EIP-AGRI Focus Group
Permanent Grassland

Minutes 1st meeting Frankfurt
26-27 June 2014

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Day 1

The meeting was held during the 26th and 27th of June in Frankfurt. See the agenda in Annex.

Session 1

After welcome by Quico Ónega (EIP-AGRI Service Point) all participants introduced themselves explaining their expectations and their expertise in the topic. Then, three introductory presentations were done. Pilar Gummá (DG AGRI unit H5) presented the European Innovation Partnership on Agricultural Productivity and Sustainability[1] (EIP-AGRI) and the general framework of the Focus Groups[2]. Remco Schreuder (EIP-AGRI Service Point) made a brief description of the roles and activities of the EIP-AGRI Service Point. Finally, Quico Ónega introduced the overall question of the Focus Group on Profitability of Permanent Grassland (FG-PPG) and summarised the main steps that the FG will follow as well as the expected results.

The objective of the Focus Group is to identify and exchange knowledge and practices that allow an increased efficiency and profitability in grassland management while keeping biodiversity values and carbon sequestration, as well as a better recognition of the interrelationships among those functions.

The Focus Group is expected to:

- Identify and describe the **main farming systems** using permanent grassland.
- Identify **practices to improve efficiency and productivity** in milk/meat production systems both for extensive and intensive farming systems.
- Identify grassland management **practices which enhance animal health, welfare** and productivity as well as grassland **composition and management** practices that allow for the development of **premium and functional products**.
- Identify **key traits** that relate grassland management with **biodiversity and carbon footprint**; as well as **examples of strategies to combine** maintenance of biodiversity and low carbon footprint with farming profitability.
- Identify **fail factors that limit the use of the identified techniques/systems** by farmers and summarize how to address these factors.

Regarding the process, it can be summarized as follows:

- Starting paper prepared by the key expert, Koldo Osoro and distributed to all participants before the first meeting.
- Contributions submitted by participants before first meeting.
- Two face to face meetings (June and November 2014)
- Interactive process during and between meetings.
- Preparatory work and homework (before and after the meetings). A number of thematic papers (*mini-papers*) will be elaborated by participants.

[1] http://ec.europa.eu/agriculture/eip/index_en.htm
[2] http://ec.europa.eu/agriculture/eip/focus-groups/index_en.htm

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- Final output: report.

Session 2

Koldo Osoro presented the starting paper, mainly focussing on the proposed framework for analysis, and also summarised the main results of the preparatory work among the group members to identify the most important issues to take into consideration when addressing the overall question of the FG.

After his presentation there was a breakout session to analyse and discuss which are the main management issues and concrete management objectives (problems or opportunities) in the frame of different farming systems based on permanent grasslands. This session complemented the work done during the preparation of the meeting by the group members and focussed on productivity and resource efficiency in management of permanent grasslands.

The results are gathered in annex 2 which includes the updated preparatory work and complementary comments and remarks made by the experts during the meeting.

At the end of the session all management objectives (in view of productivity) were prioritised by voting by the experts. Each expert selected the three issues to address the question of how to increase productivity of permanent grassland.

Day 2

Session 1

Based on the results of the previous day, the organizers presented the issues which had three votes or more and clustered and summarised them. The issues selected were:

- Improve quality of grass using legume
- Forage/protein self-sufficiency
- Better use of forage resources
- Grassland persistence and resilience
- Help farmers to manage grass production related to animal needs
- Overgrazing, stocking rates regulation
- Use the animal species and breeds adapted to physical conditions of the farm
- Improve economic viability of natural grasslands with final product
- Benchmark pasture, Dry Matter production at regional and national levels

Farmers in the group made a short reflection on the issues with more votes. Overall they considered them quite important, although some needed a more detailed description to be relevant at farm level. Besides, there were other comments from the group:

- The topics are recognisable, but quantity should also be included. It could be rephrased as "Improve quality and quantity of grass and grass/legume".

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- In the topic "Better use of forage resources", a distinction between intensive and extensive prod systems should be made and the percentage of utilisation included.
- The issues are more or less general. The way they are handled will differ depending on the intensity of the farming systems
- Topics not discussed –nor selected-:
    - Lack of information, therefore importance of grassland is under estimated. Network to record yield and other parameters. Remark: it may be included in the last topic
    - Under grazing is a bigger problem –compared to overgrazing- and is related to utilisation issue
    - Missing the profitability of the farm. Search for less time consuming activity's to increase profitability. Remark: it can be included in topic number five.
    - Marketing of grassland based product (relation to FG on HNV, short chains, promotion of nutritional value)

After that Alain Peeters presented the arable and livestock regions in EU according to Pflimlim *et al.* (2005) (see presentation as Annex attached). This classification uses the percentage of grasslands (including permanent) and maize as main criteria for defining eight main livestock regions in EU so it could be used as an alternative or complement for differentiating farming systems. It could be extended to EU-28 –currently applied to EU15-.

Comments:

- Could it be merged with environmental maps (Natura2000) in order to fine-tune the classification?
- Mediterranean and Nordic regions subtypes should be included.

Session 2

It consisted in a breakout session following the same approach of the previous day. The aim was to identify concrete management objectives (problems or opportunities) in view of biodiversity conservation, animal welfare&health, product quality and GHG balance. The group was divided in four sub-groups which rotated through all the four topics. Some potential approaches or techniques for dealing with the identified objectives were also pointed out.

The results are gathered in annex 2 which includes the updated preparatory work plus complementary comments and remarks done by the experts during the meeting.

At the end of the session all the management objectives were prioritised by voting by the experts. In this case both the selected issues from the day before and the ones discussed during this session were considered. This allowed that management objectives related to increase productivity, biodiversity conservation, animal health and welfare, product quality and carbon sequestration were

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considered at the same time. The question posed to the experts when doing the selection was: **Which concrete management problems/opportunities at farm level you think that need to be worked further for answering the overall question of the focus group -** how to manage permanent grassland in a way that combines profitability, carbon sequestration and biodiversity-**?**

Each expert selected three issues considered as more important from their perspective.

