Production and replacement costs of permanent grasslands compete with those of sown grasslands

Mesbahi G.[1,2], Bayeur C.[2], Plantureux S.[1]
[1]: Université de Lorraine, Inrae, LAE, F-54000 Nancy, France
[2]: Parc Naturel Régional des Vosges du Nord, 67290 La Petite Pierre, France

Abstract

Farmers' endorsement is crucial to conserve biodiversity in permanent grasslands, but the lack of visibility on their economic value is a major obstacle. We studied the production costs (i.e., the cost to produce one Mg of dry matter) and the replacement costs (i.e., the cost to replace grassland fodder with a mixture of wheat, soya and cereal straw) of 59 permanent and two sown grasslands from the Vosges Mountains (eastern France). We measured profitability as the difference between replacement costs and production costs. Our results highlighted a strong variability between grasslands, with lower production costs associated to grazing and higher production costs associated to low productivity. Permanent grasslands with low productivity were also associated to low profitability, but our calculation did not take into account their high conservation status which could deliver public subsidies. However, 75 % of the mainly cut permanent grasslands were more profitable than the cut sown grassland, and 75 % of the exclusively grazed grasslands were more profitable than the grazed sown grassland. Overall, permanent grasslands can be more profitable than sown grasslands while protecting biodiversity. We argue for the maintenance of agri-environment schemes that preserve grasslands of high ecological interest.

Keywords: economy, profitability, husbandry, ecosystem services

Introduction

European permanent grasslands are the main source of fodder, but they are often seen as poorly productive and thus, of poor economic interest. Production costs, replacement costs and profitability of permanent grasslands are mainly affected by management. Grazing is generally perceived as less expensive than cutting, because it requires less material and fuel. Fertilization improves yield and nutritive value, but increases production cost, especially when mineral fertilizer is used instead of manure. Several studies highlighted a positive correlation between plant biodiversity and profitability. These studies were often run on sown temporary grasslands (Schaub *et al*., 2020a) or experimental sown permanent grasslands (Schaub *et al*., 2020b), which limits the generalization of their results to spontaneous permanent grasslands (Tonn *et al*., 2021).
In this study, we calculated production costs, replacement costs and profitability of spontaneous permanent grasslands managed by farmers. We hypothesise that permanent grasslands can be more profitable than sown grasslands, thanks to lower production costs.

Materials and methods

We studied 58 commercial permanent grasslands from the Vosges Mountains (eastern France). Grasslands were either cut, grazed, or cut and grazed, and N-fertilisation varied from 0 to 259 $kg.ha^{-1}$. Elevation, climate and soil properties also strongly differed between grasslands. We sampled fodder during the first use (at production peak) to analyse nutritive value in 2018 and 2019. We interviewed farmers to obtain information about management

and to calculate mean annual yield production. Two representative sown grasslands were also studied: one only cut and one only grazed.
Production costs (€/Mg) included costs for engines use, working force, fuel and fertilizers (Bayeur et *al.*, 2013; Table 1). Replacement costs (€/Mg) were purchase prices to substitute grassland fodder with soya, cereal grains, and cereal straw (Chambre d'Agriculture des Deux-Sèvres, 2018; Table 1). Profitability (€/Mg) was the difference between replacement costs and production costs.

Results and discussion

Our results showed a high diversity of costs between grasslands: production costs ranged from 9.6 to 298.8 €/Mg, replacement costs from 105.6 to 221.6 €/Mg and profitability from -143.2 to 212 €/Mg (Figure 1). This diversity is mainly related to the mode of use and to fodder yields.
Grazed grasslands had lowest production costs, resulting in higher profitability than cut grasslands. 34 (81%) of the cut grasslands had positive profitability. The eight unprofitable cut grasslands produced low yield, mainly due to high altitude or sandy soil. However, high altitude and dry grasslands are known to be particularly important for biodiversity conservation (Napoleone et al., 2021).
Unlike Schaub *et al*. (2020b), we did not observe a clear relationship between specific richness and profitability. However, it is now important to extend the scope of future research to the relationship between conservation status and profitability. For example, despite their important conservation role, the specific richness of high altitude and dry grasslands do not correlate with their conservation status (Napoleone et al., 2021).

