Characterising permanent grassland-based farming systems in Europe

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Abstract

Permanent grasslands (PG) provide a wide range of ecosystem services (ES) and are also the basis for many highly valued landscapes and support rural vitality and recreational potential in many regions; and yet in many parts of Europe, PG systems are threatened by abandonment and afforestation, intensification, or conversion to arable land. To support the maintenance and sustainable management of PG, the Horizon 2020 SUPER-*G* project (SUstainable PERmanent Grassland Systems and Policies) has set out to (i) increase understanding of the importance and functioning of PG within a range of important European biogeographic regions; (ii) benchmark PG performance across Europe; (iii) develop integrated approaches for sustainable PG management; and (iv) develop tools and policy mechanisms inclusive of stakeholder and citizen priorities. A PG-based farming systems typology will provide one of the strata for the implementation of these activities. This paper presents first outcomes of an inventory of PG-based farming systems in five biogeographical regions of Europe.

Keywords: permanent grassland, grassland typology, farming systems, ecosystem services

Introduction

According to Eurostat data for 2013, PG covers almost 60 million hectares across the 28 EU-countries and accounts for 34% of the total Utilised Agricultural Area (UAA), although there are large differences between countries and biogeographical regions (BGRs) in terms of proportion of UAA, spatial fragmentation and distribution (Huyghe *et al.*, 2014). This results in contrasting priorities for the specific roles played by PG depending on local conditions. PG provide a wide range of ecosystem services (ES) and can support social infrastructure and high levels of biodiversity that in turn enhance ecosystem function and value to society (Cardinale *et al.*, 2012). In various parts of Europe, PG systems are threatened by abandonment and afforestation, intensification, or conversion to arable land. To curb these trends, the Common Agricultural Policy reform in 2013 introduced protective measures, including the obligation for national governments to maintain the ratio of PG to the total agricultural area. The ability of farmers and land owners/managers to maintain and manage grasslands with a view to ES delivery depends on local conditions (including soil type, slope, ground water level and climate), farming system (FS) (e.g. dairy, beef, sheep, goat, and their intensification level), the profitability of the farming business and any financial support/incentive provided by rural development programmes.
PG typologies and FS typologies are closely intertwined, and both are needed as frames to enable the assessment of technological innovations and policy interventions geared towards the tailored optimisation of economic performance and ES delivery by PG-based systems. Farming systems and management regimes, such as grazing, cutting, fertilization and

productivity. Grassland composition, farming system and production intensity are also key factors governing the delivery of ES such as pollination, biodiversity, water regulation and erosion control, carbon sequestration, and landscape value.

Methods

We made a first and still tentative inventory of PG-based farming systems, their geographical distribution, their characteristics and the role PG plays in them, as the starting point for a FS classification. The latter will serve to quantify how farm and PG management options affect economic performance and ES delivery by PG-based systems. Subsequently, the classification aims to help in ranking FS types in terms of ES delivery, to define the main threats they face, and to design dedicated policies to support them and mitigate the threats.
The inventory and analysis of FS characteristics was based on (1) available databases at European scale: Eurostat database where farms are classified using FADN classes and PG surface is clearly separated from other land uses; and (2) literature review and the collection of expert knowledge within the project partnership, i.e. the main farm types as identified by each of the partner countries' formal or informal classifications.
Features that discriminate between PG-based farm types were identified using Multi Correspondence Analysis (MCA), performed in R (R Core Team, 2018) and FactomineR package (Le *et al*., 2008). Variables included BGR (Alpine, Atlantic, Boreal, Continental, Mediterranean); farm products (crops, bioenergy, live animals, meat, dairy, wool); PG exploitation (haymaking, silage, grazing); PG agronomic management (overseeding, mineral fertilisation, manure fertilisation, irrigation); animal species (cattle, goats, sheep, horses, pigs, other); and the proportion of total farm UAA that is PG.

Results and conclusions

Preliminary outcomes are presented in Fig.1 and Fig. 2. Ellipses representing confidence intervals of the distributions show a good cohesion of FS around centroids when plotted by BGR, but also a high degree of overlapping (Figure 1). Overlaps between BGRs and between countries suggest the need for a harmonised farm classification across Europe.
The position of FS along axes in Figure 1 depends mainly on variables related to farm products, PG exploitation and PG management (Figure 2), as highlighted by the percentage contribution of these variables on axis one. In particular, the main drivers affecting the position of BGR ellipses was the absence of cattle, and consequently the absence of dairy products, most agronomic management options and cutting for silage. Conversely, the proportion of the farm area occupied by PG had limited power to separate FS types.
These preliminary results will be used to address the next step in the farm system classification, to validate the information on the most important variables and rationalise farming systems between biogeographic regions and countries.

