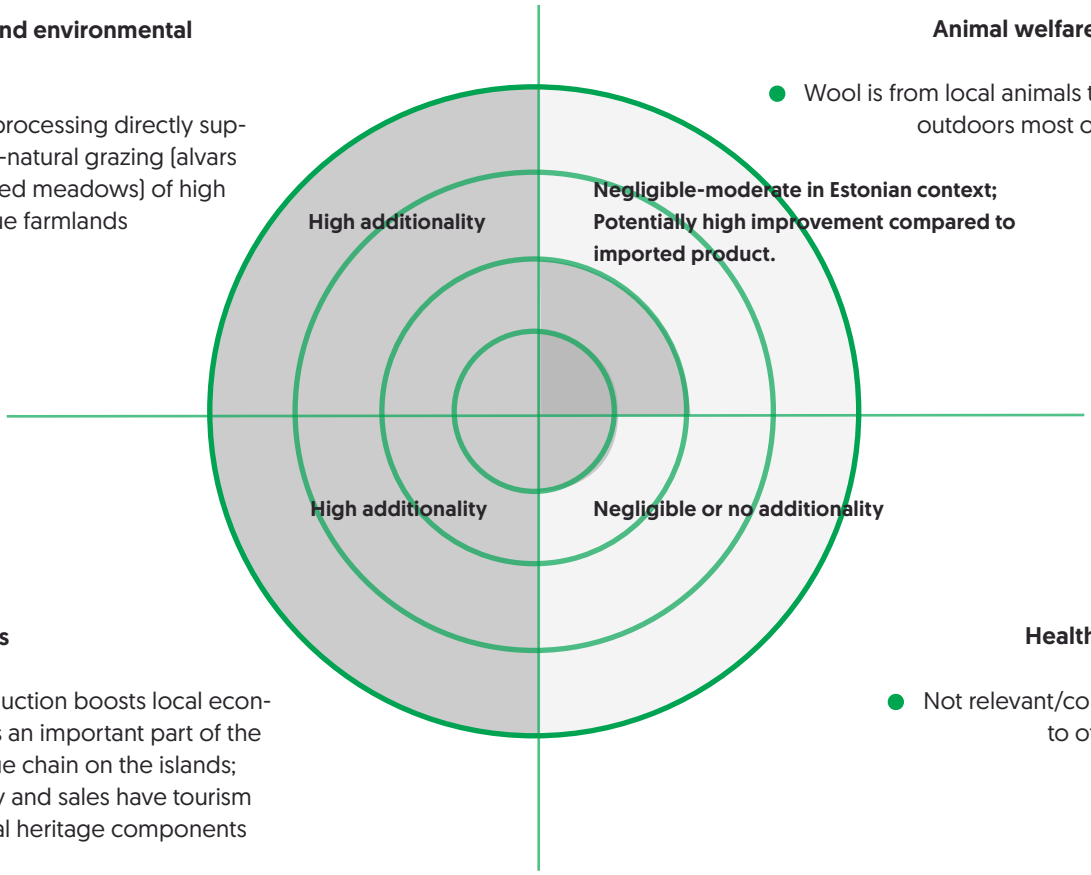
# Assessment of embedded added values in a product: wool and knitwear from Hiiu Vill Vaemla Wool Factory

**Biodiversity and environmental benefits**

- The wool processing directly supports semi-natural grazing (alvars and wooded meadows) of high nature value farmlands

**Animal welfare benefits**

- Wool is from local animals that graze outdoors most of the year




**Social benefits**

- Local production boosts local economy and is an important part of the sheep value chain on the islands;
- The factory and sales have tourism and cultural heritage components

**Health benefits**

- Not relevant/comparable to other wool

Figure 18c A visual representation of the added values embedded in products from Hiiu Vill Vaemla Wool Factory, Estonia. The assessment is preliminary and based on the case as described in Section 11 (textiles) in Part II (case studies) of this report.

The scale as presented here is undefined. Criteria for defining the framework's assessment categories (labelled in the figures as benefits) should be further developed using reliable, context-specific indicators that would allow products to be objectively compared.

To this end, it may be appropriate to involve multiple stakeholders (producers, experts, consumer groups) to help define benefits resulting in additionality and set parameters for the assessment scale (low-medium-high).

# 19. TESTS FOR IDENTIFYING ADDED VALUE OF GRASSLAND PRODUCTS

The following tables provide examples of tests that can be used in research to identify potential added value in grassland products. The tables include tests that can be carried out to evaluate product quality and to test for differences between products from grasslands compared to non- grassland equivalents or semi-natural grassland products compared to those from improved grasslands. Each of the five product categories (meat, dairy, honey and grass products as well as grassland-sourced medicinals) thus far addressed in Part I: Semi-natural grassland-related Products: Scoping of the Literature are included here, with the denoted tests being specific to the individual product category.

## 19.1 Meat Products

The main added values for meat products are nutritional value, environmental benefit and animal welfare. Sensory qualities may also add value.

| Value | Test(s) | Literature |
|---|---|---|
| **Nutritional (in cows and human).** What are the differences regarding polyunsaturated fats and fatty acids in animals and humans depending on the pasturing regime? | Undertake:<br>● Biochemical analysis of polyunsaturated fats in meat from grass-fed vs. non-grass-fed livestock;<br>● Dietary analysis of polyunsaturated fatty acids (plasma and platelet fatty acids) in a controlled human study (4 weeks) (McAfee et al, 2011). | Daley, C.A., Abbott, A., Doyle, P.S., Nader, G.A., Larson, S. 2010. A review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef. The Journal of Nutrition. 9:10 12p.<br>McAfee, A.J, McSorley, E.M, Cuskelly, G.J., Fearon, A.M., Moss, B.W., Beattie, J.A., Wallace, J.M., Bonham, M.P., Strain, J.J. 2011. Red meat from animals offered a grass diet increases plasma and platelet N-3 PUFA in healthy consumers. British Journal of Nutrition. 105: 80-89. |
| **Human nutrition and preference.** How does grassland produced meat compare in the agrifood chain and according to consumer preferences? | ● Host expert tasting panels;<br>● Measure animal performance by carcass weight;<br>● Simulate retail experiments of attractiveness and shelf life. | Fraser, M.D., Davies, D.A., Vale, J.E., Nute, G.R., Hallett, K.G., Richardson, R.I., Wright, I.A. 2009. Performance and meat quality of native and continental cross steers grazing improved upland pasture or semi-natural rough grazing. Livestock Science. 123:70–82<br>Bedoin, F. & Kristensen, T. 2013. Sustainability of grassland-based beef production: case studies of Danish suckler farms. Livestock Science. 158(1–3):189–198. |

| | | |
|---|---|---|
| **Environmental sustainability (climate).** What is the carbon footprint of meat production when soil organic carbon is included? | Compare production systems (semi-natural grassland or grass-based or conventional diet, mob grazing vs. continuous grazing) using a life cycle assessment approach including soil carbon accounting and based on a combination of on-farm data and scientific literature. | Stanley, P.L. Rowntree, J.E., Beede, D.K., DeLonge, M.S., Hamm, M.W. 2018 Impacts of soil carbon sequestration on life cycle greenhouse gas emissions in Midwestern USA beef finishing systems. Agricultural Systems 162: 249–258. |
| **Environmental sustainability (planetary boundaries).** What is a 'safe' level of meat consumption based on 'ecological leftovers' that include semi-natural grasslands? How much meat & dairy can be consumed within a safe planetary operating space and with reasonable social and economic impact? | Develop country-specific alternative scenarios (based on intensive vs. extensive farming systems) and assess environmental impacts using a planetary boundaries framework downscaled to country level and adapted to standard diet. | Röös, E., Patel, M., Spångberg, J., Carlsson, G., Rydhmer, L. 2016. Limiting livestock production to pasture and by-products in a search for sustainable diets. Food Policy 58: 1–13. |
| **Environmental sustainability (biodiversity).** What biodiversity embedded in semi-natural grassland meat products? | Ascertain biodiversity values of semi-natural grasslands using well established and commonly accepted indicators of biodiversity value, such as flora and fauna inventories and surrogate indicators where needed. | Peciña, M.V., Ward, R.D., Bunce, R.G.H., Sepp, K., Kuusemets, V., Luuk, O. 2019. Country -scale mapping of ecosystem services provided by semi-natural grasslands. Science of the Total Environment 661: 212–225. |

## 19.2 Dairy Products

The main added values for dairy products are nutritional value, environmental benefit and animal welfare. Sensory qualities may also add value (see also 19.1 Meat Products). The influence of different types of grass forage on dairy can be tested.

