



Ecosystem services of permanent grasslands

- **AUTHORS:** Stanislav Hejduk, René Schils and Paul Newell-Price
- **DESCRIPTION:** Permanent grasslands cover around 34% of the European Union’s utilised agricultural area and are vital for a wide variety of ecosystem services or ‘public good’ that are essential for our society. Over recent decades, the permanent grassland (PG) area in Western Europe has declined. For example, in the EU-6 countries, permanent grassland losses have been estimated at about 30% between 1967 and 2007
 - ✓ Nevertheless, grass is the cheapest high-quality feed sources for efficient ruminant meat and dairy production and should be the dominant feed within sustainable livestock grazing systems. In addition to the provision of feed, permanent grasslands sustain a broad range of additional ecosystem services (ES), including climate regulation through carbon sequestration, regulation of water flows (e.g. flood control, underground water recharge) and quality, cultural values, protection against erosion, and pollination of food crops

Ecosystem service	Example of indicators
Provision of animal feed	Dry matter yield, crude protein content, digestibility
Biodiversity	Presence of threatened species; other plant, invertebrate (worms, insects, spiders etc.), bird and mammalian species dependent on or supported by PG
Climate regulation	Emissions of CH ₄ , CO ₂ , N ₂ O, carbon sequestration
Water purification	Content of nitrates, ammonium ions, phosphates, pesticides, faecal indicator organisms in surface, coastal and ground waters
Erosion and flood control	Soil bulk density, water infiltration rate, ground cover, penetration resistance, hydraulic conductivity, aggregate stability
Pollination services	Presence of nectar producing flowers, sequential cutting, nesting sites for wild pollinators
Aesthetics & Recreation	Presence of flowers, grazing animals, old solitary trees

Fig.1: List of the main ecosystem services and their indicators provided by permanent grasslands



Ecosystem services of permanent grasslands

- RATIONALE:** The above-mentioned ecosystem services are vital for a functioning society and human well-being. Most people take them for granted and do not realize that without permanent grasslands, ensuring biodiversity, clean water, healthy soil and attractive landscapes would be challenging, costly and in some cases impossible. The value of non-provisioning services (positive externalities) have much higher value for society than the provision of food, wool or hides, but farmers have no or limited income opportunities for providing them (there is no market price). The delivery of non-provisioning ecosystem services is now the main reason for the payment of subsidies to farmers.



Fig.2: Grasslands provide food for humans via livestock grazing but also protect the soil from erosion and create an open landscape attractive for recreation (photos S. Hejduk).

- MECHANISM OF ACTION :** Most farmland in the world is covered by grasslands (including steppes, savanas, prairies, velds and pampas). In Europe, permanent grasslands are typically on shallow, stony, sloping or wet soils prone to flooding or in areas that are too cold and rainy, where cropping is not possible or profitable
 - ✓ As for providing food for humans, grass forage is an intermediate product. Thus, livestock are used to transform forage into meat and milk. In many areas, grassland-based ruminant farming provides a livelihood, social networks, cultural heritage, identity and purpose for the whole of the local community
 - ✓ In species-rich PG, it is possible to find as many as 116 vascular plant species in an area of 25 m², and an order of magnitude more invertebrate species. These are therefore the most species-rich habitats in Europe, and there are many important bonds between individual species that ensure high ecosystem resilience
 - ✓ Although ruminants release methane during enteric fermentation, grassland farming can lead to the sequestration of large amounts of carbon in the soil and the preservation of carbon stocks (thereby mitigating increases in carbon dioxide concentrations in the atmosphere)



Ecosystem services of permanent grasslands

- **MECHANISM OF ACTION (cont.):**

- ✓ Nevertheless, overall, ruminant milk and meat production contributes to climate warming, particularly where the number of ruminant livestock is increasing, and mitigation actions are needed to reduce their impact
- ✓ Ruminant livestock systems that rely on grass as the main source of fodder not only deliver a wide range of ecosystem services but also tend to have a lower overall land and carbon footprint than systems reliant on other sources of fodder
- ✓ The quality of groundwater percolating through grasslands is much higher compared to water under arable land due to longer growing season of the grass, its extremely dense root system and high nutrient demands. Grasslands on lower slopes can also intercept surface runoff from arable land and allow it to infiltrate, thereby protecting waterways and reservoirs from sediments, nutrients and pesticides
- ✓ Well-managed PG has a high water infiltration capacity, a network of dense roots in the soil, a healthy and diverse earthworm population and year-round soil cover, thereby protecting the ground surface from erosion and reducing the risk of flash flooding
- ✓ Grasslands containing flowering legumes and other dicotyledonous plants produce nectar and high quality pollen, and allow insect pollinator populations to develop. Unfortunately, this does not apply to intensively used grasslands which are typically cut before forbs flower
- ✓ Many people are attracted by areas with flowering meadows, especially if they contain orchids or other endangered species. Although ruminant livestock production has received some criticism due to related greenhouse gas emissions (e.g. enteric fermentation), tourists mostly prefer landscapes with grazing animals as they make the countryside more attractive. Grasslands with grazing livestock and scattered trees are particularly valued as a relaxing environment that enhances human well-being