Acknowledgement

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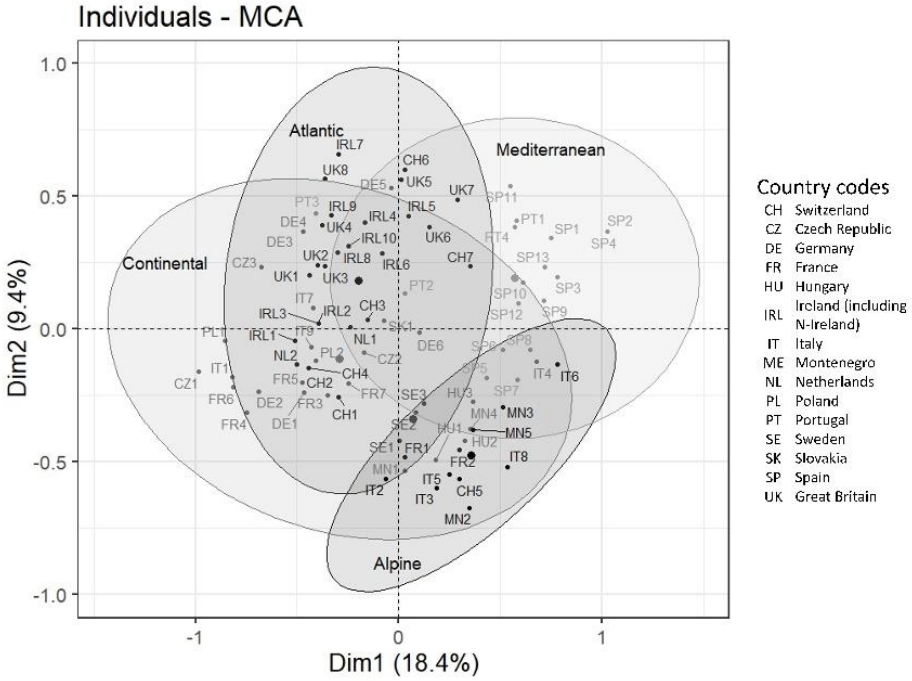

Figure 1: Plot of the described farms types in the first two MCA dimensions

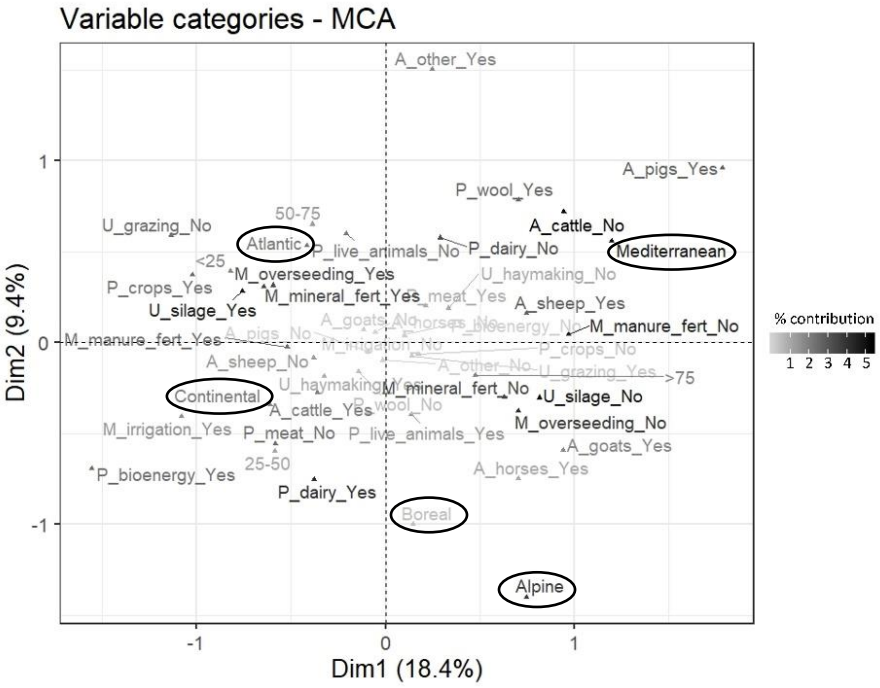

Figure 2: Plot of the variables, including BGRs outlined in black, in the first two MCA-dimensions. Grey shades indicate different percents of contribution of each variable to Dimension 1.