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PESagri: A novel payments for ecosystem services framework for targeted agrienvironmental policy

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Abstract. Multifunctional farms and policy makers need to connect agricultural management with the delivery of ecosystem services (ES) to improve policy outcomes and satisfy social demands. Despite the increasing understanding of the complex causal relationships between agricultural practices, biophysical processes and ES delivery, the application of the ES framework to agrienvironmental policy remains very limited. In this context, we developed a reliable and flexible framework of Payments for Ecosystem Services (PES) for the implementation of targeted agrienvironmental measures at the farm level. The PES framework i) focuses on agricultural activity as the main driver of many ES such as biodiversity and landscape conservation; ii) links objectively the real practices at the farm with the provision of relevant ES; iii) uses expert knowledge that allows evaluating and comparing the multiple effects of agricultural practices on ES; iv) reflects the views of all stakeholders involved; and v) constitutes a generic and versatile framework that can be used in diverse agroecological and policy settings. The paper describes the structure and operation of the PES system that is implemented in Excel. We use the case of sheep and mixed sheep-crops systems in the Euro-Mediterranean basin to illustrate the results of the PES application with diverse environmental objectives; for example, a policy targeting the real preferences of society for ES provision by Spanish sheep systems (i.e. wildfire prevention 53.2% of total importance, provision of quality products linked to the territory 20.2%, conservation of biodiversity 18.4%, and conservation of agricultural landscape 8.2%).

Keywords. Agricultural practices – Experts' biophysical assessment – Mixed sheep-crop farming systems – Mediterranean agriculture.

PESagri: Un nouveau cadre pour le paiement des services écosystémiques pour une politique agroenvironnementale ciblée

Résumé. *Les exploitations multifonctionnelles et les décideurs politiques ont besoin d'établir la liaison entre les pratiques agricole et la provision des services écosystémiques (SE) afin d'améliorer la gestion des mesures politiques et de satisfaire les demandes de la société. Malgré de la croissante connaissance qu'il existe sur les complexes relations entre les pratiques agricoles, les processus biophysiques et les SE rendus, l'application d'une approche SE aux politiques agroenvironnementales est encore limité. On a développé un cadre pour le paiement des services écosystémiques (PSE) flexible et fiable pour la mise en œuvre des mesures agro-environnementales au niveau de l'exploitation. Ce system de PSE i) se centre sur l'activité agricole comme la force motrice principale de beaucoup des ES ainsi que la biodiversité et la conservation du paysage, ii) relie les pratiques au niveau de l'exploitation avec la provision des principaux ES, iii) utilise la connaissance d'experts on permettant évaluer et comparer des multiples effets des pratiques sur les ES, iv) reflète des points de vue des parties intéressées et v) constitue an encadrement générique et polyvalent que peut être appliqué sur différents contextes agroécologiques et politiques. Ce travail décrit la structure et le fonctionnement d'un system de PES qui est implémenté en Excel. On utilise les cases de systèmes ovins et mixtes ovins-cultures dans le bassin méditerranéen pour illustrer les résultats obtenues de l'application du system PES avec divers objectifs environnementaux, par exemple, avec des objectifs politiques basées sur les préférences de la société par rapport aux ES rendus pour les systèmes ovins (c.-à-d., prévention des incendies 53,2% de l'importance totale, la provision de produits de qualité liées au territoire 20,2%, conservation de la biodiversité 18,4% et du paysage agraire 8,2%).*

Mots-clés. *Pratiques agricoles – Évaluation biophysique des experts – Systèmes d'exploitation mixtes ovins-cultures – Agriculture méditerranéenne.*

I – Introduction

It is increasingly recognized that agricultural policy should reward the contribution of farmers to the delivery of multiple ecosystem services (ES) to society. Therefore, both farmers and policy makers need improved tools for setting objective environmental targets and fair distribution of subsidies. Payments for ecosystem services (PES) applied to farming constitute a way to achieve this. The importance of land management is acknowledged in the descriptions of all the existing PES, but they do not explicitly include the effect of agricultural management on the provision of ES. This is partially due to the incomplete scientific understanding of the complex causal relationships between management actions, biophysical processes and ES delivery and the lack of homogenized biophysical assessments . In this sense, a better understanding of the agricultural practices that influence trade-offs and synergies among ES would allow the outputs of a range of ES to be envisioned and address a greater integration between agri-environmental schemes to attain a wider and more efficient delivery of ES . In this paper, we present and apply a generic framework of management-based PES (PESagri) for sheep and sheep-crop farming systems.

