

## ASSESSMENT OF ECOSYSTEM SERVICES FROM PERMANENT GRASSLAND SYSTEMS

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### INTRODUCTION

The SUPER-G consortium and the preceding EIP-AGRI Focus group on permanent grassland (EIP-AGRI, 2016) define permanent grassland (PG) as ‘any land dominated by grasses or herbaceous forage that can be grazed/mown and has not been included in the crop rotation of a holding for five years or more’. According to Eurostat data for 2013, PG covers almost 60 million hectares across the EU-28 and accounts for 34% of the total Utilised Agricultural Area (UAA) (Huyghe *et al.*, 2014). PG provides a wide range of ecosystem services (ES) and can support social infrastructure and high levels of biodiversity that in turn can enhance ecosystem function and value to society (Cardinale *et al.*, 2012). However, in various parts of Europe, PG maintenance and functions are threatened by abandonment and afforestation, intensification, or conversion to arable land, and in some regions also by increased drought and/or heat stress due to climate change. The overall objective of the SUPER-G project is to co-develop sustainable PG farming systems and policies with farmers and policy makers that will be effective in improving productivity and economic sustainability, supporting biodiversity and delivering a number of ES, including climate regulation through carbon storage and sequestration.

### GRASSLAND TYPOLOGY, FARMING SYSTEMS AND ECOSYSTEM SERVICES

Local conditions (e.g. topography, soil, hydrology) in contrasting biogeographic regions have resulted in a diverse range of grassland types and farming systems; and associated variation in a number of grassland characteristics, including species composition, biomass production, feed value, duration of growing season, and need for irrigation. A new grassland typology will build on a classification proposed by the EGF Working Group on Grassland Terms (Peeters *et al.*, 2014). It will also incorporate concepts defined in the frame of the Habitats Directive, the latter covering 43% of total PG area in EU28; and take account of farming systems and management regimes, which have an impact on plant species composition and productivity.

The Millennium Ecosystem Assessment (MA, 2005) defined four categories of ES: 1. Provisioning services, 2. Regulating services, 3. Cultural services, and 4. Supporting services. The Economics of Ecosystems and Biodiversity (TEEB) study provided a more detailed description and examples of these services (TEEB, 2010) from which the SUPER-G project has selected a number of ES associated with PG (Table 1). Numerous studies have addressed one or more of these ES, but few have aimed to provide a full overview of all ES potentially delivered by PG in different circumstances (D’Ottavio *et al.*, 2018).

**Table 1.** Selected ecosystem services provided by permanent grassland

Services	Output
1. Provisioning services	fodder, bioenergy crops, fibre, fresh water
2. Regulating services	C-sequestration & storage, water regulation and flood prevention, water purification, erosion prevention, pollination of arable and fruit crops
3. Cultural services	landscape, recreation & tourism
4. Supporting services.	habitats for species

## CONCLUSIONS

The SUPER-G project will develop a comprehensive European grassland typology and a shared conceptual model of how PG can deliver in terms of productivity, biodiversity and other ES such as climate regulation, and the mediation of water flows. The potential of PG to deliver multiple ES will be informed by benchmarking and testing, involving a network of farms and experimental platforms in 14 countries covering the Mediterranean, Atlantic, Continental/Pannonian, Alpine and Boreal regions. An accurate analysis of farming systems using PG will provide management suggestions to make ES delivery from PG economically sustainable.

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## REFERENCES

- Cardinale, B.J., Duffy, J.E., Gonzalez, A., Hooper, D.U., Perrings, C., Venail, P., Narwani, A., Mace, G.M., Tilman, D., Wardle, D. A., Kinzig, A.P., Daily, G.C., Loreau, M., Grace, J.B., Larigauderie, A., Srivastava, D.S. and Naeem, S. (2012) Biodiversity loss and its impact on humanity. *Nature*, 486, 59-67.
- D'Ottavio, P., Francioni, M., Trozzo, L., Sedić, E., Budimir, K., Avanzolini, P., Trombetta, M.F., Porqueddu, C., Santilocchi, R. and Toderi, M. (2018) Trends and approaches in the analysis of ecosystem services provided by grazing systems: A review. *Grass and Forage Science*, 73, 15-25.
- EIP-AGRI (2016) *Profitability of permanent grassland*. EIP-AGRI Focus Group, Brussels.
- Huyghe, C., De Vlieger, A., Van Gils, B., Peeters, A. (eds) (2014) *Grasslands and herbivore production in Europe and effects of common policies*. Synthèses. Éditions Quae, Versailles Cedex, France
- MA (2005) *Ecosystems and human well-being: Synthesis*. Millennium Ecosystem Assessment. Island press, Washington DC.
- Peeters, A., Beaufoy, G., Canals, R.M., De Vlieghe, A., Huyghe, C., Isselstein, J., Jones, G., Kessler, W., Kirilov, A., Mosquera-Losada, M. R., Nilsson-Linde, N., Parente, G., Peyraud, J-L., Pickert, J., Plantureux, S., Porqueddu, C., Rataj, D., Stypinski, P., Tonn, B., van den Pol-van Dassel, A., Vintu, V. and Wilkins, R.J. (2014) Grassland term definitions and classifications adapted to the diversity of European grassland-based systems. *Grassland Science in Europe*, 19, 743-750.
- TEEB (2010) *Mainstreaming the economics of Nature: A synthesis of the approach, conclusions and recommendations of TEEB* The Economics of Ecosystems and Biodiversity.