Increasing the resource efficiency of permanent grassland: outcomes of an EIP-AGRI Focus Group

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Abstract

This paper summarizes outcomes of a focus group that examined resource-use efficiency of permanent grassland in the context of profitable utilization, taking account of trade-offs needed to deliver other ecosystem services. Resource efficiency is considered at the levels of (1) improved herbage production and quality; (2) improved herbage utilization; (3) improved livestock utilization to deliver higher product value; and (4) resource efficiency to improve ecosystem services. A range of farm-scale and system-scale measures and innovative actions are identified that have potential for realizing improved resource-use efficiencies.

Keywords: grass, production, utilization, biodiversity, carbon sequestration

Introduction

Focus groups of EIP-AGRI are temporary groups of experts (researchers, farmers, advisers, non-governmental organisations) brought together to explore practical innovative solutions to problems (http://ec.europa.eu/eip/agriculture/en/content/focus-groups). The EIP-AGRI permanent grassland focus group was established in 2014. Its objective is to identify and exchange knowledge and practices that allow increased efficiency and profitability in grassland management consistent with maintaining or improving biodiversity and carbon sequestration. Maintaining the area of permanent grassland is an important element in the greening of the Common Agricultural Policy. Permanent grassland in Europe is in decline due to (1) abandonment of areas unsuited to crops and where socio-economic factors and environmental conditions limit the profitable use of grassland-based farming; and (2) conversion of grassland to maize or arable crops on land which can be easily cultivated. These two changes impact on other ecosystem-service provisions of permanent grassland: its roles in carbon (C) sequestration and supporting biodiversity, and its contribution to cultural heritage and local economies associated with landscapes, recreation or tourism. This short paper, based on contributions of the focus group, summarizes aspects of resource-use efficiency of permanent grassland in the context of profitable utilization, with further consideration of the trade-offs needed to deliver other ecosystem services. Opportunities for potential improvement of resource efficiency of permanent grassland are considered in terms of four main categories.

Improving herbage production and quality

Herbage production and quality are highly variable between sites, depending on environment, management and sward composition. Land with low levels of dry matter production, that is insufficient in amount and feed value for economically viable livestock production, is most vulnerable to abandonment. Optimum net herbage accumulation requires that limitations to growth and herbage accumulation are addressed, e.g. by improving the efficiency of use of water, light, nutrients and forage species, consistent with the farm situation and environmental objectives, notably C sequestration and biodiversity. Improved forage production may be incompatible with other ecosystem services, but loss of permanent grassland through abandonment or cultivation to crops can have greater environmental consequences. A challenge is to achieve acceptable levels (for the farmer) of quality herbage while at the same time ensuring provision of

additional ecosystem services. Opportunities for achieving environmentally sound herbage productivity include grasses bred for production and C sequestration and use of well-adapted multi-species swards. Appropriate N-fixing legumes in multi-species mixtures can also benefit root development, reduce methane emissions and improve the biodiversity relative to simple grass swards. However, the use of N-fixing legumes may be incompatible with grassland biodiversity if swards of conservation status are dependent on low nutrient levels.

The focus group proposed the following to address resource-use efficiency in forage production: (1) a need for site-specific soil information to help overcome edaphic limitations on plant growth potential, especially of productive species in the sward, (2) a need for information on forage resources to determine the opportunities for improvement of sward quality and growth potential appropriate to the site, and (3) identification of issues of incompatibility between sward improvement and local agri-environmental requirements.