II – Material and methods

We designed a generic and sound PES framework that links beneficial agricultural practices at farm level with the provision of single or multiple ES (maintenance of agricultural landscapes, biodiversity conservation, wildfires prevention, carbon sequestration and production of quality products linked to the territory). Expert knowledge about links between practices and ES was collected with an on-line Delphi panel. From a list of 66 agricultural practices with potential to deliver public goods in Europe, we selected 36 that were carried out in 10 monitored sheep and mixed sheep-crops farms in Mediterranean mountains and semiarid lowlands in Aragón. Experts had to rate, in two rounds of deliberation, the positive contribution of each agricultural practice to ES using a Likert scale (from 0 none to 5 very high; including the “don’t know” option). The contribution of each agricultural practice to a particular ES was considered as the percentage of the contribution of all agricultural practices to that ES. We assumed that the valuations of the experts reflected the biophysical effect of agricultural practices on ecosystem properties and functions, and on ES delivery, providing a unique and comparable unit of measurement . In this way, the allocation of economic resources (payments to farmers) depends on the agricultural practices carried out at the farm level, where the decisions take place. We also aimed at including different actor involvement (farmers, researchers, society, policy makers) by allowing to customize the agricultural practices and the weight of environmental targets. These characteristics give flexibility to PESagri, which consitutes a usefull tool to address dinamic complex socio-ecological systems. PES agri can be exported to other socio-ecological systems by adapting the variety of agricultural practices, social demands and data availability. We applied PESagri using a socio-cultural and economic prioritization of ES in Mediterranean agro-ecosystems.

III – Results and discussion

1. PESagri framework

Figure 1 depicts the designed framework of PESagri that considers several steps. First, the definition of beneficial agricultural practices taking place at farm level. Second, the link of agricultural practices and a variable number of targeted ES. These links are quantified according to the expert-based assessment, but researchers can define these links in alternative ways according to the type of agro-ecosystem and data available. Third, the establishment of the evironmental targets through diferent combinations of ES (e.g., conservation policy, societal demand). Fourth, the user can define the budget and allocate it according to the targeted ES. If needed, agricultural practices can

be customized, e.g., the group of agricultural practices related to crops and species could be excluded for animal specialized farming systems using only natural pastures. PESagri is implemented in Excel and is fully operational. However, for PESagri to be effective in delivering the desired outcomes, there must be a system of monitoring in place at farm level.

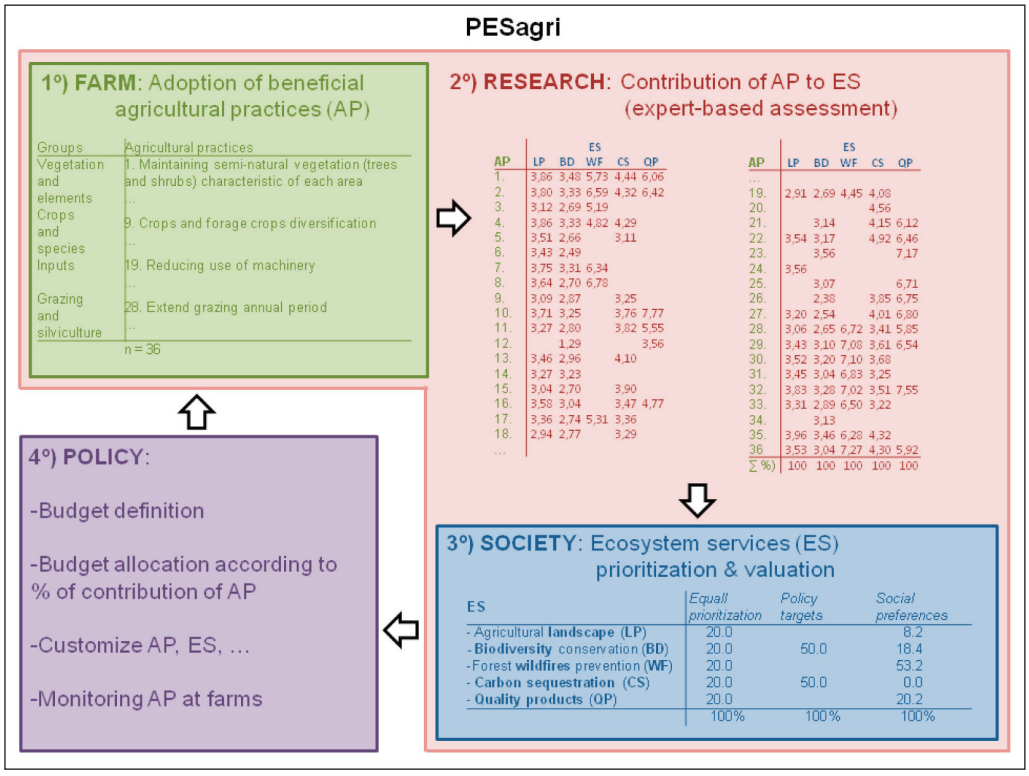

Fig. 1. The PESagri framework.

