Agricultural Systems 136 (2015) 70–78

Contents lists available at ScienceDirect

Agricultural Systems

journal homepage: www.elsevier.com/locate/agsy

Increasing the cost-effectiveness of EU agri-environment policy measures through evaluation of farm and field-level environmental and economic performance

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ARTICLE INFO

Article history:
Received 1 August 2014
Received in revised form 13 February 2015
Accepted 15 February 2015
Available online 18 March 2015

Keywords:
Sustainable value approach
Farm and field modelling
Linear programming
Organic agriculture
Agri-environmental measures
Policy assessment and design

ABSTRACT

A lot of attention in the debate on the 2014–2020 programming period of the EU CAP and rural development policy revolves around the policy's contribution to enhancing resource use efficiency, decreasing environmental impact, restoring ecosystems and how to ensure more efficient and effective agri-environmental measures (AEMs). Nevertheless, studies that simultaneously address multiple measures with multiple environmental objectives and targets are underrepresented in the scientific literature. The objectives of the present article are (i) to present an integrated tool-kit for AEM design resulting from the combination of farm modelling with the Sustainable Value Approach (SVA), and (ii) to evaluate the potential of the tool-kit to support AEM design through an application to estimate cost-effective organic agriculture payments for the dairy sector in Mugello, northern Tuscany. Sustainability assessment of organic and conventional farming systems (OFS and CFS, respectively) under the 2007–2013 EU CAP support schemes and a no EU support scenario show better OFS performances regarding nitrogen leaching (–52% and –47% under the current CAP and the no EU support scenarios, respectively), soil erosion (–24% and –34%), potential pesticide risks (–100%), biodiversity (+13% and +30%). Income foregone for the production of environmental benefits from organic agriculture under a no EU support scenario is equal to 210 Euro/ha. Sustainable value calculations combined with modelling results indicate soil erosion and nitrogen leaching as the environmental processes to be addressed with specific policy measures to further increase the efficiency of organic farming. A new organic agriculture support scheme designed based on such indications further increases the OFS SV and almost closes the GAP with a benchmark farm of the area, featured with ideal performances in terms of environmental and economic indicators. The payment scheme we designed with the support of the integrated tool-kit shows to be more cost-effective and efficient of current AEMs.

1. Introduction

The process of the Common Agricultural Policy (CAP) reform – which aims at a more competitive and sustainable agriculture in vibrant rural areas – is reaching its final steps with the approval of the different regulations and implementing acts by the end of 2013 and the CAP reform anticipated to be put in place during 2014 (European Commission, 2013). A lot of attention in the debate on the future of the rural development policy revolves around the policy's contribution to enhancing resource use efficiency, decreasing environmental impact, restoring ecosystems and how to ensure more efficient and effective policy measures. More efficient and effective policy measures mean moving away from a spending towards an outcome-oriented approach while considering the extremely heterogeneous context of EU rural environments (European Commission, 2011).

During the 2007–2013 CAP programming period, agri-environment measures (AEMs) have been a key element for the integration of environmental concerns. They provide payments to farmers who subscribe, on a voluntary basis, to environmental commitments related to the preservation of the environment and maintaining the countryside. The same applies to the agri-environmental-climate and organic farming measures of the 2014–2020 period. There is, however, increased pressure to show that environmental outcomes are being achieved from public spending. The report by the European Court of Auditors (2011) has highlighted (i) that objectives included in the rural development programmes for agri-environment payments have been insufficiently specific to assess whether they were achievable, (ii) that environmental pressures have not provided clear justification for

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http://dx.doi.org/10.1016/j.agsy.2015.02.004
0308-521X/

current agri-environment payments and (iii) that very little information was available on the environmental benefits achieved. They recommended increased targeting, more focus on payments to address specific environmental problems and higher use of evidence to support management decisions. Also Cooper et al. (2009) argued that while the current EU agri-environment and cross-compliance measures had succeeded in stemming decline in several areas of public good provision, there was a need for clearer target setting and improved cost-effectiveness of measures. It has been noticed that in the past there has often been a lack of robust and quantitative analysis of the linkages between policy drivers and environmental outcomes in the agricultural sector. Decisions have been taken that have relied heavily on "trial and error" approaches to establish "which policies work" (OECD, 2010a).

Cost-effectiveness refers to the costs of achieving society's environmental objectives. The cost-efficient policy instrument is one that minimizes compliance costs while achieving environmental targets, thus maximizing cost-effectiveness. Cost-effectiveness can be defined with respect to reductions in environmental pressures, or in terms of improvements in environmental states. Landscape-level cost-efficiency implies farm-level cost-efficiency at the landscape level. However, the opposite is not true due to differences in the impacts of individual farms on the landscape-level environmental outcomes and variation in their costs of achieving them (OECD, 2010b).