Again, the topics with at least three votes were selected. After this, and also by groups, each topic was fine-tuned in terms of definition and a preliminary outline was detailed to be further elaborated. Table below shows the first list of topics as it was selected (column 1) and how it was worked out further by the experts (column 2):

Topic	Rephrased topic
Increase quality and quantity of grass and grass legume mixtures using legumes	Increase quality and quantity of grassland by diversifying functional groups (e.g. legumes, herbs, shrubs, grass). • Yield, seasonal production, persistency. • Grass hybrids e.g. Festulolium • Quality components, carbon hydrates, protein, biochemical (condensed tannins, MG, etc.). Seasonal. • Sward characteristics. • Maximise protein utilisation: legumes and forbs (tannins) • Control unsown (weedy) species • Rhizobium, mycorriza • Legume and rhizobium diversity
Benchmark grassland, DM production at regional and national levels	Benchmarks • DM- yields (yearly, weekly) variation • Amount of species (flora) • Quality of grasses • Grazing period • For Lolium perenne classification of species (variety?) usage
Differentiation of grass based products, high market value	Effect/technical Traceability Implementation Differentiation: 1) concentrate/grass 2) within grass 3) fresh forage/conserved Document scientific 1 and 3 demonstrated and easy methods, lack of knowledge on 2. Even traceability possibility is up to consumers. Awareness. But is complex, origin, EMV 4) Connection of biodiversity, by products valorisation/landscape. 5) Ecosystem services and animal welfare Knowledge, traceability, implementation. Is this ok, could CAP contribute and what about the costs.
Roles of grassland mixtures based on different functional groups	See 1
Define grassland typology in relation to biodiversity and	Step by step: 1) Region 2) Ecological attributes of GL sites

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productivity	3) Use indicators for biodiversity (amount of species), biomass production
Life cycle assessment data (at global scale)	LCA: all aspects including biodiversity Compare carbon footprint from protein content in milk and meat and where the protein comes from. (grass instead of soya grain and sources that can be used for human consumption. Need of a right measurement methodology (software) for LCA assessment. Database on LCA parameters adapted locally
Increase resource efficiency (better growth rate, less fodder/kg product, lower calf mortality, etc.)	Increase resource efficiency Increase feed utilisation through maximisation of intake and increase the proportion of forage intake used for animal growth and lactation (thus reduced % used for maintenance.
Help farmers to manage grassland production vs animal needs	Focus on protein. Innovation: sensors, (virtual) electric fences, modelling, DSS. Exact measurements. Solutions related to 7. Learning process, operational groups, pilot farms.
How to evaluate biodiversity?	See 5

Those topics will be further elaborated as thematic papers ("mini papers") by sub-groups of experts.

Session 3

Quico Ónega presented the further steps to be followed by the FG (See presentation attached), specifically regarding the mini-papers (See document on Guidelines for mini papers). He also introduced preliminary framework for second meeting, to be probably held in November 2015.

Pilar Gumma closed the meeting thanking the participation and commitment of participants and pointing out again the main objectives and tasks of the Focus Group. She kindly animated the group experts to keep contact and to engage in the elaboration of the mini papers and the preparations of the second meeting later on.

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Annex 1

Updated agenda

Day 1: Thursday 26 June 2014

12:00	13:00	Lunch
13:00	14:00	Welcome and introduction to the programme by Quico Ónega (EIP-AGRI Service Point) Introduction round by participants: knowing each other
14:00	14:30	Introduction to the EIP AGRI concept and framework of focus group by Pilar Gumma (DG AGRI) Introduction to Service Point activities by Remco Schreuder (EIP-AGRI Service Point) Introduction to the whole process, roles and way of working by Quico Ónega (EIP-AGRI Service Point)
14:30	14:45	Q&A
14:45	15:05	Presentation of the starting paper, and main aspects from preparatory work by Koldo Osoro (EIP-AGRI Service Point)
15:05	15:20	Coffee break
15:20	16:20	Breakout session (I) in three groups: Discussion of farming systems and main management issues identified; identification of gaps. Focus on profitability
16:20	17:35	Breakout session (II): Completing and defining management objectives (problems/opportunities) towards efficiency and profitability
17:35	18:05	Plenary review and discussion of work done so far: Prioritization of concrete management objectives Which management issues need to be worked?
18:05	18:20	Closing of the day: evaluation, intro agenda to next day, practicalities
19:00		Dinner

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Day 2: Friday 27 June 2014

08:30	8:45	Intro to the day: agenda and working methods
8:45	9:30	Breakout session (I): Identification of management objectives towards enhanced animal health and welfare and product quality
9:30	10:15	Breakout session (II): Identification of management objectives towards maintenance of biodiversity and better carbon footprint
10:15	10:45	Coffee break
10:45	11:15	Plenary review of information gathered so far:
		Prioritization of management objectives for answering the overall question of the focus group
		Which management issues need to be worked further? Fine tuning and outline.
11:15	11:50	Discussion, evaluation and further steps
11:50	12:00	Closing
12:00	13:30	Lunch and networking
		Departure

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Annex 2

Attached as separate document

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Annex 3

List of topics for mini-papers

Define grassland typology in relation to biodiversity and productivity

Benchmark grassland, DM production at regional and national levels

Increase quality and quantity of grassland by diversifying functional groups (eg. legumes, herbs, shrubs, grass).

Increase resource efficiency (better growth rate, less fodder/kg product, lower calf mortality, etc.)

Help farmers to manage grassland production vs animal needs

Differentiation of grass based products, high market value[1]

Life cycle assessment data (at global scale)

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Annex 4

List of participants in the meeting

Name	Surname
John	Bailey
Jeanet	Brandsma
Juan	Busqué
Martin	Elsaesser
Piotr	Goliński
David	Gomes CRESPO
Alan	Hopkins
Sophie	HULIN-BERTAUD
Arno	Krause
Vibeke	Lind
María Rosa	Mosquera-Losada
Katrin	Noorkõiv
Michael	O'Donovan
Alain	Peeters
Inger	Pehrson
Giovanni	Peratoner
Claudio	Porqueddu
Lavinia	Raducescu
Dirk	Reheul
Agnes	van den Pol-van Dasselaar
Pilar	Gummá
Gaetan	Dubois
Koldo	Osoro
Remco	Schreuder
Quico	Ónega

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Annex 5

References proposed by experts as background documents

Biala, K., Terres, J., Pointereau, P. and Paracchini, M. (2008). Low Input Farming Systems: an Opportunity to Develop Sustainable Agriculture Proceedings of the JRC Summer University - Ranco, 2-5 July 2007. OPOCE (**download**)