| Value | Test(s) | Literature |
|---|---|---|
| **Quality, nutritional value.** What is the influence of breed on fodder preference and habitat selection by breed vis-à-vis meat & milk quality? | Use GPS collars on cattle herds, as well as in person monitoring, to observe foraging behaviour and diet selection. | Bele, B.; Johansen, L.; Norderhaug, A. Resource use by old and modern dairy cattle breeds on semi-natural mountain pastures, Central Norway. Acta Agriculturae Scandinavica Section A: Animal Science. 65: 73–84. |
| **Quality, nutritional value.** What is the influence of pasture on nutrient values and milk quality? | Analyse principle components including:<br>● Plasmin activity;<br>● Fatty acid composition; and<br>● Volatile compound composition. | Bugaud, C., Buchin, S., Coulon, J.B. Hauwuy, A., Dupont, D. 2001. Influence of the nature of alpine pastures on plasmin activity, fatty acid composition and volatile compound composition of milk. Lait. 81: 401–414.<br>Falchero, L., Lombardi, G., orlier, A., Lonati, M., Odoardi, M., Cavallero, A. 2010. Variation in fatty acid composition of milk and cheese from cows grazed on two alpine pastures.<br>Dairy Science Technology. 90: 657–672. |

| | | |
|---|---|---|
| | | La Terra, S., Marina, V.M., Manenti, M., Licitra, G., Carpino, S. 2010. Increasing pasture intakes enhances polyunsaturated fatty acids and lipophilic antioxidants in plasma and milk of dairy cows fed total mix ration. Dairy Science Technology. 90: 687–698. |
| **Quality, both sensory and nutritional** What is the influence of pasture (or the addition of hay to the diet) on composition and the rheological qualities of cheese and butter? | Analyse the following under comparative conditions:<br>● Rheological measurements (strain and stress at fracture and deformability modulus);<br>● Chemical composition of cheese (pH, fat, nitrogen in different forms, etc.);<br>● Milk-composition;<br>● Sensory and texture-related properties, including: melting qualities, colour, rancidity and spreadability (butter);<br>● Product appeal (using sensory panels). | Agabriel, C., Martin, B., Sibra, C., Bonnefoy, J.-C., Montel, M.-C., Didienne, R., Hulin, S. 2004. Effect of dairy production systems on the sensory characteristics of Cantal cheeses: a plant-scale study. Animal Research. 53: 221–234.<br>Bugaud, C., Buchin, S., Noël, Y., Tessier, L, Pochet, S., Martin, B., Chamba, J. 2001. Relationships between Abondance cheese texture, its composition and that of milk produced by cows grazing different types of pastures. Lait INRA Editions. 81(5): 583–607.<br>Couvreur, S., Hurtaud, C., Lopez, C., Delaby, L, Peyraud, J.L. 2006. The linear relationship between the proportion of fresh grass in the cow diet, milk fatty acid composition and butter properties. Journal of Dairy Science. 89(6): 1956–1969.<br>Hurtaud, C., Delaby, L, Peyraud, J.L. 2007. The nature of preserved forage changes butter organoleptic properties. Lait 87: 505–519. |

## 19.3 Honey Products

The main added values of honey products are nutritional value, although there are environmental, biodiversity, health and social benefits may also be present. Studies16 to authenticate origin, plant pollen composition, adulteration and contamination, as well as active compounds could help identify potential added nutritional values of non-cultivated grassland-produced honey.

| Value | Test(s) | Literature |
|---|---|---|
| **Health, medical properties. What are the wound healing properties of honey?** | Tests of the effect of target a differentiated honey, e.g. compared to for-purpose MedihoneyTM on:<br>● Real-time growth of chronic wound bacteria, such as MRSE,<br>● MRSA, ESBL Klebsiella pneumoniae and Pseudomonas aeruginosa;<br>● Biofilm formation. | Merckoll, P., Øystein Jonassen, T., Vad, M.E., Jeansson, S.L. & Melby, K.K., 2009. Bacteria, biofilm and honey: A study of the effects of honey on 'planktonic' and biofilm-embedded chronic wound bacteria. Scandinavian Journal of Infectious Diseases. 41: 341–347. |
| **Quality, both sensory and nutritional.** How can botanical origin of honey be verified and quality assured? | Analysis of:<br>● Melissopalynology (pollen in honey) (Louveaux et al, 1970);<br>● Physicochemical properties (according to harmonized Integrated Food Security Phase Classification methods);<br>● Phenolics (HPLC analysis); and<br>● Sensory properties (Electrochemical voltammetric electronic tongue measurement). | Oroian, M. and Ropciuc, S. 2019. Romanian honey authentication using voltammetric electronic tongue. Correlation of voltammetric data with physico-chemical parameters and phenolic compounds. 157: 371–379. |
| **Nutritional quality.** How can potential nutritional differences based on botanical origin be determined? | Measurement of:<br>● Total phenolic content (TPC) using a modified Folin-Ciocalteu method;<br>● Physicochemical parameters (using electrical conductivity, moisture, pH, total sugar and colour); and<br>● Microbial contamination and stability. | Kavanagh, S., Gunnoo, J., Passo, T.M., Stout, J.C., White, B. 2019. Physicochemical properties and phenolic content of honey from different floral origins and from rural versus urban landscapes. Food Chemistry. 272: 66–75. |
| **Quality.** What are the macro- and micro- elements and toxic metal content of honey? | ● Flame atomic absorption spectrometry (FAAS) with cluster analysis to determine macroelements (Mg, Ca, K, Na, and P), microelements, (Zn, Cu, Fe, Cr, Co, Ni, and Mn), and toxic elements (Pb and Cd) for the classification and differentiation of honey types. | Grembecka, M. and Szefer, P. 2013. Evaluation of honeys and bee products quality based on their mineral composition using multivariate techniques. Environmental Monitoring and Assessment. 185: 4033–4047. |

| | | |
|---|---|---|
| **Quality.**<br>What are the volatile compounds of honey and/or beebread? | Gas chromatography on solid phase microextraction (SPME) of volatiles in honey and honey products (for example, beebread when fresh and after three months of storage). | Kaškoniene, V., Venskutonis, P.R., Čeksterytė V. 2008. Composition of volatile compounds of honey of various floral origin and beebread collected in Lithuania. Food Chemistry. 111: 988–997. |
| **Quality.**<br>What are the volatile compounds of honey and/or beebread? | Gas chromatography using hexane, ether and methanol extracts (a time consuming but inexpensive process). | Isidorov, V.A., Isidorova, A.G., Sczczepaniak, L., Czyżewska. 2009. Gas chromatographic–mass spectrometric investigation of the chemical composition of beebread Food Chemistry. 115: 1056–1063. |
| **Quality, nutritional value**<br>What is the pesticide content and nutritional value? | Undertake an:<br>● Assay of pollen collected from pollen traps at the entrance to the bee colony with concurrent floral surveys and creation of reference pollen slides; and<br>● Analysis of pollen amino acid using high pressure liquid chro-matography (HPLC) & QuEChERS analysis to determine nutritional values. | Colwell, M.J., Williams, G.R., Evans, R.C., Shutler, D. 2017. Honey bee- collected pollen in agro-ecosystems reveals diet diversity, diet quality, and pesticide exposure. Ecology and Evolution. 7: 7243–7253. |
| **Quality**.<br>What is the pollen concentration of honey? | Analysis of:<br>● Melissopalynology (pollen content) following the standard acetolysis method. | Puusepp, L., and Koff, T. 2014. Pollen analysis of honey from the Baltic region, Estonia. Grana 8pp. Čeksterytė, V. Kurtinaitienė, B., Balžekas, J. 2013. Pollen diversity in honey collected from Lithuania's protected landscape areas. Proceedings of the Estonian Academy of Sciences 62(4): 277–282. |
| **Quality.**<br>What is the influence of soil type in the area of around the hive on honey? | Survey:<br>● Vegetation;<br>● Melissopalynology (Von der Ohe et al, 2004);<br>● Sensory value;<br>● Colour (simple colour grading<br>● according to the Pfund scale);<br>● Physicochemical parameters; (using Immunohistochemistry methods)<br>● Antioxidant capacity (stable free radical DPPH test)<br>● Vitamin C (the 2,6- dichloroin-dophenol titrimetric method). | González-Porto, A.V., Arroyo, T.M., Bartolomé Esteban, C. 2016. How soil type (gypsum or limestone) influences the properties and composition of thyme honey. SpringerPlus. 5(1): 1663. |

## 19.4 Grass Products

The main added values of biofuel production in semi-natural grasslands are environmental benefits resulting from grasslands being kept open and in utilization of the biomass as a renewable energy source. Social benefits include contributions to livelihoods. The benefit of grassland-sourced fodder and supplements to the health of pets and non- production animals may also be considered.

| Value | Test(s) | Literature |
|---|---|---|
| **Environmental.**<br>What is the biogas potential, as measured by methane yield, of different grassland species and under different cutting regimes? | ● Measure, under comparative conditions:<br>● Grass yield;<br>● Methane potential;<br>● Total solid content;<br>● Volatile solid content;<br>● Solid chemical oxygen demand;<br>● and the<br>● Total nitrogen and ammonium<br>● nitrogen content. | Seppälä, M., Paavola, T., Lehtomäki, A, Rintala, J. 2009. Biogas production from boreal herbaceous grasses: specific methane yield and methane yield per hectare. Bioresource Technology. 100 (12): 2952–2958. |
| **Environmental.**<br>What is the methane yield steam exploded biomass?<br>using | Measure under comparative conditions pre-treated (steam exploded) biomass for:<br>● Dry matter content;<br>● Ash and volatile solids;<br>● Cellulose, hemicellulose, lignin;<br>● Neutral detergent fibre, acid detergent fibre and acid detergent lignin and<br>● Elemental content. | Lizasoain, J., Rinc_on, M., Theuretzbacher, F., Enguídanos, R., Nielsen, P.J., Potthast, A., Zweckmair, T., Gronauer, A., Bauer, A. 2016. Biogas production from reed biomass: Effect of pretreatment using different steam explosion conditions. Biomass and Bioenergy. 95: 84–91. |
| **Environmental.**<br>What is the contribution to carbon balance and nutrient cycling under different scenarios? | Perform a life cycle assessment (LCA) with regard to carbon, nitrogen and phosphorus flows (according to the EDIP2003 methodology for acidification and eutrophication impacts and LCA software SimaPro 8.2.0). | Pehme, S., Veromann, E., Hamelin, L. 2017. Environmental performance of manure co-digestion with natural and cultivated grass: a consequential life cycle assessment. Journal of Cleaner Production. 162: 1135–1143. |
| **Health (medicinal).**<br>What is the value of grassland forage compared to other feed? | Survey vegetation including forage by:<br>● wet chemistry;<br>● refluxing methods;<br>● atomic absorption spectroscopy);<br>● comparing with reference values; and<br>● stakeholder interviews. | French, K.E. 2017. Species composition determines forage quality and medicinal value of high diversity grasslands in lowland England. Agriculture, Ecosystems and Environment. 241: 193–2014 |
| **Social (livelihoods).**<br>What are the specific socio- economic values? | Complete a socio-economic impact study that examines:<br>● Macro-economic effects;<br>● Energy security;<br>● Health effects; and<br>● Employment impact. | Borbonus, S. 2017. Generating socio-economic values from renewable energies: an overview of questions and assessment methods. IASS 32pp. |