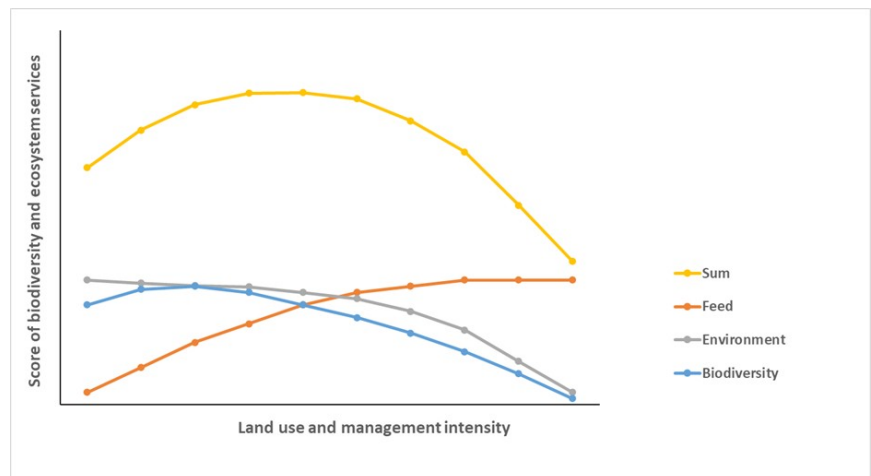
Fig.3: Grasslands provide vegetation cover throughout the year and are therefore very effective at capturing nitrates and other pollutants in percolating water (on the left). Species-rich grasslands contain a higher number of plant and invertebrate species compared to any other European ecosystem (photos: S. Hejduk)



Ecosystem services of permanent grasslands

- POTENTIAL FOR APPLYING THE MANAGEMENT OPTION:** Multiple ES are most effectively delivered through a moderate intensity of grassland management. Either extreme of management (abandonment or over grazing/over fertilising/frequent cutting) leads to reduced multifunctionality
 - When permanent grasslands are compared between biogeographic regions in Europe, it is clear that different ecosystem services are not given the same priority in all regions, and specific agricultural practices in terms of their action and timing do not necessarily have the same effect on ecosystem services in different environments
 - This makes it challenging and in some cases inappropriate to provide general management recommendations
 - However, in general, a moderate intensity of grassland management (fertilising, cutting frequency, stocking rate at grazing) tends to provide the greatest range of ecosystem services, including biodiversity (Fig. 4).

Fig.4: Conceptual relationship between grassland management intensity and level of some ecosystem services



- SUPPORT:** PG management to enhance ecosystem services is supported by European Commission agri-environment schemes, as compensation for any additional management requirement and a reduction in forage quantity and quality (i.e. income foregone)
 - Unfortunately, some farmers perceive that introducing PG management practices to deliver non-market ecosystem services automatically results in reduced productivity, making farming more complex and labour intensive, and reducing farm competitiveness and quality of life. It is doubtful that the desired change in PG management can be motivated solely through the limited economic premiums established by agri-environmental policies in their current form
 - Unfortunately, the full potential for permanent grasslands to deliver multiple ecosystem services as part of a livestock or mixed agricultural production system is not well appreciated by farmers and citizens.



Ecosystem services of permanent grasslands

Example of good practice:

An example of a region with moderate/low intensity management of multifunctional permanent grasslands is the White Carpathians protected landscape area, on the border between Czech Republic and Slovakia. There is a large area of semi-natural, high nature value grasslands managed mostly by organic and low input conventional farmers. These grasslands provide forage for beef cattle and horses, and simultaneously harbour hundreds of plant species, protect soil against wind and water erosion, provide clean sources of potable water, and sequestrate/store large amounts of carbon to the soil. It is also an attractive area for tourists as the open landscape provides beautiful scenery and many people organise their trips to this area to see the flowering orchids.

However, the permanent grasslands are endangered by a combination of climate change and overly extensive management. At some sites, droughts, in combination with a ban on fertilisers and sward improvement measures, have had a negative effect on plant diversity, soil hydrophobicity, forage yield and forage quality.



Fig.5: White Carpathians meadows create a landscape attractive for recreation with many endangered plant and insect species (photos: S. Hejduk)