Hopkins, A., Gustafsson T., Bertilsson J., Dalin G., Nilsdotter-Linde, N. and Spörndly, E.(Eds.) (2008). Biodiversity and animal feed. Future challenges for grassland production. Grassland Science in Europe. Vol-13. Uppsala (Sweden) (**download**)

Peeters, A., G. Beaufoy, R.M. Canals, A. De Vliegher, C. Huyghe, J. Isselstein, G. Jones, W. Kessler, A. Kirilov, M.R. Mosquera-Losada, N. Nilsdotter-Linde, G. Parente, J.-L. Peyraud, J. Pickert, S. Plantureux, C. Porqueddu, D. Rataj, P. Stypinski, B. Tonn, A. van den Pol-van Dasselaar, V. Vintu, R.J. Wilkins, 2014. Grassland term definitions and classifications adapted to the diversity of European grassland-based systems. Grassland Science in Europe 19: 743-750.

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	Overall goal: *Increased efficiency and productivity*			
Permanent Grassland category for which this is relevant	**Management issue**	**Concrete <u>problem</u> tackled or <u>opportunity</u> addressed**	**Description of the practice/technique/approach**	**Potential Source for complementary information (it could be a research or innovation project, a webpage, a publication, etc..)**
	Grazing, cut/silage, breed, and seeding	Forage/protein self-sufficiency	Optimum grazing technique and forage conservation techniques. Stocking rate adapted to grassland production potential. Breeding and/or use of livestock breeds and strains that are able to ingest high amount of green forage Breeding and/or use of double-goals breeds instead of hyper specialized breeds Maximum use of legumes in permanent and temporary grasslands Strategic use of concentrates instead of 'security' levels of concentrates = grass first strategy Maintaining permanent grassland forage quality and quantity at levels that minimize the amounts of supplementary feed required to maintain production	FP7 project: MultiSward
	Grass Species	How to improve permanent grassland	Tendency new grass species better production compared to permanent grassland (depending on regions)	
	Use of better grass varieties	More winterhardiness	Selection of more and better plants	Plant breeding
	Better sward composition	Avoiding of *Poa trivialis*	Reduction of soil pressure by using adapted machinery; avoiding of too high fertilizer rates	Knowledge transfer to farmers by better information technics., f.e. (www.gruenland-online.de)
	Better sward composition Without toxic plants	Avoiding *Colchicum autumnale, Common ragwort, Rumex obtusifolius, Pteridium spec*.	Increase of intensity by contemporary maintenance of botanical quality of flower rich meadows	Some research needed; knowledge transfer; increase of animal health by avoiding of feeding of toxic plants
	Grazing	Length of grazing season and amounts and quality of forage vary during the season - often not matched to demands of the production system	Improve forage resources by management to enable grazing of quality feed over longer periods. Integrate use of lower feed value grassland (that may deliver other ecosystem services) with grassland of improved high feed value to improve overall utilization of farm resources. Quantify grazing season length and how can it be increased at farm level. Identify the level of grass utilization on farms. New research innovation on calculation of grazing season lengths and grass utilization at farm level	
		Encroachment and disappearance of cultural landscape	Targeted definition of animal load to prevent encroaching	
	Grazing	Monitor location, health/sexual status and activities of livestock and forage status (productivity: production & quality) of plant communities. The aim is to couple nutritional requirements and forage availability. Try to replace/complement in what is possible the tasks performed by traditional shepherds.	Livestock: Sensors attached to animals (electronic and GPS devices) to trace activity and location, temperature, oestrus, health indicators. Geofencing (virtual fencing) Plants: Field sensors to track automatically soil temperature & humidity. Remote sensing to classify plant communities and track forage productivity/biomass	FP7 project etrack: http://www.project-e-track.eu/ European Transnational Programme POCTEFA: http://www.agripir.com/es/e-pasto/que-es
	Grazing	Higher attention for outdoor grazing.	Due to higher payments of milk from cows with outdoor grazing. More interest for grassland production specific for grazing. Also information from Ireland and New Zealand is used.	Amazing grazing: **http://www.amazinggrazing.eu/nl/**
	Grazing	New knowlegde Knowledge transfer	Grassland production and outdoor grazing are getting now higher priority on the agenda. Still concern how to pass the knowledge to the new generation.	New projects are getting started.
	Grazing	Stocking rate : Sustainable grazing	Adequate stocking rate for pigs/horses and dairy cows	projects and papers
	Grazing / Cutting hay/silage optimization	Awareness and better knowledge of permanent grassland diversity and their associated services at different spatial scales	Adaptation of the foraging practices using managing tools based on the identification of the permanent grasslands diversity. These diversity is linked to the altitude, farming management, fertilization and soil hydromorphism criteria	Program PRAIRIES AOP www.prairies-aoc.net/ . Tools addressed for Massif Central Region but methodology could be transposed to other areas
	Silvopasture	Woody vegetation us	Type, age, density, tree management to promote grassland production, animal production (strategic use of trees as forage)	Projects and papers
	Cutting / Forage quality	Low farmers' awareness concerning forage quality; costs of forage analyses	Provide the farmers with information about potential forage quality depending on cutting time, meteorology and site characteristics by means of user-friendly, low-cost, ICT-based tools	http://www.laimburg.it/en/mountain-agriculture/1903.asp
	Seeding / Fertlization	Nutrient self-sufficiency. Conflict between production + carbon sink and biodiversity when using fertilization	High levels of legumes in permanent and temporary grasslands. Reduction of mineral fertilization. Choice of optimum application dates and methods by slurry. Agro-forestry when possible. Optimum use of organic fertilizers	FP7 project: MultiSward. Description of possible legumes and change of cutting systems
	Higher nutrient efficiency		Reduction of mineral fertilization and use of legumes; choice of optimum application dates and methods by slurry	Description of possible legumes and change of cutting systems
	Fertilization	Initial fertilization	Fertilizaation date	projects and papers
	Fertilization	Organic fertilization: Date/dose/type of organic fertilizer/mangement of fertilizer	Date/dose/type of organic fertilizer/mangement of fertilizer	projects and papers
	Cultivation / renovation	Improving supply of forage during vegetative season	Using phenologically different cultivars within one species in the mixture	Goliński et al., 2008.
		Receiving more stability of the botanical composition after sowing of the mixture	Using multi-species mixture for establishing and renovation of grassland	
		Improving yield and fodder quality without negative effects on environment	Using effective and ecologically friendly methods of sward renovation (e.g. overdrilling on organic soils)	Wachendorf and Goliński, 2006; Goliński et al., 2007.
	Bioenergy production	Energy self-sufficiency	Bio-gas from slurry Biomass production from linear elements (plot margins): hedges, SRC,… Silvopastoral systems with Populus	
	Conserved forage.	Periods of nil or limited grazing frequently are filled with other feeds (maize or concentrate). Providing conserved forage of high feed value to minimize use of maize and concentrates	Improved utilization of conserved permanent grassland as quality silage (through improved knowledge and extension) in order to embed the seasonal quality attributes of grassland resources Haylage role in some regions	
	Weed control	Viable, affordable solutions for farms relying only on mechanical weed control	i.e. development of devices for targeted mechanical weed control and reducing labour input	
	Weed control	Control of invasive species	Use small ruminants, beef cattle and/or horses to stop diffusion of invasive plants. Machinery could also help alone or combined with grazing	
	Weed control	Increasing problems with certain species (e.g. docks, bracken and *Juncus*) especially where pesticides are not allowed	Use of 'cleaning' forage species like Lucerne and Italian ryegrass in temporary grasslands Mechanical weeding when possible (e.g. *Rumex*, *Cirsium*)	

