BIOECOSYS: towards the development of a decision support tool to evaluate grassland ecosystem services

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Abstract

As underlined by the Millennium Ecosystem Assessment report (2005), it is necessary to take into account and preserve all the functions and connected services associated with ecosystems. Therefore, agroecosystems such as grasslands, covering near one-fifth (19.5%) of the European territory – rising to 50% of the Walloon utilized agricultural area – and providing important ecosystem services, have to be studied and managed as multifunctional units, opening new opportunities for valorization. This will allow the answering of societal expectations oriented towards more sustainable agriculture and improved use of natural resources. In this context, the final and main goal of the BIOECOSYS project is the development of a specific methodology and decision support system for the quantification and valuation of ecosystem services provided by the grassland ecosystem linked to its history and management, to its soil and climate context, to its location in the landscape and in the socio-ecosystem. To reach this objective it is necessary to produce integrated knowledge at the different levels of organization of grassland agroecosystems: (1) to quantify ecosystem services to integrate them in decision-making processes, and (2) to give a value (economic or not) to the services provided to guide decision-making choices. A first result of the project, a provisional scheme of grassland ecosystem functioning in relation to the services provided, is presented.

Keywords: agroecosystem, management, valuation, DSS, ecosystem function

Introduction

During the last decades, the over-exploitation and degradation of ecosystems has been recognized in different reports (Millennium Ecosystem Assessment, 2005). In parallel, growing demand for agricultural products, international awareness of biodiversity loss (e.g, the 1992 United Nations Rio Earth Summit) and climate changes have led to reconsideration of agroecosystems. The current challenge is to maintain or restore these ecosystems, enabling them to produce enough food but also services to improve the environment and human well-being. This must be done not only by avoiding pollution but also by maintaining and increasing 'ecosystem services' such as public goods (maintenance of water and air quality) or environmental services (maintenance of biodiversity, carbon sequestration) (Lemaire *et al.*, 2005; FAO, 2007). To reach these goals, agriculture must rely on the increasing scientific knowledge about agroecosystems, especially considering the ecosystem-services concept, which is very useful in the agricultural and public policies establishment (Lamarque *et al.*, 2011). The concept of agroecosystems multifunctionality, translated into ecosystem services, provides a new framework to drive researches necessitating genuinely inter-disciplinary approach (Hervieu, 2002; Lemaire *et al.*, 2005). This concept also represents a key element in the development of ecologically intensive agriculture which aims to optimize the use of agroecosystem functionality to produce more while preserving, or even enhancing, its environmental services (Bonny, 2011). In Europe, grasslands are essential ecosystems representing near one-fifth (19.5 %) of the European territory – rising to 50% of the Walloon

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utilized agricultural area – and providing important ecosystem services such as forage production, erosion and resources regulation, *etc.* Nevertheless, grasslands are actually threatened by land conversion to crops and face a significant pressure. Despite the demonstrated abilities of grassland systems to provide numerous ecosystem services (Amiaud and Carrère, 2012), for the diversity of grassland agroecosystems there remains a need to provide precise information on these services linked to their management and location (Puydarrieux and Devaux, 2013).

BIOECOSYS and its objectives

In order to allow the inter-disciplinary approach that will be necessary, the expertise of several units of the Walloon Agricultural Research Centre will be mobilized in order to carry out this project. These units are (1) Farming systems, Territories and Information technology Unit, (2) Plant protection and Ecotoxicology Unit, (3) Soil fertility and Water protection Unit, (4) Food and feed quality Unit, and (5) Crop production systems Unit. The final and main goal of BIOECOSYS is the development of a specific methodology and decision support system for the quantification and valuation of ecosystem services provided by the grassland ecosystem linked to its history and management scheme, its soil and climate context, and its location in the landscape and in the socio-ecosystem. To reach this objective it is necessary to produce integrated knowledge at the different levels of organization of grassland agroecosystems. Several ecosystem services will be quantitatively studied at the field and the landscape scales, where the basic biogeochemical processes are acting, while the valuation of grassland ecosystem services will be evaluated at the regional scale, supporting socio-economic and political decisions (Lemaire *et al.*, 2005; Hein *et al.*, 2006).

