Journal of Rural Studies 25 (2009) 141–155

Contents lists available at ScienceDirect

Journal of Rural Studies

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

A conceptual framework for the assessment of multiple functions of agro-ecosystems: A case study of Trás-os-Montes olive groves

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Keywords:
Multifunctionality
Agro-ecosystem
Olive orchards
Stakeholder perspectives
Scales of assessment

A B S T R A C T

Multifunctionality in agriculture has received a lot of attention the last decade from researchers and policy-makers alike, perhaps most notably evidenced by the important changes made to the EU's Common Agricultural Policy. While the concept has been embraced by environmentalists envisioning positive impulses for decoupling and a range of local stakeholders recognizing implicit marketing opportunities involved, it has also been criticized as a mere argument in favour of disguised protectionism. Problematic in this discussion is the lack of an operationalising framework for the assessment of multiple functions. In this paper, we discuss such a framework and the role it can play in the decision-making process. Focusing on a case study about olive farming on sloping and mountainous land in northeastern Portugal, the contribution discusses methods for studying multiple functions of agro-ecosystems. While function assessment is presented from a research perspective, its relevance for stakeholders is also stressed here. By using the metaphor of a house, the method could appeal to a wide range of actors. In the case study, we conclude that olive groves on sloping and mountainous land particularly fall short in supplying ecological functions. They do however contribute significantly to the local economy, generate employment and perform an important role in maintaining the cultural landscape and identity, and are thus vital to regional development and to stop outmigration of the population. Policy-makers could use the function assessment tool to design effective cross-compliance rules and relevant agro-environmental measures to reinforce ecological and social functions, and to communicate ideas to other stakeholders. As such, it provides an extension of public debate and can reinforce decision-making by visualizing trends, development alternatives or scenarios. The role of research in this method is to facilitate dialogue between stakeholder groups and to feed the process with relevant indicators.

1. Introduction

The OECD study "Multifunctionality; towards an analytical framework" (OECD, 2001) presents a thorough analysis of the multifunctionality concept from an economist's perspective. Afterwards, a number of publications dealing with theoretical economic (Randall, 2002; Harvey, 2003), ethical (Paarlberg et al., 2002; Vatn, 2002) or sociological studies (Knickel and Renting, 2000; Knickel, 2001) have appeared on the topic, and more recently a review integrating concepts from different disciplines (McCarthy, 2005). An apparent lacuna in the literature is a study operationalising the concept (Brandt and Vejre, 2004). Moreover, the absence of studies advocating assessment of multiple functions in the decision-making process is surprising. Hall et al. (2004) come to a similar conclusion with regard to the analysis of societal wishes for the management of the countryside. A major effort to achieve informed decision-making on management of the environment is being undertaken by a global coalition of scientists in the Millennium Ecosystem Assessment (MEA, 2005).

The recognition of multiple functions of land use is in itself not a new issue. Perhaps not surprisingly, the densely populated Netherlands has had a scientific discussion about those functions dating back to the late 1960s, see, e.g. van der Ploeg and Vlijm (1978). However, the arrival of the term in policy documents in 1990s has added a dimension in that it has become linked to the discussion of paying third parties – farmers – for public services and goods that they produce alongside food and fibre (e.g. Potter and Burney, 2002). In this contemporary sense of the word, it seems

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doi:10.1016/j.jrurstud.2008.08.003

to have gradually evolved from earlier concepts as 'pluri-activity' dating back to 1980s (e.g. Fuller, 1990; Reis et al., 1990) and 'post-productivism' (e.g. Marsden et al., 1993, cited in Wilson, 2001). Evans et al. (2002) quite rightly criticise the use of the latter term, and whether or not the same line of reasoning was followed by scholars introducing the concept of multifunctionality, sure is that the shift of paradigm has followed some 'post-shockwave' behaviour in which initial excitement over other functions *overtaking* agriculture's productive functions has been matured into a neutral word not issuing any value statement as to what extent other functions may gain importance.

However, the neutrality of agricultural multifunctionality has been challenged by Wilson (2007), arguing that it should be used as a normative concept both describing and explaining rural (agricultural) change. He defines the multifunctional agricultural space as a paradigm for decision-making along a productivist/non-productivist spectrum, with notions of weak and strong multifunctionality characterizing the extremes, and an intermediate multifunctionality in the middle. While we will concentrate on multifunctional *agriculture*, a rural space could develop multifunctionality beyond agriculture, i.e. a complete loss of the productive function of agriculture.

