Land Use Policy 78 (2018) 791–802

Contents lists available at ScienceDirect

Land Use Policy

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

A Spatial Integrated Database for the Enhancement of the Agricultural Custodianship Role (SIDECAR)—Some preliminary tests using Tuscany as a case-study Region

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ARTICLE INFO

Keywords:
GIS analysis
Integration of farm and territorial data
Rural landscape
Common agricultural policy
Rural planning
Regional and sectoral programming
Soil consumption
Multifuctional agriculture
Custodian farmers
Ecosystem services
Tuscany
Lucca province
Territorial governance

ABSTRACT

Agriculture plays a fundamental role in the provision and regulation of Ecosystem Services. As a result, the loss of farmland or its mismanagement may consistently reduce community well-being. This problem is particularly felt in the Mediterranean area, where pedoclimatic conditions and high anthropic pressure on scarce resources are making rural systems more fragile. Policy is a very important driver in the promotion of sustainable agriculture and soil protection. However, it would appear that policy does not adequately address the scale and urgency of soil and environment protection issues. The complexity of factors that influence the role played by agriculture in territorial custodianship and Ecosystem service provision demands dynamic management tools, where information and territory are closely intertwined in providing adequate knowledge for intervention.

This paper presents SIDECAR (Spatial Integrated Database for the Enhancement of the Agricultural Custodianship Role[1]), a decision support system (DSS) which aims to promote an integrated approach to planning, programming and design. SIDECAR is a database where several georeferenced data were merged and developed using a Geographic Information System (QGIS). It allows for the integration of spatialized information on land use, territorial biophysical characteristics, farm socio-economic characteristics, Common Agricultural Policy aid distribution, etc. SIDECAR has been tested in the Italian region of Tuscany where there is a high level of multifunctionality in agriculture and a great variety of contexts.

Results show that the effectiveness of agricultural and spatial planning policies and their positive role for community well-being can be improved by considering: a) spatialized information; b) farm data used for forecasting agricultural trends at territorial level; c) the provision of ecosystem services by agriculture.

1. Introduction

The seminal work of Costanza et al. (1997) highlighted the role of nature in providing Ecosystem Services (ESs). Following an initial period when agriculture was considered as an activity which reduces the provision of ESs compared to natural un-anthropized areas, a growing awareness of the multifunctional role of agriculture and of the importance of well managed agro-ecosystems in providing ESs arose (OECD, 2001; Durand and van Huylenbroeck, 2003; van Huylenbroeck et al., 2007).

At present, in European countries, agriculture and forestry still cover the major part of the territory. Nevertheless, this share is steadily decreasing because of two major phenomena: economic and urban development and land abandonment (see, e.g. Verburg et al., 2006). Economic development has led to a loss in the importance of agriculture in terms of share of GDP and of employment in favor of industry and services which require a large amount of artificialized surfaces. Furthermore, the movement of population from rural to urban areas (Hall, 1997; Angel et al., 2011) has determined a sharp increase in built-up areas for residential purposes. At the same time, agriculture is gaining importance for urban populations because of the wide spectrum of ESs it produces (Gutman, 2007; La Rosa et al., 2014). The demand for ESs, such as the provision of food and amenities, by urban populations may constitute the basis for a new covenant between urban and rural areas (Gutman, 2007). Urbanization processes, in many cases, have not followed a clear vision but have assumed confused forms (Scott et al., 2013), as the result of a lack of proper regulation by public institutions. Salvati and Gargiulo Morelli (2014) provide an analysis of the urban sprawl in the Mediterranean Region and highlight that, in recent years, several cities have assumed a polycentric structure, characterized by

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[1] SIDECAR has been described in a first contribution in Italian under the name DISPAT.

https://doi.org/10.1016/j.landusepol.2018.07.025
Received 30 March 2017; Received in revised form 10 May 2018; Accepted 16 July 2018

dispersed low- and medium-density settlements. These settlements are located around urban centers and lead to the fragmenting of fertile rural areas which are suitable for agriculture and are often of high environmental quality. Salvati (2013) and Ferrara et al. (2014) confirm that the loss of productive soil caused by urbanization often affects the most productive agricultural land. Indeed, the lack of proper regulation and land use choices mainly based on private interests might determine an underestimation of the importance of agriculture, as a result of the greater economic profitability and lobbying power of other economic activities. This, in turn, could result in future costs for the collectivity.