## 19.5 Medicinal products

The main potential added values of semi and natural grassland-collected herbs are environmental, socio-economic and health-related.

| Value | Test(s) | Literature |
|---|---|---|
| **Health.** Do wild versus cultivated medicinal plant species, for example Achillea millefolium, differ in ways that would affect their health properties or other quality characteristics? | • Test commercially cultivated herbs versus wild samples for:<br>• Macronutrients (macro Kjeldahl method and other methods);<br>• Sugars (HMLC-RI);<br>• Organic acids, fatty acids (with gas-liquid chromotatography); and<br>• Tocopherols (using HPLC and florescence detection). | Dias, M.I., Barros, L., Dueñas, M., Periera, E., Carvalho, A.M., Alves, R.C., Oliveira, M.B.P.P., Santos-Buelga, C., Ferreira, I.C.F.R. 2013. Chemical composition of wild and commercial Achillea millefolium L. and bioactivity of the methanolic extract, infusion and decoction. Food Chemistry. 141: 4152–4160. |
| **Health.** Do wild versus cultivated medicinal plant species, for example Arnica montana have different physical or chemical properties that would affect their health properties or quality? | • Examine physical plant growth, morphometry;<br>• Test extracts of plant parts for volatile oils (Bergonzi et al, 2005 method) at harvest time;<br>• Identify compounds of pharmaceutical interest (using standard thin-layer chromatography-TLC) and gas- chromatography. | Sava Sand, C. 2015. Arnica montana L. as a medicinal crop species. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. 15(4):303–308. |
| **Health.** What are the benefits to quality, when optimizing the conditions of growth, collection, storage and processing vis-à-vis the efficacy of active compounds in the essential oils of semi-natural grassland- collected herbs? | Undertake:<br>Hydrodistillation; and<br>Solvent-free microwave extraction. | Mohammadhosseini, M., Sarker, S.D., Akbarzadeh, A. 2017. Chemical composition of the essential oils and extracts of Achillea species and their biological activities: a review. Journal of Ethnopharmacology. 199:257–315. |
| **Health.** What are the benefits to quality vis- a-vis contaminants since semi-natural grassland production should result in products free from agri-chemical and heavy metal contamination? | Analyse using the:<br>• QuECHERS method; and<br>• Mass spectrometry. | Malinowska, E., and Jankowski, K. 2015. Pesticide residues in some herbs growing in agricultural areas in Poland. Environmental Monitoring and Assessment. 187: 775. |
| **Environmental sustainability.** What is the impact of harvesting on species prevalence and habitat quality? What are the social impacts, including income generation? | Undertake:<br>• Interviews to gauge the level of knowledge and harvesting practices;<br>• Observations of harvesting practices;<br>• Impact assessment via species inventories/seed bank viability and compare with unharvested areas or development of exclusion areas (as part of a multi-year study); | WWF Hungary, TRAFFIC and FairWild (undated). Set of sustainability principles for wild plant collection.<br>Hamilton, A.C. 2005. Resource assessment for sustainable harvesting of medicinal plants. Plantlife International. |

| | | |
|---|---|---|
| | • The development of sustainable harvest/best practice guidelines and/or certification. | |
| **Social (cultural ecosystem services/ livelihoods).** What is the level of income generation and community development? | • Conduct qualitative assessment via interviews with community and stakeholders (to determine the change in social and cultural capital); and<br>• Conduct quantitative assessment to identify the economic benefit in terms of income generation/ employment in the context of the area of semi-natural grassland conserved (and the increased value in relation to opportunity costs). | Hamilton, A.C. 2005. Resource assessment for sustainable harvesting of medicinal plants. Plantlife International. |

# 20. CONCLUSIONS FOR PART III

The aim of Part III: Added Value of Grassland Products: Framework and Means of Assessment was to provide guidance for identifying, developing, and promoting the additionality of grassland products. Section 16 explored the ways in which grassland-sourced products may have health, social, environmental, and ethical (animal welfare) added values that are attractive to consumers and described how this potential additionality can be assessed against a baseline. Section 17 highlighted alternative agri-food networks as particularly relevant to product differentiation and consumer willingness-to-pay. All of these concepts underpin the framework for assessing and visualising added value (Section 18). In Section 19, the selection of tests, which complement the product category research from Part I of this report, provides a practical way forward for further researching and quantifying added value for each of the five product groups reviewed in this report.

Added value of sustainably produced grassland products is an outcome production methods, where: environmental benefits are realized through grassland management and the use of non-arable land for production; animal welfare is improved through freedom of movement, as well as species- appropriate diet and behaviour; nutritional and health benefits are realized through more favourable nutritional profiles of grass-produced animal products and reduced presence of agri- chemicals and other contaminants; and social value is enhances through sustainable livelihoods and income, clean rural environments, and contributions to rural life and culture.

Kristaps Kalns / GrassLIFE

Products must be differentiated in the market in order for the price to reflect the added value embedded in the products. Both Part I and Part III of this report identify gaps in knowledge about how grassland and non-grassland products may differ from each other. The framework and tests suggested here can aid in identifying and providing support for claims of product additionality. In addition to researching grassland products' potential added value and promoting those that are already established, this study recommends exploring mechanisms for distribution, such as alternative agrifood networks and certification programmes that are designed to help producers differentiate their products in the market and achieve a premium based on the values embedded in their products.

# IV. REFERENCES


**1.** Agabriel, C., Martin, B., Sibra, C., Bonnefoy, J.-C., Montel, M.-C., Didienne, R., Hulin, S., 2004. Effect of dairy production systems on the sensory characteristics of Cantal cheeses: a plant-scale study. Animal Research. 53: 221–234.

**2.** A Greener World, 2018. Certified grassfed by AGW. https://agreenerworld.org/certifications/certified-grass-fed/ [accessed 25.1.2019].

**3.** Akaichi, F., Glenk, K., Revoredo-Giha, C., 2019. Could animal welfare claims and nutritional information boost the demand for organic meat? Evidence from non-hypothetical experimental auctions. Journal of Cleaner Production. 207: 961–970.

**4.** Allen, D., Bilz, M., Leaman, D.J., Miller, R.M., Timoshyna, A. Window, J., 2014. European Red List of Medicinal Plants. Luxembourg: Publications Office of the European Union.
http://cmsdata.iucn.org/downloads/iucn_european_red_list_of_medicinal_plants_web.pdf [accessed 25.1.2019].

**5.** Andersen, E., Baldock, D., Bennett, H., Beaufoy, G., Bignal, E., Brouwer, F., Elbersen, B., Eiden, G., Godeschalk, F., Jones, G., McCracken, D., Nieuwenhuizen, W., van Eupen, M., Hennekens, S., Zervas, G., 2003. Developing a high nature value farming area indicator. Internal report. EEA. European Environment Agency, Copenhagen. http://www.ieep.eu/assets/646/Developing_HNV_indicator.pdf [accessed 10.1.2019].

**6.** Annes, A. Wright, W., 2016. Value-added agriculture: a context for the empowerment of French women farmers?.
Review of Agricultural, Food and Environmental Studies. 97(3): 185-201.

**7.** Asociación Trashumancia y Naturaleza and WWF/Adena España, 2018. High Nature Value Farming: the key to progress in the new CAP. July 2018 [accessed 10.1.2019].

**8.** Baltrušaitytė, V. Venskutonis, P.R., Čeksterytė V., 2007. Antibacterial activity of honey and beebread. Food Technolology and Biotechnology. 45(2): 201–208.

**9.** Barham, E., 2002. Towards a theory of values-based labeling. Agriculture and Human Values. 19: 349–360.

**10.** Bedoin, F. and Kristensen, T., 2013. Sustainability of grassland-based beef production: case studies of Danish suckler farms.
Livestock Science. 158(1–3): 189–198.

**11.** Bele,B.,Johansen,L.,Norderhaug,A.,2015.Resourceusebyoldandmoderndairycattlebreedsonsemi-natural mountain pastures, Central Norway. Acta Agriculturae Scandinavica Section A: Animal Science. 65: 73–84.

**12.** Berriel, V., 2018. Carbon stable-isotope and physicochemical sata as a possible tool to differentiate between honey-production Environments in Uruguay. Foods. 7: 86 8pp.

**13.** Bijttebier, J., Hamerlinck, J., Moakes, S., Scollan, N., Van Meensel, J., Lauwers, L., 2017. Low-input dairy farming in Europe:
exploring a context specific notion. Agriculture Systems. 156: 43–51.

**14.** Bilandžić,N.Đokić,M.,Sedak,M.,Kolanović,B.S.,Varenina,I.,Končurat,A.Rudan,N.,2011.Determinationof trace elements in Croatian floral honey originating from different regions. Food Chemistry 128: 1160–1164.

**15.** Bilandžić,N.,Gačić,M.,Đokić,M.,Sedak, M.,Šipušic, D.I., 2014. Major and trace elements levels in multifloral and unifloral honeys in Croatia. Journal of Food Composition and Analysis. 33: 132–138.

**16.** Borbonus, S., 2017. Generating socio-economic values from renewable energies: an overview of questions and assessment methods. IASS. 32pp. https://www.iass- potsdam.de/sites/default/files/files/iass_2017_cobenefits_assessment_methods.pdf [accessed 10.2.2019].

**17.** Bosset, J.O., Jeangros, B., Berger, T, Bütikofer, U., Collomb, M., Gauch, R., Lavanchy, P., Scehovic J., Sieber, R.,1999. Comparaison de fromages a pate dure de type gruyere produits en region de montagne et de plaine. Revue Suisse d' Agriculture. 31:17-22

**18.** Bryant, V., 2018. Melissopalynology: The science of using pollen to study honey.
Bee Culture. 28.10.2018 https://www.beeculture.com/melissopalynology/ [accessed 15.3.2019]

**19.** BuchinS.,MartinB.,DupontD.,BornardA.,AchilleosC.,1999.InfluenceofcompositionofAlpinehighland
pasture on the chemical, rheological and sensory properties of cheese. Journal of Dairy Research. 66: 579–588.