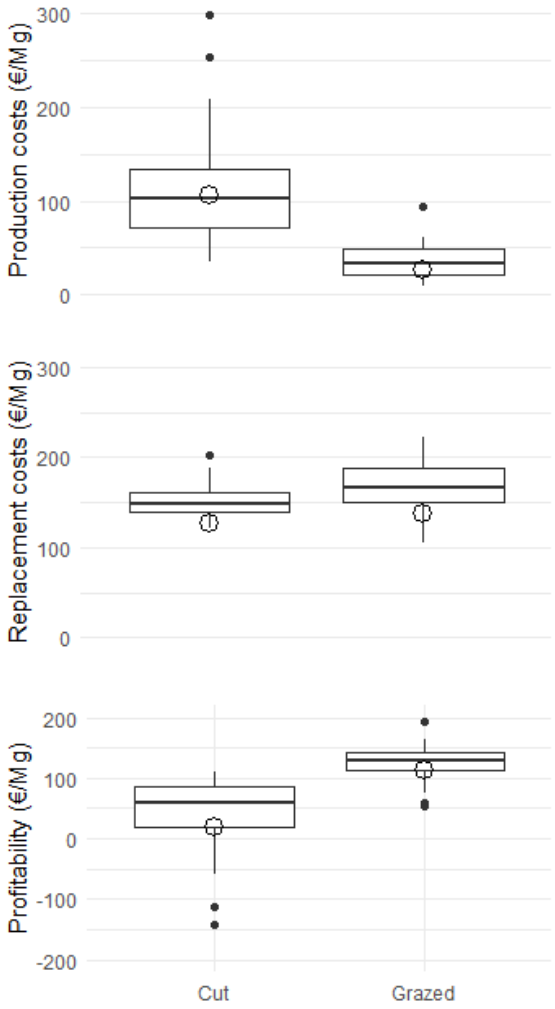

Figure 1 Production costs, replacement costs and profitability of permanent grasslands (boxplots) and representative sown grasslands (white dots). Permanent grassland are mainly cut (N=42) or only grazed (N=16).

Among the cut permanent grasslands, 30 (75%) were more profitable than the sown cut grasslands. Among the grazed permanent grasslands, 12 (75%) were more profitable than the sown grazed grasslands. This result shows the high economic potential of permanent grasslands compare to sown temporary grasslands, and is critical to counter the destruction and abandonment of European permanent grasslands (Young et al., 2005). Moreover, our calculation did not take into account the conservation status of permanent grassland which could provide public subsidies for biodiversity conservation and/or carbon sequestration. Also, the price of mineral fertilizer recently increased, which might increase costs of sown grasslands. This increase should weakly affect permanent grasslands: only 4 (7%) of the studied permanent grasslands received mineral fertilizer. Thus, permanent grasslands could be more resilient to global economy evolutions.

However, an integral switch from permanent grasslands to sown grasslands would induce massive adjustment at the farm level, due to changes in grassland yields quantity, quality and seasonality. Partial budget analysis or cost-benefice analysis would be appropriate to study the long-term economic consequences at the farm scale.

Conclusion

Most of permanent grasslands were more profitable than sown grasslands while protecting biodiversity. We argue for the maintenance of agri-environment schemes that preserve grasslands of high ecological interest, which often are less profitable.

Acknowledgements

We thank Margaux Reboul Salze for her help collecting data for sown grasslands, and farmers who collaborated with us. This research was funded by Agence de l'Eau Rhin-Meuse, European Regional Development Fund (ERDF), Fonds National d'Aménagement et de Développement du Territoire (FNADT), Commissariat à l'aménagement du massif des Vosges, Région Grand-Est.

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Management	**€/ha**
Hay gathering	173
Wrapped bales gathering	208
Silage gathering	249
Grazing	49
Solid manure spreading	32
Liquide manure spreading	32
Mineral fertilizer spreading	8
Harrowing	14

Mineral fertilizer	**€/kg**
N	1
P	1.1
K	0.7
S	0.2
Replacement costs	**€/Mg**
Soya	395
Cereal grains	182
Cereal straw	70

Table 1 Data used for production costs and replacement costs calculations, from Bayeur *et al.* (2013) and Chambre d'Agriculture des Deux-Sèvres (2018).