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Grazing for carbon

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Abstract

The potential of grasslands as a carbon (C) sink in Europe is large despite the number of uncertainties related to the effect of grazing systems on C sequestration. The EIP-AGRI Focus Group (FG) 'Grazing for Carbon', a temporary group of 20 selected European experts from research and practice, shared knowledge and experience from different disciplines on the relationship between grazing and soil C. The FG explored grazing management strategies, drivers and barriers for different grazing systems, as well as tools and business models to support them successfully. The overall aim was to identify how to increase the soil C content in grazing systems. Six priorities were addressed: the effects and trade-offs associated with approaches to sequestering C in different grazing systems, the effect of grazing on C and soil nutrients, the role of plant mixtures and native species, general guidelines for optimal grazing, effective monitoring of soil C as a tool for soil quality evaluation and incentives to promote the adoption of grazing systems to optimise soil C content.

Keywords: carbon, focus group, grasslands, grazing, management, sequestration

Introduction

It is commonly understood that the potential of grasslands as a carbon (C) sink is large and promotes soil quality improvement by improving the organic matter content and thus soil physical properties. However, there are several, conflicting views with respect to the effects of grazing systems on C sequestration in Europe (e.g. Thornley and Cannell, 1997). It is currently unclear to what extent grazing systems can contribute to C sequestration and related greenhouse gas emission mitigation. The aim of this study was to explore the different existing grazing management systems with their respective drivers and barriers, and tools and business models to support them successfully. One way to establish and assess innovative grazing strategies that are promising for C sequestration is through multi-stakeholder approaches that unite experts from practise and from science.

The EIP-AGRI FG 'Grazing for Carbon' was established to assess how to increase the soil C content in grazing systems. Focus groups are temporary groups of 20 selected experts from research and practice throughout Europe. The experts' views and experiences were summarised into six thematic priorities: (1) the effects and trade-offs associated with approaches to sequestering C in different grazing systems; (2) the effect of grazing on C and soil nutrients; (3) the role of plant mixtures and native species; (4) general guidelines for optimal grazing, to be adapted and adopted in different parts of Europe; (5) effective monitoring of soil C as a tool for soil quality evaluation, and (6) incentives to promote the adoption of the best grazing systems. The topics were analysed through the drafting of 'mini-papers' encompassing a brief review of literature, ideas for operational groups (to be funded by rural development programs), research needs from practice and further developments.

To improve understanding of strategies towards better soil C management in grazed grasslands, a synthesis of empirical data of grazed grassland experiments conducted by the FG found sequestration to be 0.8 ± 0.2 Mg C $ha^{-1}yr^{-1}$ (rates ranging from losses to gains of more than 1 Mg C $ha^{-1}yr^{-1}$ (e.g. Soussana *et al*., 2010; Conant *et al.*, 2017)). Despite this, there is little information on region-specific appropriate grazing management practices that sequester C or, equally importantly, maintain the current C stocks in the soil. Good grazing management is usually good for the environment and for people (food quality, income), while poor grazing management increases risks of the degradation of natural resources and yields. Improved grazing management may increase soil C content, e.g. by adjusting animal stocking rates or periodically removing grazing livestock to prevent overexploitation. The effect may vary depending on the timing, frequency and intensity of grazing, as well as pedo-climatic factors.

Increased plant diversity (mixing plant species, legumes, functional types or traits) has been reported to enhance yield and soil organic C (e.g. Kirwan *et al*., 2007; Fornara and Tilman, 2008). However, there is also uncertainty due to scarcity of biodiversity-function experiments including grazing and insufficient information about underlying mechanisms triggered by plant diversity and acting under different grazing managements.

To optimise grazing for C, guidelines are required. Currently, a range of grazing guidelines exist in Europe, from simple to complex, and they are better developed in some regions/grazing systems than in others. They focus on important issues like grazing infrastructure, herbage utilisation, regrowth intervals, stocking rate and measurement tools. However, grazing guidelines generally do not yet consider soil C sequestration.

Effective monitoring of soil C is required to document the provision of C sequestration services by farmers/land managers. There are two main viable ways to do this: (1) measure the soil organic C content or the soil organic matter directly over time and use these data to estimate the change in C stocks (gold

standard), and (2) register farm activities or indirect indicators of farm activities, calculate their potential for increasing C storage, and monitor only those activities. Usually the latter is a cheaper approach due to less intensive sampling, but it relies either on prior data or on modelling to identify relevant farming practices and quantify their effect. The two options are not mutually exclusive.

Incentives to promote the adoption of the best grazing systems must be targeted towards the appropriate stakeholders. Incentives can be policy driven (e.g. EU, national or regional policies, alleviating, simplifying actions), market driven (e.g. private production standards, voluntary C markets and funds, labelling) or farmer driven (e.g. influencing social norms and the mind-set of farmers by public campaigns; recognising the intrinsic value of C sequestration). Since improvements in grazing management and associated increases in C sequestration can be reversed, it is important that incentive schemes also take a long-term view. Finally, they may lead to more indirect valorisation by consumers, industries and distributor companies. Good examples of incentive schemes combine monetary and non-monetary compensation.

Conclusion

The strategy of the EIP-AGRI Focus Group, i.e. combining stakeholders from practise and science and from different disciplines in one group, has led to a clear overview of important issues with respect to C in grazing systems. Grazing systems are important for C storage. Optimal grazing management should be focused on additional C sequestration and on maintaining current C stocks.

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