**20.** Bugaud,C.,Buchin,S.,Coulon,J.B.Hauwuy,A.,Dupont,D.,2001a.Influenceofthenatureofalpinepastureson plasmin activity, fatty acid composition and volatile compound composition of milk. Lait. 81: 401–414.
https://lait.dairy-journal.org/articles/lait/abs/2001/03/bugaud/bugaud.html [accessed 5.3.2019].

**21.** Bugaud, C., Buchin, S., Noël, Y., Tessier, L, Pochet, S., Martin, B., Chamba, J., 2001b.
Relationships between Abondance cheese texture, its composition and that of milk produced by cows grazing different types of pastures. Lait INRA Editions. 81(5):583-607. https://hal.archives-ouvertes.fr/hal-00895349/document [accessed 5.3.2019]

**22.** Bugaud C., Buchin S., Hauwuy A. and Coulon J.B., 2001c. Relationships between flavor and chemical composition of Abondance cheese derived from different types of pastures. Lait. 81(6): 757-773.
https://lait.dairy- journal.org/articles/lait/pdf/2001/06/bugaud.pdf [accessed 5.3.2019].

**23.** Calderón,F.,Tornambé,G.,Martin,B.,Pradel,P.,Chauveau- Duriot,B.,Noziére,P.,2006. Effectsofmountain grassland maturity stage and grazing management on carotenoids in sward and cow's milk. Animal Research. 55:533–544.

**24.** Carpino,S.,Horne,J.,Melilli,C.,Licitra,G.,Barbano,D.M.,VanSoest,P.J.,2004a. Contributionofnativepasture to the sensory properties of Ragusano cheese. Journal of Dairy Science. 87: 308-315.

**25.** Carpino, S., Mallia, S., LaTerra, S., Melilli, C., Licitra, G., Acree, T. E., Barbano, D. M., Van Soest, J. V., 2004b.
Composition and aroma compounds of Ragusano cheese: native pasture and total mixed rations. Journal of Dairy Science. 87: 816-830.

**26.** Catană,R.,Lazăr,M.,Holobiuc,I.,Florescu,L.,2018.Seedgerminationofsomemedicinalplantspeciesfor conservative purpose.
Romanian Biotechnological Letters. DOI: 10.26327/RBL2018.207.

**27.** Čeksterytė, V. Kurtinaitienė, B., Balžekas, J., 2013. Pollen diversity in honey collected from Lithuania's protected landscape areas. Proceedings of the Estonian Academy of Sciences. 62(4): 277–282.
**28.** Chang,J.,Ciais,P.,Viovy,N.,Vuichard,N.,Herrero,M.,Havlík,P.,Wang,X.,Sultan,B.,Soussana,J.-F.,2016.Effect of climate change, CO2 trends, nitrogen addition, and land-cover and management intensity changes on the carbon balance of European grasslands. Global Change Biology. 22: 338–350.
**29.** Chillard,Y.,Glasser,F.,Ferlay,A.,Bernard,L.,Rouel,J.,Dourau,M.,2007.Diet, rumenbiohydrogenation,and nutritional quality of cow and goat milk fat. European Journal of Lipid Science and Technology. 109: 828–855.
**30.** Collins, S. and 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.
**31.** Colwell, M.J., Williams, G.R., Evans, R.C., Shutler, D., 2017. Honey bee-collected pollen in agro-ecosystems reveals diet diversity, diet quality, and pesticide exposure. Ecology and Evolution. 7: 7243–7253.
**32.** Conant, R.T., Paustian, K., Elliott, T., 2001. Grassland management and conversion into grassland: effects on soil carbon. Ecological Applications. 11: 343–355.
**33.** Corbella, E. and Cozzolino, D., 2006. Classification of the floral origin of Uruguayan honeys by chemical and physical characteristics combined with chemometrics. LWT Food Science and Technology. 39: 534–539.
**34.** Corbella, E. and Cozzolino, D., 2005. The use of visible and near infrared spectroscopy to classify the floral origin of honey samples produced in Uruguay. Journal of Near Infrared Spectrometry. 13: 63–68.
**35.** Coulon, J.B., Verdier, I., Pradel, P., Almena, M., 1998a. Effect of lactation stage on the cheesemaking properties of milk and the quality of Saint-Nectaire type cheese. Journal of Dairy Research. 65: 295–305.
**36.** Coulon, J.B., Pradel, P., Cochard, T., Poutrel, B., 1998b. Effect of extreme walking conditions for dairy cows on milk yield, chemical composition, and somatic cell count. Journal of Dairy Science. 81: 994–1003.
**37.** Coulon,J.-B.,Delacroix-Buchet,A.,Martin,B.Pirisi,A.,2004.Relationshipsbetweenruminantmanagementand sensory characteristics of cheeses: a review. Lait. 84: 221-241.
**38.** Consumer Reports, 2015. Beef report. Consumer Reports Food Safety and Sustainability Center August 2015. 51pp.
Retrieved from https://www.consumerreports.org/content/dam/cro/magazine- articles/2015/October/Consumer%20Reports%20Food%20%26%20Sustainability%20Center%20Beef%20Report_ 8-15.pdf [accessed 25.1.2019].
**39.** Couvreur,S.,Hurtaud,C.,Lopez,C.,Delaby,L.,Peyraud,J.L.,2006.Thelinearrelationshipbetweentheproportion of fresh grass in the cow diet, milk fatty acid composition and butter properties. Journal of Dairy Science. 89(6): 1956–1969.
**40.** Cuevas-Glory, L.F., Pino, J.A., Santiago, L.S., Sauri-Duch, E., 2007. A review of volatile analytical methods for determining the botanical origin of honey. Food Chemistry. 103: 1032–1043.
**41.** Daley, C.A., Abbott, A., Doyle, P.S., Nader, G.A., Larson, S., 2010. A review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef. Nutrition Journal Nutrition Journal. 9:10 12pp.
**42.** Deru,J.G.C.,Bloem,J.,deGoede,R.,Keidel,H.,Kloen,H.,Rutgers,M.,vandenAkker,J.,Brussaard,L.,van Eekeren, N., 2018. Soil ecology and ecosystem services of dairy and semi-natural grasslands on peat. Applied Soil Ecology. 125: 26–34.
**43.** DeSmet, S., Raes, K., Demeyer, D., 2004. Meat fatty acid composition as affected by fatness and genetic factors: a review. Animal Research. 2004, 53: 81-98.
**44.** de Vries, M., van Middelaar, C.E., de Boer, I.J.M., 2015. Comparing environmental impacts of beef production systems: a review of life cycle assessments. Livestock Science. 178: 279–288.
**45.** Dias,M.I.,Barros,L.,Dueñas,M.,Periera,E.,Carvalho,A.M.,Alves,R.C.,Oliveira,M.B.P.P.,Santos-Buelga,C., Ferreira, I.C.F.R., 2013. Chemical composition of wild and commercial Achillea millefolium L. and bioactivity of the methanolic extract, infusion and decoction. Food Chemistry. 141: 4152–4160.
**46.** Donnisson,I.S.andFraser,M.D.,2016.Diversificationanduseofbioenergytomaintainfuturegrasslands.Food and Energy Security. 5(2): 67–75.
Retrieved from https://onlinelibrary.wiley.com/doi/10.1002/fes3.75 [accessed 3.3.3019]
**47.** Dumont, B., Thórhallsdóttir, A. G., Farruggia, A., and Norderhaug, A., 2013. Livestock grazing and biodiversity in semi-natural grasslands. Grassland Science in Europe. 18: 314–326.
**48.** Ernst, M., and Woods, T. 2011. "Adding Value to Plant Production-An Overview." Cooperative Extension Service, College of Agriculture, University of Kentucky.
http://www.uky.edu/ccd/sites/www.uky.edu.ccd/files/vaoverview.pdf [accessed 22.8.2019].
**49.** European Commission (EC), 2012. Two agricultural product names registered (the first Lithuanian, and also the first transnational PDO).
Retrieved from https://ec.europa.eu/agriculture/newsroom/70_en [accessed 15.3.2019].
**50.** EuropeanFoodSafetyAuthority(EFSA),2018.Animalwelfare. Retrievedfrom https://www.efsa.europa.eu/en/topics/topic/animal-welfare [accessed 25.2.2019]
**51.** Euronews, 2014. Flower power. 14.4.2014. (Video and article).
Retrieved from https://www.euronews.com/2014/04/14/unearthing-the-hidden-healing-powers-of-flowers [accessed 11.2.2019].
**52.** Evans, J., 2015. Bee bread. Nordic Food Lab.
Retrieved from http://nordicfoodlab.org/blog/2015/9/4/bee- bread?rq=bee [accessed 15.3.2019]
**53.** FairWildFoundation,2018. Retrieved from http://www.fairwild.org/ [accessed8.2.2019].
**54.** FairWild Foundation, 2018. FairWild Certification Scheme: FairWild-certified ingredients under production. Last updated 24.10.2018.
Retrieved from http://www.fairwild.org/publication-downloads/other-documents/FairWild_species_products.pdf [accessed 8.2.2019].