			Composting of farmyard manure when risk of weed seed dissemination Use of mixed grazing	
	Machinery	Using machineries for mowing and removing scrubs potential negative impact on biodiversity.	An alternative will be to use small machineries which are not sagging the soil and give opportunity for biodiversity (reptiles, birds, amphibians) to search for alternative habitats. Reduction of soil pressure by using adapted machinery	http://www.fundatia-adept.org/?content=lifeplus_whatwedid&news_id=&set_lang=ro. Knowledge transfer to farmers by better information technics., f.e. (www.gruenland-online.de)
	Production – economy - biodiversity	Conflict between EU-rules for environmental support and how farmers want to manage their semi natural grasslands with trees and bushes		
	Resource efficiency	Farmers lack of reliable, rational information about changes in profitability depending on production intensity (i.e. LU/ha, milk production)	Decisional support to calibrate milk production intensity and use of livestock manure: i.e. user-friendly, low-cost, ICT-based tools for simulating farm costs depending on management issues Goal=profitability <> production level	
	Products / Produce Products / Produce	Production cost reduction	Milk and meat production based on grass for reducing concentrate use. Optimum grazing and grass conservation techniques for reducing concentrate use . Use of legume for decreasing nitrogen fertilizers Input purchasing cooperatives	FP7 project: MultiSward
		Income resilience	Strategy of production cost reduction based on grass. Short marketing chain. Diversification. Quality products sold at high price Marketing and purchase cooperatives	FP7 project: MultiSward
	Knowledge transfer	Transfer knowledge across countries	ECIP. European Cattle Innovation Partnership. Farmers and representants of dairy boards from 9 different countries want to work together on different subject.	http://www.scar-cwg-ahw.org/index.php/livestock-sectors/cattle/
Silvopastoral and scrubs	Grazing	Adapted grazing and re-use of marginal land	Support of goat shepherds in woodlands and matorral for shrub and fire control	
Silvopastoral and scrubs	Grazing in Oak wood pastures	Natural replacement of oak (*Quercus robur* and *Q. petraea*) by beech (*Fagus sylvatica*) has been related recently to grazing abandonment by large herbivores (cows and horses).	Promote moderate grazing by cows, horses in order to increase needed light gaps for oak saplings development, while maintaining thorny shrubs acting as protection against herbivory. Accept oak woodlands as admissible for CAP grants, but under an adequate grazing plan	Vera et al, 2006 See also several manuals by Natural England or Scottish Natural Heritage.
Improved vegetation patches in areas dominated by low nutritive and productive pastures	Perform an adequate grazing schedule of the improved areas	In free-ranging situations, especially with horses, overgrazing of the improved areas will diminish its productivity and finally change its botanical composition to less valuable species (e.g. from *Lolium perenne* to *Agrostis capillaris*)	Electric fencing can be easy with large animals (cattle/horses), but less so with goats and sheep. Virtual fencing could be an option to investigate	
Natural grass vegetation and scrubs	Grazing	Improving sward/vegetation utilization rate	Mixed grazing of suckler cows and small ruminants	Nowakowski et al. 2000
		Better utilization of forage resources	Optimizing the stocking rate on the grazed area	Goliński et al., 2008
		Preventing overgrowth of open landscape in mountains by forest	Restoration of grazing on mountain pastures using small ruminants	www.owcaplus.pl
		Improve feed quality	Use different methods to promote species of feed quality and biodiversity. Species like *Deschampsia cespitosa*, *Anthriscus sylvestris, Filipendula ulmaria* are of interest in scrubs/scrubs + herbaceous pastures .	
		Supervision of grazing animals in big paddocks with natural vegetation too time consuming.	GPS-sender on one or more animals in the herd or other electronic tools.	
		Better use of dairy calves for beef production for better economy and reduce carbon footprint	Use sexed semen in dairy herds for dairy heifers and beef semen for 30-50 % of the cows. Best combination of breeds and feeding/management for cross breed heifers and steers?	
Natural grass vegetation and scrubs	Grazing / Machinery	Reopen abandoned areas, maintain biodiversity, control invasive plants	Use small ruminants, beef cattle and/or horses to stop invasive species. Use of machinery alone or combined with grazing	
Semi-natural grasslands	Grazing	Better utilization of forage resources	Extended grazing season of suckler cows or winter pasturing of suckler cows	www.multisward.eu, Opitz et al, 2006a; 2006b; Goliński et al., 2007, 2013
Semi-natural grasslands	Livestock breeds	Improving sward/vegetation utilization rate	Selection of local breeds or introduction of new one for specific site conditions	Chodkiewicz and Stypiński, 2011; www.multisward.eu,
Improved grasslands	Grazing	Enhance sward intake of grazing animals	Introduction of legume and herbs into pasture Topping where possible	www.multisward.eu
Improved grasslands	Breeds	Increasing pasture sward in feed diet of dairy cows	Promotion of crossbreeds between HF and pasture breeds with medium [too high] level of milk production	www.multisward.eu
		Maximizing of grazing in beef and sheep production	Using of breeds adapted to pasture feeding	www.multisward.eu
Improved grasslands	Fertilization	Reducing N fertilization	Introduction of legume species into sward / technique/ timing	Goliński and Golińska, 2008; Suter et al., 2013
		Reducing of nutrient losses and better yielding by application of slurry	Using of injection and other application techniques preventing emissions into soil and air	
		Securing legume proportion after mixture sowing	Using of lime fertilizers (granular oxide) in specific sites / soil testing	Poozesh et al., 2010
Improved grasslands	Seeding	Reseeding levels too low in certain areas so perennial ryegrass and clover content of pastures might be increased	Need to distinguish grass to grass reseeding as opposed to crops to grass reseeding	
		Establishment of grassland (After sowing)	To improve techniques of grassland establishment: i.e. proper sowing date, sowing depth, inoculation, composition of mixtures, biodiverse plants…	
		Full reseeding methods involve too much labour and are costly and may not be carbon efficient	Develop new methods of minimal cultivation for reseeding	
		Selection of adequate species / and varieties	Permanent grassland containing variable proportions of high feed value species (Lolium and legumes) depending on soil fertility and management	
		Clover use is very low on farms, and needs to be addressed	Increase clover [and other legumes] content of swards used in livestock systems require full understand how to manage clover under grazing. Some new research is required to understand clover rates need to be sown to establish clover rich pastures and maintain their longevity	Better info for farmers needed
	MEchnization	Too high soil pressure, loss of structure	Suitable machinery	
Dairy cows in improved pastures	Fertilisation	Either over fertilisation or under fertilisation	ANCA (Annual Nutrient Cycling Assessment), in Dutch: kringloopwijzer. Aim is to efficiently use minerals / decrease losses to the environment	https://www.youtube.com/watch?v=1cnERj9fooc
Dairy cows	Fertilisation	Mineral emissions from fertilizers into groundwater / surface water	In balance fertilization. Fertilization in balance with the grass production. Result: more efficient use of available minerals & lower emission of mineral.	Instrument is developed to show the whole mineral cycle.