There generally is a large variability in farm types within specific sectors or regions (e.g. intensive and extensive farms, grazing and zero-grazing dairy farms), so implementing uniform AEMs to these diverse farm types and regions might not result in the highest possible effect nor be most cost-effective. Hence, a clearer targeting of AEMs could be achieved when environmental target areas with highest optimization potential could be identified for different farm types and sectors in different regions. For example, Van Passel and Meul (2012) showed that in Flanders (Belgium), the highest potential for decreasing environmental impact of intensive dairy farms lies in reducing nitrogen surplusses, while this is less a problem for Flemish intensive arable farms, for whom however availability of land is a major problem. Hence, different measures will be most effective for intensive dairy farms compared to arable farms in Flanders. Within environmental target areas, targeting those farmers who farm the most environmentally sensitive fields or livestock enterprises or those who can deliver environmental goods with least cost would further increase the efficiency of the programme (OECD, 2010b).

Modelling the economic trade-offs of applying different environmental optimization measursures at these farms allows to simulate which measures can be implemented at lowest cost. This would increase the development of farming systems compatible with constraints and goals set by policymakers at highest cost-effectiveness. Hence, taking the differences between fields, farms and sectors into account when designing AEMs at regional level could increase the efficiency and effectiveness of applied measures, i.e. increase the succes of obtaining the intended environmental effect while also increasing cost-effectiveness.

To achieve this, models need to be applied that allow to evaluate environmental and economic performance of farms and allow to simulate the effect of implementing certain optimization measures defined by policymakers. The European Commission (EC) uses an improved set of aggregated indicators of the common monitoring and evaluation framework (CMEF) to monitor and evaluate current rural development interventions. However, the CMEF does not aim at designing more efficient measures, it is designed to assess the outcomes of existing measures.

Uthes et al. (2010) present three outstanding policy impact assessment tools (SIAT, SEAMLESS-IF, MEA-Scope tool). They reveal that while market instruments and direct payments are comparatively well represented, the ability to model rural development measures is mostly beyond the scope of these tools. Uthes and Matzdorf (2013) surveyed a total of 419 studies published between 1994 and 2011, including empirical-statistical, model-based, methodological, review and discussion papers on AEM, and observed that studies that simultaneously address multiple measures with multiple environmental objectives and targets are underrepresented in the literature. Based on an extensive literature review, Carof et al. (2013) selected MODAM (Zander and Kächele, 1999) and the modelling framework of Pacini et al. (2004a) as appropriate models to simulate impacts of new economic-environmental schemes on farmers' decisions under an optimization perspective.

Pacini et al. (2004a) developed an ecological-economic linear programming (LP) model to evaluate farm and field-level environmental-economic trade-offs with special reference to multi-objective policymaking and applied this model to evaluate the impact of the Agenda 2000 reform on sustainability of organic dairy farming in northern Tuscany (Italy). The model implemented at a detailed spatial scale allowed pedo-climatic characteristics, spatial aspects, impacts of alternative production practices and their economic performances to be addressed. The application of the model for alternative policy scenarios provided insights on opportunity costs of environmental benefits and on the practical use of the modelling framework for policy design (Pacini et al., 2004b). However, further optimization of the cost-effectiveness of intended policy measures could result from an identification of the efficiency of resource use/production of ecosystems services of a given farm type as compared to the efficiency of an ideal farm. This would allow to tailor the amount of organic farming payments based on sustainability efficiency figures in addition to insights from optimized farm management to achieve environmental targets. Sustainability efficiency figures can be delivered from applying the Sustainable Value Approach (SVA) (Figge and Hahn, 2004, 2005; Van Passel et al., 2007, 2009). Indeed, by using the logic of opportunity costs, the SVA is able to size the single contributions to overall farm sustainability originated by farmers' decisions on different agro-environmental processes as well as to summarize the sustainability performance of the whole farm into a single value.

Against this background, the two main objectives of this paper are: (i) to present an integrated tool-kit for AEM design resulting from the combination of the modelling framework of Pacini et al. (2004a), as updated at ten years since its early development, with the SVA along the lines of Figge and Hahn (2004, 2005) and Van Passel et al. (2007, 2009), and (ii) to evaluate the potential of the tool-kit to support AEM design through an application to estimate cost-effective organic farming payments for practical use in rural development plans.

2. Materials and methods

2.1. Study area

The Mugello basin is located some 30 km north of Florence, northern Tuscany (latitude 44°N). The Mugello area has a temperate climate with orographic rain regime and a mean annual rainfall of 1000 mm. From an economical viewpoint, the northern area of Florence Province, Mugello basin included, is defined as a zone with a prevailing mountain economy. This area can be subdivided into the foothills and the mountainous area. Professional farms (farms with at least one full-time work unit) are mainly located in the former area. Agriculture in Mugello is mostly extensive. The average agricultural area used (AAU) by professional farms is quite high compared to other regions of Tuscany. Large holdings (defined as those with an AAU higher than 50 hectares) farm 67% of the AAU. Ruminant production systems have a central role in the Mugello area (53% of