**55.** Falchero,L.,Lombardi,G.,Gorlier,A.,Lonati,M.,Odoardi,M.,Cavallero,A.,2010.Variationinfattyacid composition of milk and cheese from cows grazed on two alpine pastures. Dairy Science Technology. 90: 657–672.
**56.** Farm animal Welfare Council (FAWK), 2009. Five Freedoms. Archived by the National Archives.
Retrieved from https://webarchive.nationalarchives.gov.uk/20121010012427/http://www.fawc.org.uk/freedoms.htm [accessed 25.2.2019]
**57.** Farruggia,A.,Martin,B.,Boumont,R.,Prache,S.,Doreau,M.,Hoste,H.,Durand,D.,2008.Quelsintérêtsdela diversité floristique des prairies permanentes pour les ruminants et les produits animaux? (floristic diversity of permanent pastures important for ruminants and animal products?) INRA Productions Animales. 21: 181–199.
**58.** Federation of Veterinarians of Europe (FVE), 2009. 1 European Veterinary Code of Conduct and 2. Veterinary Act. 23pp.
Retrieved from https://www.fve.org/publications/code-of-conduct-veterinary-act/ [accessed 25.2.2019]
**59.** Feldmann, C. and Hamm, U., 2015. Consumers' perceptions and preferences for local food: a review. Food Quality and Preference. 40(A): 152–164.
**60.** Finnish Ministry of Agriculture and Forestry, 2013. Local food – but of course! Retrieved from https://mmm.fi/lahiruoka?p_p_id=56_INSTANCE_TrnS2ZmabtSl&p_p_lifecycle=0&p_p_state=normal&p_p_mode =view&p_p_col_id=column-2&p_p_col_count=3&_56_INSTANCE_TrnS2ZmabtSl_languageId=en_US [viewed 20.2.2019]
**61.** Fischer, K. and Röös, E., 2018. Controlling sustainability in Swedish beef production: outcomes for farmers and the environment. F ood Ethics. 2: 39–55. Retrieved from https://link.springer.com/content/pdf/10.1007%2Fs41055-018-0027-7.pdf [accessed 5.2.2019].
**62.** Food and Agriculture Organisation (FAO), 2014. Sustainability Assessmentof Foodand Agriculture Systems (SAFA) v. 3.0. Rome.
Retrieved from http://www.fao.org/3/a-i3957e.pdf [accessed 1.15.2019]
**63.** Fraser,M.D.,Davies,D.A.,Vale,J.E.,Nute,G.R.,Hallett,K.G.,Richardson,R.I.,Wright,I.A.,2009.Performanceand meat quality of native and continental cross steers grazing improved upland pasture or semi-natural rough grazing. Livestock Science. 123: 70–82.
**64.** Fraser, D., Weary, D.M., Pajor, E.A., Milligan, B.N., 1997. A scientific conception of animal welfare that reflects ethical concerns. Animal Welfare. 6: 187–205.
**65.** French, K.E. ,2017. Species composition determines for agequality and medicinal value of high diversity grasslands in lowland England. Agriculture, Ecosystems and Environment. 241: 193–2014.
**66.** Gillenwater, M., 2012. What is additionality? Part 1: A long standing problem. Discussion paper no. 001. 1/2012 v. 3. GHG Management Institute 29pp. Retrieved from http://ghginstitute.org/wp- content/uploads/2015/04/AdditionalityPaper_Part-1ver3FINAL.pdf [accessed 25.2.2019]
**67.** González-Porto, A.V., Arroyo, T.M., Bartolomé Esteban, C., 2016. How soil type (gypsum or limestone) influences the properties and composition of thyme honey. SpringerPlus. 5: 1663.
**68.** Green, T.C., and Mellor, D.J., 2011. Extending ideas about animal welfare assessment to include 'quality of life' and related concepts. New Zealand Veterinary Journal. 59(6): 263-271.
**69.** Grembecka, M. and Szefer, P., 2013. Evaluation of honeys and bee products quality based on their mineral composition using multivariate techniques. Environmental Monitoring and Assessment. 185: 4033–4047.
**70.** Guthman,J.,2007.ThePolanyianway?Voluntaryfoodlabelsasneoliberalgovernance.Antipode.39(3):456–478.
**71.** Guzelmeric,E.Ristivojević,P.,Vovk,I.,Milojković-Opsenica,D.,Yesilada,E.,2017.Qualityassessmentofmarketed chamomile tea products by a validated HPTLC method combined with multivariate analysis. Journal of Pharmaceutical and Biomedical Analysis. 132: 35–45.
**72.** Hagyó, A. and Tóth, G., 2018. The impact of environmental policy on soil quality: organic carbon and phosphorus levels in croplands and grasslands of the European Natura 2000 network. Journal of Environmental Management. 223: 9–15.
**73.** Hamilton, A.C., 2005. Resource assessment for sustainable harvesting of medicinal plants. Plantlife International. presented at a side-event at the International Botanical Congress (Vienna) on Source to Shelf: Sustainable Supply Chain Management of Medicinal and Aromatic Plants, organized by Dagmar Lange, Klaus Dürbeck and Chlodwig Franz (21-22 July 2005).
**74.** Heinsoo, K., Melts, I., Sammul, M., Holm, B., 2010. The potential of Estonian semi-natural grasslands for bioenergy production. Agriculture, Ecosystems and Environment. 137: 86–92.
**75.** Holland, J., Douma, J., Crowley, L., James, L., Kor, L., Stevenson, D., Smith, B., 2017. Semi-natural habitats support biological control, pollination and soil conservation in Europe. A review. Agronomy for Sustainable Development. 37(4): 1-23.
**76.** Hooks, T., Macken-Walsh, Á., McCarthy, O., Power, C., 2017. The impact of a values-based supply chain (VBSC) on farm-level viability, sustainability and resilience, case study evidence. Sustainability.
Retrieved from file:///Users/tracibirge%201/Downloads/sustainability-09-00267.pdf [accessed 11.8.2019].
**77.** Horn, M., Steinwidder, A., Gasteiner, J., Podstatzky, L., Haiger, A. Zollitsch, W., 2013. Suitability of different dairy
cow types for an Alpine organic and low-input milk production system. Livestock Science. 153(1-3): 135–146.
**78.** Hurtaud,C.,Delaby,L,Peyraud,J.L.,2007.Thenatureofpreservedforagechangesbutterorganoleptic properties. Lait. 87: 505–519.
**79.** Häkkinen, J., 2007. Traditional use of reed. pp. 63–71. In: Ikonen and Hagelberg (Eds.).
2007. Read Up on Reed! Southwest Finland Regional Environment Centre. 123pp.
Retrieved from https://www.ymparisto.fi/download/noname/%7B59D7F1BA-E2C9-4712-9AE5-6E28EF9877CE%7D/118375 [accessed 14.2.2019].
**80.** Isidorov, V.A., Isidorova, A.G., Szczczepaniak, L., Czyżewska, U., 2009. Gas chromatographic–mass spectrometric investigation of the chemical composition of beebread. Food Chemistry. 115: 1056–1063.
**81.** Jalli,V.-M.,Kask, Ü., Laizans, A., 2013. Biogas production from reed. pp.88–98. Kask, Ü. (Ed.) 2013. Guidebook of reed business. COFREEN – Reed for bioenergy and construction.
Retrieved from https://www.ymparisto.fi/download/noname/%7BCCDBCAB8-A4B6-400B-BF6F-4F1D04CCD126%7D/120479 [accessed 3.3.2019]