				ANCA – annual nutrient cycle assessment **http://www.archief.verantwoordeveehouderij.nl/producten/PZprojecten/Kringloopwijzer/Description%20Annual%20Nutrient%20Cycling%20Assessment.pdf** Improvement needed continuously
Dairy cows	Fertilisation	Production of milk within maximum P produced	More milk could be produced within boundaries maximum P-production in Netherlands (EU-regulation, derogation 2002). Only when minerals are produced more efficiently. Large project for implementation ANCA for all dairy farmers with P surplus.	ANCA implementation for all dairy farmers with surplus of P. 10.000 dairy farmers will start with ANCA 1 jan 2015. Most of them already using a earlier version of ANCA; which describes smaller part of the N & P cycle.
Dairy cows	Fertilisation	Low input manure and fertilizer	The input is too low for "normal/standard" agricultural practices. Implementation of Nitrogen Directive & Waterframe work gives maximum of N & P per hectare. Strategies to use available manure (and N-fertilizer) as efficient as possible.	http://www.bemestingsadvies.nl/ (in Dutch)
Dairy cows in improved pastures	Grazing losses	Grazing losses are too high	Faeces lead to grazing losses and thus reduce yield	"pasturewasher": **https://www.youtube.com/watch?feature=player_embedded&v=UZextingDdAzPEQ (still in idea phase)**
Dairy cows in improved pastures	Grass intake	Grass intake not known	Management by measurement: measurement of grass yields via several meters	Part of the project Amazing Grazing
Dairy cows in improved pastures	Grazing	Farmers lack knowledge	Farm walk, regular grazing emails (weidevakmail)	**http://www.stichtingweidegang.nl/activiteiten/farmwalk.html**;
Dairy cows in improved pastures	Grass use and robotic milking	Combination is experienced as being difficult	Automation (e.g. sensors: animals, grass)	www.autograssmilk.eu
Dairy cows in improved pastures	Reseeding	Improved grass varieties are needed	Continuous improvement of grass varieties	**https://www.plantum.nl/english**
Dairy cows in improved pastures	Balance people, planet, profit	Different interests for different actors	Sustainable Dairy Chain, an initiative to bring the actors together	**http://www.duurzamezuivelketen.nl/eng/content/objectives**
Dairy cows in improved pastures	Grazing management	Strip grazing most efficient grazing system, however, very time consuming	Virtual electric fence / auto border collie	**http://www.amazinggrazing.eu/nl/themas/auto-border-collie** (still in initial phase)
Dairy cows in improved pastures	Animal breed	Which cow fits which grassland production system the best?	Both between breeds and within breeds (cows with different behaviour)	http://www.amazinggrazing.eu/nl/themas/de-waarheid-van-de-koe
Grazed swards in NW regions of British Isles	Extreme poaching of grazed swards with increased frequency of extreme wet weather events during the growing season linked to Global Warming (with potential for reducing loss of aquatic biodiversity)	**Problems**: ▪ Loss of soil structure and sward growth potential ▪ Reduced animal utilization of herbage, reduced milk production per unit area ▪ Increased reliance on imported concentrate feeds for milk production **Opportunities**: ▪ Prevention of sward spoilage by trampling and excreta deposition ▪ Prevention of soil structure damage and reductions in sward productivity and need for appreciable investment in sward rejuvenation (up to € 600/ha). ▪ Considerably improved utilization of grass DM for milk production – minimum spoilage losses ▪ Reduced losses of ammonia-N with elimination of urine patches in fields. ▪ Improved efficiency of manure-N utilization for grass production by eliminating direct animal deposition to swards and instead applying all manure using trailing shoe spreading. ▪ Reduced potential of P loss to aquatic ecosystems through reduced need for P-containing concentrate feeds. **Possible Negatives/Risks**: ▪ Increased emissions of CO_2 with increased use of fuel for harvesting and transport of grass to housed animals – but these may be partially or fully offset against enhanced manure nutrient efficiency and the reduced need for fertilizer (with its CO_2 cost). ▪ Increased man-hours spent cutting and transporting forage and in cleaning and bedding barns. ▪ Animal welfare issues, lameness, less fit animals owing to lack of exercise, lower fertility – however quality housing could help overcome many of these issues	Introduction of full-time or part-time 'Zero-grazing' where fresh grass is harvested daily (using tractors and harvesters with low-pressure tires to prevent damage to soil structure), or when conditions are unsuitable for grazing, during the growing season and transported to cattle in well ventilated, spacious and clean housing	Haskel et al., 2006; Reijs et al. 2013
Dairy	Cooperation	How to get dairy farmers and dairy industry working on goals together.	The Sustainable Dairy Chain (Duurzame Zuivelketen) is an unique initiative in which the dairy industry and dairy farmers strive to make the Dutch dairy sector the world leader in sustainability. The Dutch Dairy Organisation (NZO) and the Dutch Confederation of Agriculture and Horticulture (LTO Nederland) have joined forces in the Sustainable Dairy Chain. Together, we are dedicated to generating future support from both the market and society at large. To learn more about how we intend to accomplish our goals, please have a look at this website and be inspired. Goals related to grassland are: outdoor grazing, more efficient use of minerals, biodiversity.	**www.duurzamezuivelketen.nl** Tools are to finance relevant projects, transfer knowledge to farmers, and if necessarily put in quality programs of dairy industry.
	Overall goal: *Increased efficiency and productivity while maintaining biodiversity*			
Permanent Grassland category for which this is	**Management issue**	**Concrete <u>problem</u> tackled or <u>opportunity</u> addressed**	**Description of the practice/technique/approach**	**Potential Source for complementary information (it could be a research or innovation project, a webpage, a publication, etc..)**