Weak and strong multifunctionality were also distinguished by Hollander (2004), with the 'weak' end of the spectrum representing an ill-conceived protectionalist policy-driven concept. The OECD (2001) definition of multifunctionality as "a characteristic, either present or not, of agriculture (or any other type of economic activity) whereby products are – either intentionally or not – co-produced", has been criticized as too narrowly economistic and not capable of addressing what multifunctionality is about (Wilson, 2007). The multiple functions of agriculture include products (goods or services, marketable or public) but also less tangible elements of rural development, such as social inclusion, cultural heritage and landscape value, which may not be easily disentangled. Contested though the definition of multifunctionality may be, there is general consensus that where applied it should be firmly area-based (Holmes, 2002, 2006; Wilson, 2007).

Several classifications of the various functions of (agro-) ecosystems have been made, roughly taking two different approaches:

(i) Functions are defined as ecosystem functions with humans (potentially) attaching values to functions (de Groot, 1992; de Groot et al., 2002). This approach is followed by the Millennium Ecosystem Assessment (MEA, 2005), with similar applications relating to landscapes (not necessarily agricultural ones, Brandt and Vejre, 2004) and an Andean 'socio-ecosystem' (Rodriguez et al., 2006). This approach evolves from an ecologist's perspective emphasizing the entity of the natural environment (van der Maarel and Dauvellier, 1978).
(ii) Functions are defined taking a broader, human-centred perspective including types of capital other than natural capital (e.g. Bosshard, 2000; von Wiren-Lehr, 2001; Gómez-Sal et al., 2003). The role of the natural ecosystem in this approach can ultimately be reduced to satisfying the demands from society (for an early account, see Bouma and van der Ploeg, 1975).

Combinations of the above approaches are also possible, by taking an hierarchical approach with ecosystem functions at the basis and other functions as 'derived' functions. For example, van Cauwenbergh et al. (2007) present a hierarchical framework for assessing the sustainability of agricultural systems based on de Groot's ecosystem functions but including functions in economic and social domains.

Function assessment as it is understood here is a method to study the multifunctionality of (parts of) agro-ecosystems, in this case Sloping and Mountainous Olive Plantation Systems (SMOPS) in southern Europe. Agro-ecosystems are ecosystems modified by human beings to produce agricultural products, thereby acquiring a socio-economic dimension (Conway, 1987). SMOPS, as (major components of) agro-ecosystems, have some specific characteristics: they often originate from Roman times and developed on land where other crops would not grow and irrigation was not feasible. In order to adapt to the peculiar Mediterranean climatic conditions a range of soil and water conservation measures has been practiced (Stroosnijder et al., 2008). As SMOPS cannot compete with better endowed plantations in lowland regions in the narrowly productive sense, the concept of multifunctionality is particularly relevant for their future development.

An important characteristic of different types of functions is that by putting more emphasis on one function, other functions can be affected in variable ways. A (participatory) planning process aims to arrive at a decision about what mix of functions to pursue. Crucial in this process is that different stakeholders may value functions differently and that the importance of functions varies across scales of analysis (Hein et al., 2006). Hence, to assess agro-ecosystem functions, indicators are needed that are (1) informative about changes in important processes; (2) sensitive to changes; (3) appropriate at temporal and spatial scales considered; (4) well-understood and based on generally accepted conceptual models; (5) relatively undemanding in terms of data collection; (6) preferentially reliant on existing monitoring systems; and (7) easily understandable by policy-makers (MEA, 2005, p. 50).

Indicators work best if they serve a well-defined purpose. If this purpose concerns sustainability evaluation, a holistic framework is required (López-Ridaura et al., 2005; van Cauwenbergh et al., 2007). If this is assessing multifunctionality, a selection of indicators that capture the importance of key functions (those aimed at by stakeholders) suffices. The use of indicators has been criticized (Wilson and Buller, 2001), most importantly for claiming objectivity while missing out on important (arguably socio-cultural) processes and their tendency to reinforce narrow-based policy objectives. However, acknowledging that indicators are a social product of negotiation (Slee, 2007) opens the way for indicators as instrument of conveying messages across actors and scales. To be useful at multiple scales, indicators should be linkable between relevant assessment levels (Pacini et al., 2003), and preferably be indicators of *objectives* rather than *means* (van der Werf and Petit, 2002). However, when indicators of the first kind are difficult, time-consuming or costly to assess – as is often the case in Mediterranean environments – there is a need to define sustainable land management practices as means-based indicators (Zalidis et al., 2002).

The objective of this paper is to present a conceptual framework for the assessment of multiple functions and to illustrate it with a particular case study at two scales of assessment: region level and farm level, with most emphasis given to the former. The results of the case study are used to discuss the potential of the method. In the remainder of the paper, the function assessment methodology will first be described, and the case study area introduced: the Terra Quente zone within the Portuguese Agrarian Region of Trás-os-Montes. Results are thereafter presented and discussed in relation to other approaches, and conclusions with recommendations for future research are drawn.

2. Methods

2.1. Conceptual framework

2.1.1. The 'house of functions'

The 'house of functions' is a tool for assessing the functions of agro-ecosystems (as defined by Conway, 1987). It offers a universal