**82.** Joosse, S. and Hracs, B.J., 2015. Curating the quest for 'good food': the practices, spatial dynamics and influence of food-related curation in Sweden. Geoforum. 64: 205–216.
**83.** Joseph, B., Hensgen, F., Bühle, L, Wachendorf, M., 2018. Solid fuel production from semi-natural grassland biomass: results from a commercial-scale IFBB plant. Energies. 11, 17pp. Retrieved from https://www.mdpi.com/1996-1073/11/11/3011 [accessed 3.3.3019].
**84.** Kask, Ü. (Ed.) 2013. Guidebook of reed business. COFREEN – Reed for bioenergy and construction.
Retrieved from https://www.ymparisto.fi/download/noname/%7BCCDBCAB8-A4B6-400B-BF6F-4F1D04CCD126%7D/120479 [accessed 3.3.2019]
**85.** Kask, Ü. And Kask, L, 2013. Reed as a renewable energy source, equipment and technologies for using reed in energy industry. Pp. 55-75. IN: Kask, Ü. (Ed.) 2013. Guidebook of reed business. COFREEN – Reed for bioenergy and construction. Retrieved from https://www.ymparisto.fi/download/noname/%7BCCDBCAB8-A4B6-400B-BF6F-4F1D04CCD126%7D/120479 [accessed 3.3.2019]
**86.** Kavanagh, S., Gunnoo, J., Passo, T.M., Stout, J.C., White, B., 2019. Physicochemical properties and phenolic content of honey from different floral origins and from rural versus urban landscapes. Food Chemistry. 272: 66– 75.
**87.** Kaškoniene,V.,Venskutonis,P.R.,ČeksterytėV.,2008.Compositionofvolatilecompoundsofhoneyofvarious floral origin and beebread collected in Lithuania. Food Chemistry. 111: 988–997.
**88.** Knickel, K. and Maréchal, A., 2018. Stimulating the social and environmental benefits of agriculture and forestry: an EU-based comparative analysis. Land Use Policy. 73: 320-330.
**89.** Korres, undated. Retrieved from https://www.korres.com/en/herbs/ingredients [accessed19.2.2019].
**90.** Kärki, S., 2015. Reko local food groups bring producers and consumers together. 19.2.2015 Aitojamakuja.
Retrieved from http://www.aitojamakuja.fi/blogi/?p=713 [accessed 1.3.2019].
**91.** La Terra, S., Marina, V.M., Manenti, M., Licitra, G., Carpino, S. 2010. Increasing pasture intakes enhances polyunsaturated fatty acids and lipophilic antioxidants in plasma and milk of dairy cows fed total mix ration. Dairy Science Technology. 90: 687–698.
**92.** Laizans, A., 2013. Business models and social-economic effects of reed business. pp.99–107. Kask, Ü. (Ed.) 2013. Guidebook of reed business. COFREEN – Reed for bioenergy and construction. Retrieved from https://www.ymparisto.fi/download/noname/%7BCCDBCAB8-A4B6-400B-BF6F-4F1D04CCD126%7D/120479 [accessed 3.3.2019]
**93.** Lamine, C. and Dawson, J., 2018. The agroecology of food systems: reconnecting agriculture, food, and the environment. Agroecology and Sustainable Food Systems. 42(6): 629–636.
**94.** Lapiņa,L.,2016.DiversityofhoneyinLatvia;MedusdaudzveidībaLatvijā.ConferencepublicationZinātniski praktiskā konference 'Līdzsvarota Lauksaimniecība', 25.– 26.02.2016., LLU, Jelgava, Latvija. p. 134–138.
**95.** Lensu, H., 2018. Valion kunnianhimoinen suunnitelma: Maito hiilineutraaliksi – muutos tehdään lannan ja nurmen avulla. [Valio's ambitious plan: carbon neutral milk – changeover with the help of manure and grass. Maaseudun Tulevaisuus 20.9.2018.
Retrieved from https://www.maaseuduntulevaisuus.fi/maatalous/artikkeli-1.304118 [accessed 30.1.2019].
**96.** Lizasoain,J.,Rincón,M.,Theuretzbacher,F.,Enguídanos,R.,Nielsen,P.J.,Potthast,A.,Zweckmair,T.,Gronauer, A., Bauer, A., 2016. Biogas production from reed biomass: Effect of pretreatment using different steam explosion conditions. Biomass and Bioenergy. 95: 84–91.
**97.** Lorenz, S., Buettner, A., Ender, K., Nuernberg, G., Papstein, H.J., Schieberle, P., 2002. Influence of keeping system on the fatty acid composition in the longissimus muscle of bulls and odorants formed after pressure cooking. European Food Research and Technology. 214: 112–118.
**98.** Louveaux J., Maurizio A., Vorwohl G., 1978. Methods of Melissopalynology. Bee World. 59: 139–157.
Retrieved from http://chemistry.armstrong.edu/nivens/Chem3300/methmels.pdf [accessed 15.3.2019]
**99.** Lu, R. and Dudensing, R., 2015. What do we mean by value-added agriculture? Choices. 30(4): 1–8)
**100.** Łuczaj, L, Pieroni, A., Tardío, J., Pardo-de-Santayana, M., Sõukand, R., Svanberg, I., Kalle, R., 2012. Wild food plant use in 21st century Europe: the disappearance of old traditions and the search for new cuisines involving wild edibles.
Acta Societatis Botanicorum Poloniae. 81(4): 359–370.
**101.** Lugato, E., Panagos, P., Bampa, F., Jones, A., Montanarella, L., 2014. A new baseline of organic carbon stock in European agricultural soils using a modelling approach. Global Change Biology. 20(1): 313–326.
**102.** MÁDARA, 2017. ESG Environmental Sustainability, Social Responsibility and Corporate Governance Report 2017.
Retrieved from https://www.madaracosmetics.com/en/esg [accessed 19.2.2019].
**103.** MÁDARA, undated. Retrieved from https://www.madaracosmetics.com/en/ingredients [accessed 19.2.2019].
**104.** Maione, C., Barbosa Jr., F., Barbosa, R.M., 2019. Predicting the botanical and geographical origin of honey with multivariate data analysis and machine learning techniques: a review. Computers and Electronics in Agriculture. 157: 436–446.
**105.** Malinowska, E., and Jankowski, K., 2015. Pesticide residues in some herbs growing in agricultural areas in Poland. Environmental Monitoring and Assessment. 187: 775. 7pp.
**106.** Manteca, X., Mainau, E., Temple, D., 2012. What is animal welfare? Farm Animal Welfare Education Centre (FAWEC). 6.2012. 2pp.
Retrieved from https://www.fawec.org/en/fact-sheets/28-general-welfare/106-what-is-animal-welfare [accessed 25.2.2019]
**107.** Markova-Nenova, N. and Wätzold, F., 2018. Fair to the cow or fair to the farmer? The preferences of conventional milk buyers for ethical attributes of milk. Land Use Policy. 79: 223–239.
**108.** Martin, B., Verdier-Metz, I., Buchin, S., Hurtaud, C., Coulon, J.-B., 2005. How do the nature of forages and pasture diversity influence the sensory quality of dairy livestock products? Animal Science. 81(2), 205-212 © British Society of Animal Science 2005, published by Cambridge University Press.
**109.** McAfee, A., McSorley, E.M., Cuskelly, G.J., Fearon, A.M., Moss, B.W., Beattie, J.A., Wallace, J.M., Bonham, M.P., Strain, J.J., 2011. Red meat from animals offered a grass diet increases plasma and platelet n-3 PUFA in healthy consumers. British Journal of Nutrition. 105(1): 80–89.
**110.** McAuliffe, G.A., Takahashi, T., Lee, M.R.F., 2018. Framework for life cycle assessment of livestock production systems to account for the nutritional quality of final products. Food and Energy Security. 7: e00143

**111.** McCulloch, S.P., 2013. A critique of FAWC's Five Freedoms as a framework for the analysis of animal welfare. Journal of Agricultural and Environmental Ethics. 26: 959–975.
**112.** Mellor, D.J., 2016. Moving beyond the 'Five Freedoms' by updating the 'Five Provisions' and introducing aligned 'Animal Welfare Aims'. Animals 6(10): 59.
**113.** Merckoll, P., Øystein Jonassen, T., Vad, M.E., Jeansson, S.L. & Melby, K.K., 2009. Bacteria, biofilm and honey: A study of the effects of honey on 'planktonic' and biofilm-embedded chronic wound bacteria. Scandinavian Journal of Infectious Diseases. 41: 341–347.
**114.** Misra, A., 2009. Studies on biochemical and physiological aspects in relation to phyto-medicinal qualities and efficacy of the active ingredients during the handling, cultivation and harvesting of the medicinal plants. Journal of Medicinal Plants Research. 3(13): 1140–1146.
Retrieved from http://www.academicjournals.org/app/webroot/article/article1380528338_Misra.pdf [accessed 8.2.2019].
**115.** Mohammadhosseini, M., Sarker, S.D., Akbarzadeh, A., 2017. Chemical composition of the essential oils and extracts of Achillea species and their biological activities: a review. Journal of Ethnopharmacology. 199: 257–315.
**116.** Morris, C. and Kirwan, J., 2011. Ecological embeddedness: an interrogation and refinement of the concept within the context of alternative food networks in the UK. Journal of Rural Studies. 27: 322–330.
**117.** Mutersbaugh, T., Klooster, D., Renard, M.C., Taylor, P., 2005. Certifying rural spaces: quality-certified products and rural governance. Journal of Rural Studies. 21(4): 381–388.
**118.** National and Kapodistrian University of Athens, 2014. AgroCos: From Biodiversity to Chemodiversity: Novel Plant Produced Compounds with Agrochemical and Cosmetic interest. Final Report. 23 pp.
Retrieved from https://cordis.europa.eu/project/rcn/94701_en.pdf [accessed 8.2.2019].
**119.** Nijdam, D., Rood, T., Westhoek, H., 2012. The price of protein: review of land use and carbon footprints from life cycle assessments of animal food products and their substitutes. Food Policy. 37: 760–770.
**120.** OECD, 2003. Harnessing Markets for Biodiversity: towards conservation and sustainable use. OECD Publishing, Paris. 125pp.
Retrieved from https://www.oecd-ilibrary.org/environment/harnessing-markets-for-biodiversity_9789264099241-en [accessed 7.3.2019].
**121.** Oppermann, R., Beaufoy, G., Jones. G. (Eds.), 2012. High Nature Value Farming in Europe: 35 European countries – experiences and perspectives. Verlag regionalkultur. 544pp.
**122.** Oroian, M., and Ropciuc, S., 2019. Romanian honey authentication using voltammetric electronic tongue. Correlation of voltammetric data with physico-chemical parameters and phenolic compounds. 157: 371–379.
**123.** OÜ Transar EF, undated. Retrieved from http://www.tansar.ee/thatched-roofs/?lang=en [accessed 14.3.2019]
**124.** Paarup Meyer, A.K., Raju, C.S., Kucheryavskiy, S., Holm-Nielsen, J.B., 2015. The energy balance of utilising meadow grass in Danish biogas production. Resources Conservation and Recycling. 104: 265–275.
**125.** Pardo-de-Santayana, M., Quave, C.L., Sõukand, R., Pieroni, A., 2015. Chapter 29. Medical ethnobotany and ethnopharmacology of Europe. pp. 343–355. IN: Heinrich, M., and Jäger, A.K. 2015. Ethnopharmacology. John Wiley & Sons, Ltd.
Retrieved from http://www.andreapieroni.eu/Pardo%20et%20al.,%202015.pdf [accessed 11.2.2019].
**126.** Parts, P.-K., Rennu, M., Jääts, L., Matsin, A., Metslang, J., 2011. Developing sustainable heritage-based livelihoods: an initial study of artisans and their crafts in Viljandi County, Estonia. International Journal of Heritage Studies. 17:5: 401–425.
**127.** Pasture for Life, 2016a. Research demonstrates the human health benefits of Pasture for Life Meat. Retrieved from https://www.pasturefor-life.org/research/research-demonstrates-the-human-health-benefits-of-pasture-for-life-meat/ [accessed 22.1.2019].
**128.** Pasture for Life, 2016b. Research demonstrating the health benefits of Pasture for Life meat.
Retrieved from https://www.pastureforlife.org/media/2018/10/PFL-Health-Benefits-at-14-Sept-FINAL.pdf [accessed 22.1.2019].
**129.** Pasture for Life, 2018a. New beef systems research includes soil carbon measurements for first time. 5.24.2018.
Retrieved from https://www.pastureforlife.org/research/ [accessed 4.2.2019].
**130.** Peciña, M.V., Ward, R.D., Bunce, R.G.H., Sepp, K., Kuusemets, V., Luuk, O., 2019. Country-scale mapping of ecosystem services provided by semi-natural grasslands. Science of the Total Environment. 661: 212–225.
**131.** Pe'er, G., Lakner, S., Passoni, G., Azam, C., Berger, J., Hartmann, L. Schüler, S., Müller, R., von Meyer-Höfer M., Zinngrebe, Y. 2017. Is the CAP Fit for purpose? An evidence-based, rapid fitness-check assessment: preliminary summary of key outcomes. Leipzig, June 2017: BirdLife, EEB, NABU, iDiv, UFZ, Uni. Göttingen.
**132.** Pedroli, B., Elbersen, B., Prederiksen, P., Grandin, U., Heikkilä, R., Henning Krogh, P., Izakovičová, Z., Johansen, A., Meiresonne, L., Spijker, J., 2013. Is energy cropping in Europe compatible with biodiversity? Opportunities and threats to biodiversity from land-based production of biomass for bioenergy purposes. Biomass and Bioenergy. 55: 73–86.
**133.** Pehme, S., Veromann, E., Hamelin, L., 2017. Environmental performance of manure co-digestion with natural and cultivated grass: a consequential life cycle assessment. Journal of Cleaner Production. 162: 1135–1143.
**134.** Petersen, B.M., Knudsen, M.T., Hermansen, J.E and Halberg, N., 2013. An approach to include soil carbon changes in life cycle assessments. Journal of Cleaner Production. 52(1): 217–224.
**135.** Plantureux, S., 2014. Flowering meadows: An operational concept to characterize semi-natural grasslands? 25th European Grassland Association EGF workshop. Retrieved from https://www.europeangrassland.org/fileadmin/documents/Working_Groups/Semi- natural_Grasslands/EGF2014_SNG_Workshop_Presentation_Plantureux.pdf [accessed 2.3.3019].
**136.** Prochnow, A., Heiermann, M., Plöchl, M., Amon, T., Hobbs, P.J., 2009. Bioenergy from permanent grasslands: a review. 2. Combustion. Bioresource Technology. 100: 4945–4954.
**137.** Profeta, A., and Hamm, U., 2019. Consumers' expectations and willingness-to-pay for local animal products produced with local feed. International Journal of Food Science and Technology. doi:10.1111/ijfs.13933