relevant				
	Grazing	Define the best combination of animals, with their density and timing (mixed or sequential), according to the mosaic of types of vegetation, soils and climate, and other management actions: fertilization, shrub clearance, fire, etc.	Use of simulation models that recreate the functioning of the climate-soil-plant-herbivore system. Choose from an wide array of simulated scenarios, the ones providing sustainable plant use and animal performance	Model SAVANNA (Coughenour, 1996) Model PUERTO (Busqué, 2006)
	Stocking rate	Sustainable grazing	Adequate stocking rate for pigs/horses and dairy cows	
	Grazed habitats included in the Habitats Directive	Many shrub dominated habitats, which need a certain amount/timing of grazing to persist may not be considered as pasture for CAP payments	Research on a clear definition of what is pasture and what is not pasture, which is not merely dependent on the plant species, but also on the type of herbivore and on the spatial disposition at the landscape level	Model SAVANNA (Coughenour, 1996) Model PUERTO (Busqué, 2006)
	Free-Ranging in areas of difficult access	Predation by wolves, dogs, bears..	Combination of several approaches/practices: Training and breeding of guard dogs. Automatic systems for safe night sheltering. Research on UAV guarding devices	http://www.agripir.com/es/e-pasto/que-es (within the European Transnational Programme POCTEFA: France-Andorre-Spain)
	Wild predators (wolf, bear, lynx, fox) and wild boar + birds (eagles…)	Farmers give up their grazing because of too many losses: Especially wolfs are causing many farmers big losses and it is a very "infected" and polarized debate between those who want to reduce the number of wolfs and those who want to increase the numbers. Measures: Electric fences which are very expensive and time-consuming to manage (to cut the vegetation under the fence) Radio transmitters (GPS) on wolfs so the regional authorities (or farmers) can follow the flocks and warnings can be sent out by SMS Protective hunting. It takes very long time to get a permission. Regulated populations (license hunting following directions from EU Commission) When it comes to wild boars it is necessary to stop feeding them in the forests (as the hunters and landowners who sell hunting want) and to increase the hunting over large areas (over borders) since the animals move fast and widely. It is necessary with a co-operation between many actors, a single farmer or hunter has no chance.		
	Hay meadows	Either abandonment or intensification changing from hay to silage making and from solid manure to slurry. Transformation implies a serious decline in biodiversity.	Need to follow a monitoring protocol to record periodically the state of this type of grasslands from a representative sample at regional/state level Research on the plasticity of the plant community to improve productivity through management without diminishing biodiversity. Research on possible benefits of this type of feed on the quality of animal products. Calculate lost profits of maintaining management with respect to intensification in order to implement a specific Agri-Env measures	Monitoring schemes (e.g. The European Grassland Butterfly Indicator. EEA Technical Report 11/2013)
	Fertilization	Initial fertilization	Fertilization date	
	Organic fertilization	Date/dose/type of organic fertilizer/mangement of fertilizer	Date/dose/type of organic fertilizer/mangement of fertilizer	
	Prevention of grassland abandonment	High production costs in disadvantaged areas (high labor input, climatic constraints)	Let farmers profit of the ecosystem services they provide by quantifying the benefits provided by ecosystem services as a basis for the understanding and acceptance by European citizens of targeted supporting measures for grassland farming	
	Increase biodiversity of livestock systems	Biodiversity is not well understood in grazing systems	grazing systems require benchmarking to identify the gaps and improvement to be made in the system.	
	Need to improve the productivity and profitability of grasslands through environment friendly concepts and low cost technologies, to fix populations, prevent abandonment and loss of cultural values.	1. Plant biodiversity important to enhance productivity and stability. Most EU sown grasslands based on 1- 2 spp./cvs., mainly grasses, and many natural grasslands have lost diversity. 2. Legumes are important to improve yield and quality at low cost. Current little use of legumes in EU should reversed. 3. Animal prod. syst. on grass. are accused of contributing to GHG emissions , particularly methane and nitrites. Grasslands can largely compensate that negative effect by sequestering considerable amounts of atmospheric CO2 in the soil. 4. Only incipient knowledge is available on this important matter. 5. Nitrogen is a key nutrient to increase pasture yield and quality. The synthesis of N fertiliz. is expensive and not environment friendly. Legumes are able to fix large quantities of symbiotic N through Rhizobium /legume association. 6. Phosphorous (P) is the most important nutrient for legumes, and many soils are very poor in soluble P. The fossil minerals, from which P fertilizers are obtained, are a limited and costly resource. However, there are various symbiotic plant/ arbuscular mycorrhiza / bacteria associations able to solubilize soil phosphates, making them available to plants. 7. The accurate use of fertilizers (sometimes also amendments) to increase grassland productivity is fundamental. Not many farmers are aware of this principle and often they apply fertilizers without taking in consideration neither the soil content of the various nutrients, nor the plant requirements.	1.Use biodiverse legume rich sown grasslands composed by 6 to 20 species/cultivars, of legumes, grasses and others, chosen according to average soil and agro-climatic conditions of the local. In order to assure an efficient symbiotic N fixation , the seeds of each legume species should be inoculated with effective *Rhizobium* strains. 2. For each soil/climate condition select cvs. of productive and persistent legumes/grasses/others, attending at the following characteristics: Vegetative and reproductive cycles, perennially and persistency, content of hard seeds, depth of the root systems, summer or winter dormancy, drought and/or water logging resistance, pest and disease resistance, and feed quality, particularly intake. This program should also: look for plants rich in condensed tannins (CT) and with lower capacity to produce methane in the rumen; evaluate compatibility among species/cultivars to be included in a mixture. 3. The above will require a program of plant breeding and selection which should start by characterizing and screening entries of pasture plants coming from existing germoplasm banks (e.g. FAO, ICARDA, nationals) or from new collections or other sources of genetic variability. The evaluation of the plant material will include their characteristics of adaptation to different soil and climate conditions. 4. Develop a program on soil/plant microbiology, with particular emphasis on the *Rhizobium*/legume symbiosis and on the plant/arbuscular mycorrhiza /phosphate solubilizing bacteria, in order to enhance N fixation and phosphate availability for grasslands. As a follow up of the above, develop practical and efficient methods of producing and using inoculants.. 5. Promote the use of soil analysis to accurately determine the content of nutrients in the soil and their evolution with time, in order to adopt a rational plan of soil fertilization/ soil amendments to match the nutrient requirements of grasslands.	A 4-5 years EU funded project on the mentioned matters, involving national or international R&D institutions and private companies dealing with pasture plants, biological N fixation and micro-organisms acting as plant growth promoters, would be useful to attain satisfactory results, contributing to save most of the European grasslands from abandonment, and thus keeping their important role in adapting and mitigating the effects of Climate change, maintaining biodiversity and landscapes, and, most important, provide economic gains to keep farmers in place.
Semi-natural grasslands	Fertilization	Reduce use of fertilizers	Search for alternative ecologically friendly fertilizers and for adjusted doses	
Semi-natural grasslands	Pesticides	Reduce use of pesticides	Search for alternative ecologically friendly pesticides and for adjusted doses to minimize application without risking production	
Semi-natural grasslands	Grazing, cutting	Receiving better ecological conditions for birds nesting	Prolonged cutting date of semi-natural meadows with biomass removing for bioenergy production	Goliński and Goliński, 2013; www.danubenergy.eu