Grassland ecosystem services conceptualization: a first output

Early reflections and bibliographic researches have resulted in a first draft of grassland ecosystem functioning in relation to the services provided. Firstly, the CICES classification was examined to identify the different ecosystem services provided by grasslands. We applied the methodology described by Lamanda (2012) to conceptualize the grassland system. These services were connected with the grassland ecosystem functioning. The grassland is schematized on the basis of its three main compartments: (1) the *soil*, (2) the *vegetation cover* and (3) the *faunal composition*, in which various processes are taking place. Several abiotic factors (e.g. topography, landscape, climate, *etc.*) influence the functioning of these processes resulting in chain reactions which alter the supply of ecosystem services. In parallel, agricultural practices have a demonstrated and variable impact on the provision of ecosystem services. These different management methods (mowing rate, grazing intensity, fertilization schemes, *etc.*) and their impacts on grassland ecosystem services have to be modeled in order to allow their integration in the decision support system. This conceptualization frame will be validated by three focus groups mobilizing expertise in different fields interconnected. This will allow us to give a relative importance and an orientation to the different interconnections highlighted.

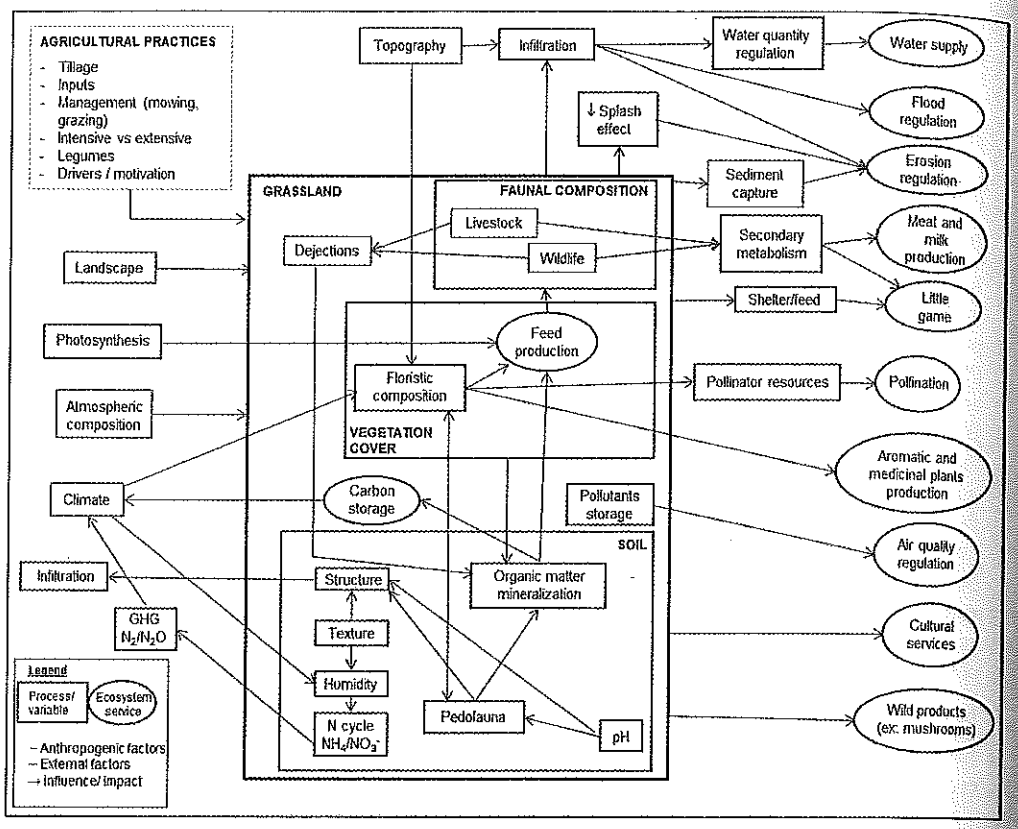

Figure 1: Conceptualization of grassland ecosystem in link to ecosystem services provided

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Grassland biodiversity

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Abstract

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Introduction

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