**138.** Provenza, F.D., Villalba, J.J., 2010. The role of natural plant products in modulating the immune system: an adaptable approach for combating disease in grazing animals. Small Ruminant Research. 89(2–3): 131–139.
**139.** Puusepp, L., and Koff, T., 2014. Pollen analysis of honey from the Baltic region, Estonia. Grana 8pp.
**140.** Quave, C.L., Pardo-de-Santayana, M., Pieroni, A., 2012. Medical ethnobotany in Europe: from field ethnography to a more culturally-sensitive evidence-based CAM? Evidence-based Complementary and Alternative Medicines Article. ID 156846, 17 pp.
**141.** Reed, H., Clay, S., Smart, A., Clay, D. Ohrtman, M., 2019a. Chapter 2: Mob grazing results in high forage utilization and reduced western snowberry size. pp. 19-33. In: Edvan, R.L. and Santos, E.M. (Eds.). 2019. Forage Groups. IntechOpen.
Retrieved from https://www.intechopen.com/books/forage-groups/mob-grazing-results-in-high- forage-utilization-and-reduced-western-snowberry-size [accessed 2.3.3019].
**142.** Reed, H., Smart, A., Clay, D.E., Ohrtman, M., Clay, S.A., 2019b. Chapter 4: Mob vs. rotational grazing: impact on forage use and Artemisia absinthium. pp. 53–70. In: Edvan, R.L. and Santos, E.M. (Eds.). 2019. Forage Groups. IntechOpen. Retrieved from https://www.intechopen.com/books/forage-groups/mob-vs-rotational-grazing- impact-on-forage-use-and-artemisia-absinthium [accessed 2.3.3019].
**143.** Renting, H., Marsden, T., Banks, J., 2003. Understanding alternative food networks: exploring the role of short food supply chains in rural development. Environment and Planning A: Economy and Space. 35: 393–411.
**144.** Reynaud, A., Fraisse, D., Cornu, A., Farruggia, A., Pujos-Guillot, E., Besle, J.-M., Martin, B., Lamaison, J.-L., Paquet, D., Doreau, M., Graulet, B., 2010. Variation in content and composition of phenolic compounds in permanent pastures according to botanical variation. Journal of Agricultural and Food Chemistry. 58(9): 5485–5494.
**145.** Rock, A., 2015. How safe is your ground beef? Dec. 21, 2015. Consumer Reports.
Retrieved from https://www.consumerreports.org/cro/food/how-safe-is-your-ground-beef.htm [accessed 25.1.2019].
**146.** Rockström, J., Steffen, W., Noone, K., Persson, Å., Chapin, F.S. III, Lambin, E.F., Lenton, T.M., Scheffer, M., Folke, C., Schellnhuber, H.J., Nykvist, B., de Wit, C.A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P.K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R.W., Fabry, V.J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., Foley, J.A. 2009. A safe operating space for humanity. Nature. 461: 472–475.
**147.** Röös, E., Patel, M., Spångberg, J., Carlsson, G. & Rydhmer, L., 2016. Limiting livestock production to pasture and by-products in a search for sustainable diets. Food Policy. 58: 1–13.
**148.** Rūsiņa, S., 2017. Chapter 1. Characteristics of grasslands. In Rūsiņa, S. (ed). 2017. Protected Habitat Management Guidelines for Latvia. Volume 3. Semi-natural Grasslands. Nature Conservation Agency. Siulda. 21-44. Retrieved from https://www.daba.gov.lv/upload/File/Publikacijas_b_vadlinijas/Hab_Manage_Guidelines_2017_3_Grasslands_01 .pdf [accessed 10.1.2019].
**149.** Salonen, A., Ollikka, T., Grönlund, E., Ruottinen, L., Julkunen-Tiitto, R., 2009. Pollen analyses of honey from Finland. Grana. 48(4): 281–289.
**150.** Sæther, N. H., Sickel, H., Norderhaug, A., Sickel, M. & Vangen, O., 2006. Plant and vegetation preferences for a high and moderate yielding Norwegian dairy cattle breed grazing semi-natural mountain pastures. Animal Research. 55: 367–387.
**151.** Sava Sand, C., 2015. Arnica montana L. as a medicinal crop species. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development. 15(4): 303–308.
**152.** Sava Sand, C. and Antofie, M.-M., 2018. Bioprospecting wild biodiversity in Romania: Case study Gentiana lutea. Romanian Biotoechnological Letters. DOI: 10.26327/RBL2018.157.
**153.** Scehovic, J., 1990. Tannins et autres polymétres polyphénoliques dans les plantes des prairies: déterminationa de leur teneur et de leur activité biologique. Revue Suisse d'Agriculture. 22:179–184.
**154.** Scollan, N., Padel, S., Halberg, N., Hermansen, J., Nicholas, P., Rinne, M., Zanoli, R., Zollitsch, W., Lauwers, L., 2017. Organic and low-input dairy farming: avenues to enhance sustainability and competitiveness in the EU. EuroChoices. 16(3): 40–45.
**155.** Schippmann, U., Leaman, D.J. Cunningham, A.B., 2006. A comparison of cultivation and wild collection of medicinal and aromatic plants under sustainability aspects. pp.75–95. IN: Bogers, R.J., Craker, L.E., Lange, D. (Eds.) Medicinal and Aromatic Plants. Springer.
**156.** Seppälä, M., Paavola, T., Lehtomäki, A, Rintala, J., 2009. Biogas production from boreal herbaceous grasses – specific methane yield an methane yield per hectare. Bioresource Technology. 100 (12): 2952–2958.
**157.** Serrano, S., Villarejo, M., Espejo, R., Jodral, M., 2004. Chemical and physical parameters of Andalusian honey: classification of Citrus and Eucalyptus honeys by discriminant analysis. Food Chemistry. 87: 619–625.
**158.** Setchell, K.D.R., Brown, N.M., Lydeking-Olsen, E., 2002. The clinical importance of the metabolite equol: a clue to the effectiveness of soy and its isoflavones. Journal of Nutrition. 132: 3577–3584.
**159.** Sickel, H., Abrahamsen, R.K., Eldegard, K., Lunnan, T., Nordenhaug, A., Ohlson, M., Sickel, M., Steenhuisen, F., Torp, T., 2016. Effects of grazed plant groups in Norwegian alpine rangelands on milk production and quality parameters. pp.551–553. IN: Höglind, M., Bakken, A.K., Hovstad, K.A., Kallioniemi, E., Riley, H. Steinshamn, H. Østrem, L. (Eds) 2016. The Multiple Roles of Grassland in the European Bioeconomy. EGF 2016(21) Wageningen.
**160.** Sickel, H., Bilger, W., Ohlson, M., 2012. High levels of α-tocopherol in Norwegian Alpine grazing plants. Journal of Agricultural and Food Chemistry. 60: 7573–7580.
**161.** Smith, P., Merbold, L., Van den Pol-Van Dasselaar, A., 2016. Role of European grasslands in the mitigation of climate change: potential, constraints, and research challenges. Grassland Science in Europe. 21: 730–743.
**162.** Soares, S.; Amaral, J.; Oliveira, M.B.; Mafra, I., 2017. Comprehensive review on the main honey authentication issues: production and origin. Comprehensive Review of Food Science and Food Safety. 16: 1072–1100.
**163.** Stanley, P.L. Rowntree, J.E., Beede, D.K., DeLonge, M.S., Hamm, M.W., 2018. Impacts of soil carbon sequestration on life cycle greenhouse gas emissions in Midwestern USA beef finishing systems. Agricultural Systems. 162: 249 – 258.
**164.** Stypinski, P., 2011. The effect of grassland-based forages on milk quality and quantity. Agronomy Research. 9(II): 479–488.