2. PESagri application to Mediterranean agro-ecosystems

When considering the social prioritization of ES (landscape 8.2%, biodiversity 18.4%, wildfires 53.2% and quality products 20.2%) described by, the agricultural practices that related to the management of grazing and silviculture (with a contribution of 41.79%) had the largest importance (Figure 2), followed by those related to vegetation and other elements (28.17%), mostly due to their contribution to wildfire prevention, highly prioritized by society.

Therefore, despite the relative contribution of agricultural practices to individual ES delivery was rather similar in the expert-based assessment (Figure 1), when considering the ES as prioritized by the public, differences in the importance of diverse agricultural practices were apparent. This resulted in a narrower number of agricultural practices determined by the PESagri, but with more differentiated contribution to each ES (Figure 2).

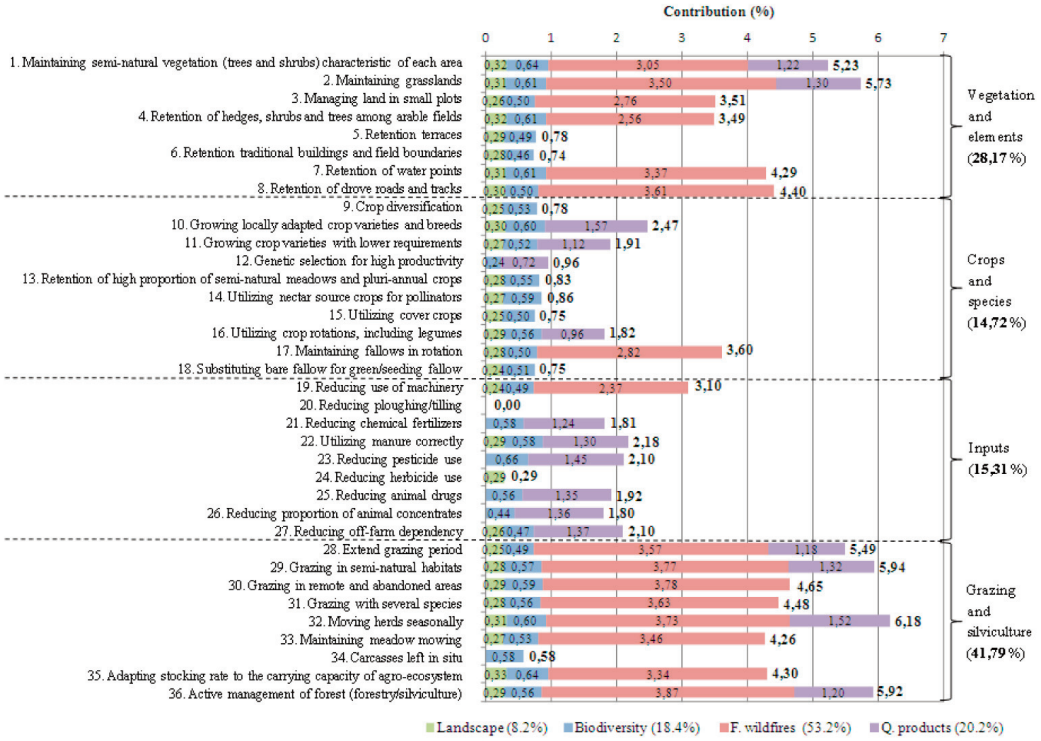

Fig. 2. Contribution of agricultural practices to ES in Mediterranean agro-ecosystems according to societal demand.

IV – Conclusions

PESagri is able to elucidate the contribution of individual agricultural practices to diverse ES and, potentially, reward farmers according to the ES they deliver. The framework is generic, customizable according to particular agro-ecosystems and policy targets, and easy to use. The quantification of the multiple effects of agricultural practices on one or several ES is central in the operation of the PESagri. Promoting particular practices that have a strong influence on a single ES is advisable when this particular ES is the only target. However, by promoting multiple practices with synergic effects on several ES we can deliver ES bundles.

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