Semi-natural grasslands	Grazing, cutting	Increasing of plant and animal species in grassland ecosystem	Continuous grazing system with low stocking density	Nowakowski et al., 2008
	Silvopasture	Woody vegetation use	Type, age, density, tree management to promote grassland production, animal production (strategic use of trees as forage)	
Improved ryegrass/clover pastures plus areas of marshland and natural meadows. *Dairy cows plus traditional cattle breeds.*	Enhancing both milk production and biodiversity conservation within dairy farms in NW regions of the British Isles	**Problem:** ▪ Incompatibility of intensive dairy production and biodiversity conservation – High milk production demands high yields of high quality forage from ryegrass (clover) swards receiving high nutrient inputs, whereas biodiversity (*plant, animal and insect*) conservation requires low nutrient inputs to multi-species swards of low productivity. Consequently, where intensive production is the focus, less productive meadows or marshy areas on farms tend to be cleared or drained to improve productivity – albeit often just marginally - or else simply abandoned to be overgrown with trees or gorse thereby loosing indigenous pasture biodiversity. **Opportunities:** ▪ Farms in NW regions of the British Isles often have areas of productive grassland alongside areas of less productive, meadows or marshland, there is opportunity for parallel systems of intensive and extensive farming to co-exist – but only if the agri-environment scheme budget in Pillar 2 could be used to prioritise measures which support biodiversity conservation on grassland farms, i.e. High Nature Value Farming **Possible Negatives/Risks:** ▪ TB transmission to traditional cattle from Badger populations in conservation areas ▪ **Without Pillar 2 budget support, it may not be cost-effective to manage conservation areas appropriately.**	Alongside high-input dairy farming on ryegrass/clover swards – with or without Zero-grazing practiced, traditional cattle breeds (e.g. Irish Moiled cattle, Red Devons, Sussex cattle, Aberdeen Angus and Hereford) which can thrive on a mixture of pasture species (*and help to control undesirable species such as rush*) can be kept on marshy or meadow lands for organic meat production and thus help to preserve meadow flower, bird and insect species by grazing and preventing overgrowth by rush, gorse or scrub Where badgers are present, vaccination of the local badger population would help to reduce the risk of TB spread to traditional cattle or to dairy herds	•Natural England Commissioned Report NECR078 •Avon Valley Grazing Project www.naturalengland.org.uk •http://www.wildlifetrusts.org/CAP •www.irishmoiledcattlesociety.com/files/-ine-rush...pdf •http://www.grasslands-trust.org/sites/default/files/files/Meadows.pdf
	Overall goal: Smaller Carbon footprint (+GHG emissions)			
Permanent Grassland category for which this is relevant	**Management issue**	**Concrete <u>problem</u> tackled or <u>opportunity</u> addressed**	**Description of the practice/technique/approach**	**Potential Source for complementary information (it could be a research or innovation project, a webpage, a publication, etc..)**
improved pastures used for grass silage cropping	Enhancing dairy production whilst simultaneously reducing GHG emissions per unit of milk produced (*Reducing the risk of N_2O emissions following application of manure and fertilizer N to cutting land)*	**Problem:** Following the removal of 1st cut silage crops cattle slurry and fertiliser N are often applied almost simultaneously to swards. Slurry, however, has a rich supply of carbon, which allows bacteria to convert fertiliser nitrate N to the potent greenhouse gas (GHG) nitrous oxide. Studies by AFBI have shown that applying fertiliser N at least 4 days after slurry application, when the slurry carbon has been absorbed by the soil, significantly reduces the amount of N lost as nitrous oxide	▪ Apply fertiliser N at least 4 days after slurry (manure) application, when the slurry carbon has been absorbed by the soil to significantly reduce the amount of N lost as nitrous oxide (N_2O)	Stevens and Laughlin (2001, 2002) http://www.dardni.gov.uk/ghgip-phase-one-report.pdf
Dairy cows on improved pastures + crops (Maize)	Enhancing dairy production whilst simultaneously reducing GHG emissions per unit of milk produced	**Problem:** High level of GHG emissions (largely methane – CH_4) per unit of milk produced **Possible Negatives:** Cultivation of forage Maize in NW Regions of British Isles is difficult owing to cool wet climate and can lead to enhanced N_2O and Nitrate emissions from soil in autumn.	▪ Improve forage quality and digestibility by better fertilizer management and shorter cutting intervals will lead to increased milk production per cow and reduced enteric CH_4 production per liter of milk produced ▪ Inclusion of forage maize in dairy cow diets will reduce enteric CH_4 production per liter of milk produced ▪ Increase in-heat (oestrous) detection efficiency through increased observation or investment in automated in-heat detection equipment, resulting in fewer (*not in-calf*) cows culled and shortened calving intervals resulting in lowered CH_4 emissions per litre of milk produced ▪ Selection of sires on production traits (e.g. milk yield, fertility, growth efficiency) can reduce GHG emissions by 1% per year per unit milk produced	Garnsworthy, 2004; Van Laar and Van Straalen, 2004; Jones et al., 2008
	Carbon footprint	Reduce carbon footprint and better economy	Combine beef production with production of bioenergy (*Populus* hybrids)	
Dairy cows on improved pastures	Lower ammonia output	Techniques too lower ammonia emission with application of manure. Direct injection into the ground is for permanent pasture difficult on peat and some periods for clay	Projects started for alternative techniques for example add water with manure application	
	Options mitigation, adaptation	Synergies & trade-offs	Best practices	www.animalchange.er
	Overall goal: *Livestock health*			
Permanent Grassland category for which this is relevant	**Management issue**	**Concrete <u>problem</u> tackled or <u>opportunity</u> addressed**	**Description of the practice/technique/approach**	**Potential Source for complementary information (it could be a research or innovation project, a webpage, a publication, etc..)**
	Parasite control	Increasing or persistent problems with parasites	Use of rotational grazing and tannin-rich plants (e.g. *Lotus*, *Plantago*, chicory, leaves of shrub and tree) / in combination with lower stocking rate	
	Control of paras Parasite control.	Increasing problems with parasites (*Fasciola hepatica*) with grazing along lakes, rivers, etc. There is an serious increase in		