**165.** Thrasyvoulou, A., Tananaki, C., Goras, G., Karazafiris, E., Dimou, M., Liolios, V., Kanelis, D., Gounari, S., 2018 Legislation of honey criteria and standards. Journal of Apicultural Research. 57(1): 88–96.
Retrieved from http://www.ihc-platform.net/legislationofhoneycriteriaandstandards.pdf [accessed 15.3.2019]
**166.** Tuomela, O., 2007. Flexible reed: the use of reed in handicrafts, art objects, and fine art. pp. 84–91. In: Ikonen and Hagelberg (Eds.). 2007. Read Up on Reed! Southwest Finland Regional Environment Centre. 123pp. Retrieved from https://www.ymparisto.fi/download/noname/%7B59D7F1BA-E2C9-4712-9AE5-6E28EF9877CE%7D/118375 [accessed 14.2.2019].
**167.** *UC Sustainable Agriculture Research and Education Program. 2017. "Values-based Supply Chains." What is Sustainable Agriculture? UC Division of Agriculture and Natural Resources. <http://asi.ucdavis.edu/programs/sarep/what-is-sustainable-agriculture/practices/values-based-supply-chains>*
**168.** UEBT, 2017. Biodiversity-based innovation in the European Union: Key elements of EU regulation 511/2014.
Retrieved from https://www.ethicalbiotrade.org/s/UEBT-ABS-EU-2017.pdf [accessed 8.2.2019].
**169.** United Nations Development Programme (UNDP), 2016. Bioprospecting. 15.3.2016.
Retrieved from http://www.undp.org/content/dam/sdfinance/doc/Bioprospecting%20_%20UNDP.pdf [accessed 8.2.2019].
**170.** Uudenmaan Ruoka, 2019. FoodHub: A new way to obtain locally grown fair food. https://uudenmaanruoka.fi/en/ [accessed 1.3.2019]
**171.** Van Meerbeek, K., Ottoy, S., de Andrés García, M., Muys, B., Hermy, M., 2016. The bioenergy potential of Natura 2000: a synergy between climate change mitigation and biodiversity protection. Frontiers in Ecology and the Environment. 14(9): 473–478.
**172.** Van Oort, B. Andrew, R. 2016. Climate footprints of Norwegian dairy and meat – a synthesis. CICERO Report 2016: 06. 73pp.
**173.** Volpentesta, A.P., and Della Gala, M., 2013. Analyzing mobile services in alternative agrifood networks. In: Camarinha-Matos, L.M., Scherer, R.J. (Eds.), Collaborative Systems for Reindustrialization. Springer, Berlin, Heidelberg, pp. 314–323.
**174.** Von der Ohe, W., Persano Oddo, L., Piana, M.L., Morlot, M., Martin, P., 2004. Harmonized methods of melissopalynology. Apidologie. 35: S18–S25. Retrieved from http://ihc-platform.net/melissopalynology.pdf [accessed 15.3.2019].
**175.** Weleda, 2019a. Fair Trade Arnica: Carpathian Mountains, Romania.
Retrieved from https://www.weleda.com/ingredients/fair-trade-farming/fair-trade-arnica [accessed 8.2.2019].
**176.** Weleda, 2019b. Fair Trade Euphrasia: Rhineland-Palatinate, Germany.
Retrieved from https://www.weleda.com/ingredients/fair-trade-farming/fair-trade-euphrasia [accessed 8.2.2019].
**177.** Wichmann, S. and Köbbin, J.F., 2015. Common reed for thatching: A first review of the European market. Industrial Crops and Products. 77: 1063–1073.
**178.** Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L.J., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J.A., DeVries, W., Sibanda, L.M., Afshin, A., Chaudhary, A., Herrero, M., Agustina, R., Branca, F., Larty, A., Gan., S., Crona, B., Fox, E., Bignet, V., Troell, M., Lindahl, T., Singh, S., Cornell, S.E., Reddy, K.S., Narain, S., Nishtar, S., Murray., C.J.L., 2019. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. The Lancet. 393(10171): 9–15.
**179.** WWF Hungary, TRAFFIC and FairWild, (undated). Set of sustainability principles for wild plant collection.
Retrieved from http://wwf.hu/media/file/1352287695_interregleaflet_eng.pdf [accessed 8.2.2019]
**180.** WWF, 2014. Luonnonlaidunliha (Natural Pasture Meat).
Retrieved from https://wwf.fi/alueet/suomi/metsalaidunhanke/luonnonlaidunliha/ last updated 22.4.2014. [accessed 6.2.2019].
**181.** WWF, 2015. WWFs Naturebetesprojekt: Långsiktiga effecter av 25 års arbete. 60 pp.
Retrieved from https://www.wwf.se/source.php?id=1665627 [accessed 5.2.2019]

# ANNEX 1. SELECTION OF RELEVANT PROJECTS

| Project Name and Website | Topic, Funder and Region | Aims | Relevance to GrassLIFE | Project Duration |
|---|---|---|---|---|
| **AGROCOS:**<br><br>From Biodiversity to Chemodiversity: Novel Plant-Produced Compounds with Agrochemical and Cosmetic Interest<br><br>cordis.europa.eu/project/rcn/94701/reporting/en | Cosmetics,<br><br>EU<br><br>multicountry | Discover, and carry to the stage of development, plant derived small molecules with the potential to serve as new cosmetic and agrochemical agents. Among the objectives were to enhance the competitiveness of the European cosmetic and agrochemical industry through the discovery of novel compounds for | Database and methods of relevance for exploring and developing uses for semi- natural grassland- derived species. | 4.2010–9.2014 |
| **COFREEN:**<br><br>Concepts for Using Reed Biomass as Local Bioenergy and Building Material<br><br>keep.eu/project/5279/concepts-for-using-reed-biomass-as-local-bioenergy-and-building-material | Reeds,<br><br>EU<br><br>Estonia, Finland and Latvia | The project introduced the concept of integrated coastal planning and Reed Strategy in 2007. It created a framework for wider utilization and looked for new ways to use reed in the construction industry. The objective of the project was to realise the sustainable management of reed beds in Southern Finland, Estonia and Latvia. | Reed business opportunities. | 5.2010–4.2013 |
| **HNV-Link**<br><br>High Nature Value Farming: Learning, Innovation and Knowledge<br><br>hnvlink.eu | High nature value farmland,<br><br>EU<br><br>multicountry | The project brought 13 partners together to create a network focused on promoting high nature value farming, including through developing 'learning areas' and disseminating and facilitating knowledge exchange. | Learning materials, including examples from high nature value grassland systems in EU. | 4.2016–3.2019 |
| **LegLINK:**<br><br>Using Legume-based Mixtures to Enhance the Nitrogen Use Efficiency and Economic Viability of Cropping Systems.<br><br>organicresearchcentre.com/?go=Research%20and%20development&page=Crop%20production&i=projects.php&p_id=19 | Legumes,<br><br>DEFRA ,<br><br>UK | Improve nitrogen use efficiency in UK arable systems. The project included components addressing low-impact dairy and other livestock farming as well as agroforestry. | Research and guidance on complementar y feed for semi-natural based systems (e.g. proteins). | 12.2009–2.2012 |
| **iSAGE:**<br><br>Innovation for Sustainable Sheep and Goat Production in Europe<br><br>isage.eu | Sheep and goats,<br><br>EU<br><br>multicountry | Enhance the sustainability, competitiveness and resilience of the European sheep and goat sectors through collaboration between industry and research. | Consumer and market research for sheep and goat farming. | 1.2016–2.2020 |

| | | | | |
|---|---|---|---|---|
| **PROGRASS:**<br><br>Securing the Conservation of Natura Grassland Habitats with a Distributed Bioenergy Production<br><br>prograss.eu | Grassland-biofuel,<br><br>EU<br><br>Germany | The objective was to scale up, demonstrate and implement the University of Kassel's approach to producing bio-energy (electricity and solid fuel) on extensive areas of grassland for the first time. | Developing bioenergy from grasslands. | 1.2009-6.2012 |
| **Projets prairies:**<br><br>Fourrages Natura 2000 et MAEC<br><br>fourragesmieux.be/projet.html | Semi-natural grasslands as fodder<br><br>France-based | Determine the dietary value of fodder from highly diverse grassland flora; characterise the quantitative and qualitative yields of grasslands and practices for the valorisation of fodder; and to conduct a technico-economic study on the use of such fodder. | Fodder studies. | 1.2016– |
| **SEEGSLIP:**<br><br>Sustainable Economic and Ecological Grazing Systems - Learning from Innovative Practitioners<br><br>ceh.ac.uk/our-science/projects/seegslip | Grazing systems,<br><br>UK-based | To evaluate the Pasture for Life certified approach to grazing management and its potential as the basis of a sustainable UK-wide system. | Evaluation of 100 percent grass-fed livestock grazing systems. | 1.2018–12.2020 |
| **SOLID:**<br><br>Sustainable Organic and Low Input Dairying<br><br>solidairy.eu | Dairy,<br><br>EU<br><br>multicountry | The project provided tools to: improve the technical performance of dairy production; improve the economic competitiveness of organic and low-input dairy farms; maximize the delivery of environmental goods from the sector; and to enhance the biodiversity on the farms. | Teaching materials and research on low-impact dairy; consumer/marketing research. | 1.2011–3.2016 |
| **SUSHERB:**<br><br>Promoting Sustainable Herbal Harvest in Bulgaria<br><br>susherbsbg.eu/en | Herbs,<br><br>EU<br><br>Bulgaria | The project addressed the commercial over-exploitation of wild populations of medicinal and aromatic plants in Bulgaria. | Herb fairs, manuals and other outputs, networking relevant stakeholders. | 10.2012–3.2016 |
| **Viva Grass:**<br><br>Integrated Planning Tool to Ensure Viability of Grasslands<br><br>vivagrass.eu | Grassland,<br><br>EU<br><br>Latvia, Lithuania and Estonia | The project aimed to prevent the loss of High Nature Value grasslands by developing an Integrating Planning Tool and considering socio-economic factors that impact the nature conservation policy. | Conservation tool, learning platform. | 6.2014–4.2019 |


www.grasslife.lv