Improving the efficiency of utilization of herbage from permanent grassland

Improved resource-use efficiency requires a high proportion of the metabolisable energy (ME) value of grass biomass to be converted to utilized ME (UME, energy for growth, lactation and maintenance); thus, losses due to senescence or spoilage should be minimized. Seasonal herbage growth and accumulation seldom match the seasonal demands of livestock. This can result in overgrazing and/or seasonal underutilization, with potential environmental damage and financial consequences for producers. A good combination of grazing with forage conservation is needed to increase resource efficiency and profitability. The focus group identified several examples of practices to address these limitations, including: (1) in Mediterranean rain-fed permanent pastures, grazing may be extended throughout the year, with conserved late-spring forage from crops specially grown for that purpose, or from irrigated permanent pastures, to optimize yield and quality; (2) utilization of pasture (often biodiverse) of low feed value in conjunction with areas of high feed value, e.g. the 'HFRO two-pasture' system in upland UK (Eadie, 1978) and later variants of this system under Mediterranean conditions; (3) use of sward height guidelines and adjustment of stocking rates to the average growth potential of a pasture to improve the efficiency of pasture herbage utilization, taking account of the important trade-off between growth and utilization.

Efficiency of utilization of grassland to convert utilized metabolisable energy into profitable output

This is the pivotal stage for producers in terms of efficiency of resource use from permanent grassland. The proportion of UME used for animal maintenance should be minimized. The focus group listed several resource inefficiencies in utilization, including: periods of slow growth and seasonal weight loss, periods of non-lactation in female livestock, high fodder intake per kg product, and high calf/lamb mortality. The focus group identified potential opportunities: (1) use of high-sugar forages to support utilization of the crude protein of legumes in the rumen, (2) strategic use of other protein sources to support low feed value forage, (3) use of species (e.g. lotus, sainfoin) in grassland swards beneficial to animal health and protein utilization, (4) reduced use of single-suckling cows, (5) reducing the period when dairy cows are not in lactation (by improved oestrus determination), (6) reducing losses of animals or animal products due to disease.

Resource efficiency that contributes to carbon sequestration and biodiversity

Here we consider how improving efficiencies of resource-use interacts with environmental objectives and the need for trade-offs. Soils and below-ground organic materials (roots, soil invertebrates, etc.) represent an important C pool that has potential to be increased to offset increasing atmospheric CO_2. Evidence suggests that permanent grassland contributes to C sequestration but this varies with composition, yield, soil and climate (conversely, conversion to arable cultivation reduces soil C). The effect of grazing on

soil C is complex; whether soil C increases or decreases in response to grazing may depend on severity, selectivity, effects on root biomass and extent of faecal returns (Bardgett and Wardle, 2010). Normally, mown grasslands are less efficient in promoting soil C sequestration than grazed pastures (Laidlaw and Sebec, 2012). Abandonment of permanent grassland might lead to short-term increased C sequestration but can greatly increase the likelihood of wildfires and C losses. Moderate grazing pressures should therefore be maintained.

Permanent grasslands are of particular value for supporting biodiversity, e.g. Mediterranean grasslands (a global biodiversity hotspot), and temperate grassland hay meadows. Improving economic profitability by changing the botanical composition and/or edaphic conditions affects biodiversity. There are trade-offs between agricultural and environmental goals, but sometimes there are synergies. In Mediterranean zones, biodiverse legume-rich sown permanent pastures are efficient in increasing pasture productivity and soil fertility, while also contributing to ecosystem services including capacity to sequester CO_2 in the soil, drought survival and erosion control (Cosentino *et al.*, 2014). More generally, intrinsic properties of regional types of permanent grassland can be utilized through valorisation of grassland products – thereby raising the economic and social efficiency of permanent grassland.

Innovative actions

The focus group identified potential actions, including: (1) greater use of N-fixing diverse legumes in permanent grasslands, especially where legumes are currently not well used; (2) increased use of nutritionally beneficial plants that might increase the value of pastures to support productive healthy animals; (3) attention to the role of soil microorganisms in phosphorus availability, due to its importance for legume growth (noting research requirements on this topic). The group also identified other challenges for permanent grasslands that could require innovative actions. These included developing improved mixed grazing systems; animal health and mortality problems due to parasites and predators; better use of silvo-pastoral systems for meat, bioenergy and biodiversity on the same area; and labour implications of new technology for supervising animals on large areas.

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