	Conflict between production/animal welfare and biodiversity.	animals and herds infected with common liver fluke (*Fasciola hepatica*). It is sheep, beef cattle and dairy cattle. In an investigation recently (milk samples from 4-500 farms) 25 % of all dairy herds had antibodies and 10 % had decreased production because of the infection. It seems that a strategic and directed use of anthelmintics is the only way to handle the problem. It has been shown that disease eradication and/or vaccination are difficult. A mass use of anthelmintic is not sustainable due to the risk of development of anthelmintic resistance which is emerging globally in cattle parasites. The possibilities of grazing management strategies are also limited in areas where agro-environmental payments are available for maintaining biodiversity by grazing.		
	Health	Use of natural resources for animal health	Use of tannin-rich forbs/legumes/woody species by browsing trees and shrubs improving animal health	
		Health problems related to unbalanced diets and inappropriate productive demands	Balanced diet Reasonable level of production (see also parasite control)	
		Grazing has a number of key benefits to livestock, these are not fully acknowledged.	Major requirements to ensure all grazing benefits are to be understood and quantified	
Dairy cows	Health	Consequences for animal health with lower P-levels in feed.	The combined feed industry took the initiative to lower the P level in concentrates, for higher P-efficiency. In combination with lower P in grass. Farmers are concerned for animal health in relation to P.	**http://www.archief.verantwoordeveehouderij.nl/Producten/PZprojecten/CommissieBemesting/3%20CBGV%20themamiddag_Goselink%20v2.pdf** (= in Dutch)
	Overall goal: *Product quality*			
Permanent Grassland category for which this is relevant	**Management issue**	**Concrete problem tackled or opportunity addressed**	**Description of the practice/technique/approach**	**Potential Source for complementary information (it could be a research or innovation project, a webpage, a publication, etc..)**
	Product quality	Grazing is most environmentally friendly way to produce meat/ milk	Develop indices that can trace pasture produced products. Establish traceability of pasture produced meat and milk products.	
		Obtain high quality “green” products (milk, cheese, meat)	Promotion of grazing in animal feeding. Production of good quality meadow hay for animal feeding beyond the grazing season	www.prosafebeef.eu
	Increasing added value of mountain products	Production costs from disadvantaged areas (i.e. mountain regions) are higher than those from favorable areas	Providing sound links between grassland management, product origin and product quality as a basis for the marketing of authentic, regional premium products; establishment of a local network for producing and selling high-quality, regional products at a remunerative price	http://www.kovieh.com/de/ http://www.biobeef.it/deu/willkommen.html
	Expansion of herds and grazing platforms leading to increased time spent by animals and stockmen going to and from distant pastures	**Problems**: • Labor requirement and amount of time needed to move large dairy herds longer distances to grazing platforms. • Complexity of managing grazing for large numbers of cows and heifers. • Losses of nutrients on roadways etc when cattle are moved over large distances to grazing platforms. • Inaccessibility of grazing areas owing to necessity of crossing busy roads or simply distance. **Opportunities**: • Increased time for animals to commence forage consumption between milking instead of having to walk long distances to pasture. • Animals protected from wet cold conditions often occurring during grazing seasons in NW British Isles – leading to improved milk production. **Possible Negatives/Risks**: • Animal welfare issues, lameness, less fit animals owing to lack of exercise, lower fertility – however quality housing could help overcome many of these issues. • Increased man-hours spent cutting and transporting forage and in cleaning and bedding barns.	• Introduction of full-time or part-time ‘Zero-grazing’ where fresh grass is harvested daily (using tractors and harvesters with low-pressure tires to prevent damage to soil structure), or when conditions are unsuitable for grazing, during the growing season and transported to cattle in well ventilated, spacious and clean housing.	Reijs et al. 2013