In fertile areas, the need to cope with a global competition may result in an agricultural intensification where disservices, rather than services, may be produced (Stoate et al., 2001; Huang et al., 2015). However, in most rural areas, negative impacts are mainly caused by land abandonment (Cooper et al., 2006; García-Ruiz and Lana-Renault, 2011, Pelorosso et al., 2011; Haddaway et al., 2013). The process of land abandonment is particularly important in the European Mediterranean countries which are characterized, from the one hand, by a great number of small households unable to cope with competition in a global arena, and from the other hand, by pedoclimatic conditions, i.e. summer drought and vulnerability to soil erosion. Adverse pedoclimatic conditions increase the negative effects of global warming. García-Ruiz and Lana-Renault (2011); Terres et al. (2015) and Lasanta et al. (2017) provide an analysis of the drivers of land abandonment in Europe and of the distribution in space of abandonment phenomena. Lasanta et al. (2017), on the base of the analysis of relevant literature, state that there have been two surges of land abandonment. The first surge affected mountain areas, in particular the ones located in the Mediterranean areas, as a consequence of their bio-physical limitations, low agricultural population and limited competitiveness of their products. The second surge was caused by CAP, that deeply affected the arid and semi-arid areas of Southern Europe, and, in minor degree, the regions with small-scale agriculture and fragmented land ownership. Renwick et al. (2013) analyzed the effects of policy reform on agricultural land abandonment in the EU confirming the relevance of CAP for this phenomenon. Queiroz et al. (2014) argue that scientists are still discussing whether farmland abandonment should be considered as a threat or an opportunity for biodiversity conservation. From a review of relevant literature, they conclude that researchers from Eurasian countries usually stress the negative effects while researchers from New World countries stress the positive effects. Agnoletti (2014) highlights the risk of policies promoting renaturalization in Mediterranean areas, that cause reforestation and the loss of valuable cultural landscape. In summary, the abandonment of large agricultural areas is usually seen as bringing about a loss of ESs (Huang et al., 2015; Lasanta et al., 2017) and a decrease of the custodianship role of farmers (Rovai and Andreoli, 2016).

At present, the survival of a continuous and careful management of a territory is mainly ensured by processes and productive activities that are not competitive from an economic point of view and are, consequently, unable to survive without public aid (Ahnström et al., 2009). In order to enhance agricultural positive roles, the institutional policy context represents a critical factor. Policies are not only one of the main drivers of agriculture and land use change, but they may also be used as a response for contrasting negative effects, e.g. those caused by market trends (Van Zanten et al., 2014; Rovai et al., 2016). Common Agricultural Policy (CAP) is increasingly stressing the role of agriculture in conserving and protecting natural capital, and in producing ESs for urban areas. However, since financial resources are scarce, it is important that CAP aid is distributed in an effective and efficient way. This asks for considering not only territorial and farm characteristics, but also farmers' attitudes (Mills et al., 2017). Farm size and degree of fragmentation[2] are important when setting policy instruments promoting the production of ESs related to landscape, biodiversity conservation, etc., since they are directly related to landscape heterogeneity and ecological quality (Farina, 2006). The degree of family involvement and type of management significantly influence farm strategies about land use, ES provision and farm's chances to be viable in the long run (Wilson, 2008). A good knowledge and understanding of all these characteristics is highly significant both for CAP and for spatial planning at different territorial scales.

In the EU Mediterranean Countries, the institutional context shows complexities and criticalities that hinder the effectiveness and efficiency of policy instruments. These criticalities are mainly related to: a) a governance structure organized in regionalized unitary states; b) shared competences between national and sub-national levels; c) spatial planning traditions mainly related to urbanism; and d) a weak vertical and horizontal co-ordination (Silva and Acheampong, 2015). In a recent paper about governance changes in peri-urban farmland protection, Perrin et al. (2018) highlight the practical issues of effectiveness and social acceptability that arise from power devolution and the increased complexity of procedures. Procedurecomplexity derives from multiple decision-making authorities that, in their turn, are a result of the decentralization process. Howlett (2009) highlights the need for consistency of policy aims and objectives and the importance of assessing the adequacy of policy means and instruments, as a consequence of the "nested" multi-scalar and multilevel nature of institutions.

The situation is particularly difficult in Italy where there were three administrative levels (region, province[3] and municipality) below the national level and where there are problems in ensuring a proper horizontal (e.g. among the territorial governance plan and the rural development programme at regional level) and vertical coordination (e.g. planning at regional and sub regional level). Indeed, according to Vettoretto (2009) and Cotella and Rivolin (2011), planning levels do not always have clear objectives and clearly identified and separate tasks; therefore, there are often multiple overlays among instruments adopted at different administrative levels, and sometimes also among instruments adopted at the same administrative level.

The sectorialization of policy-making processes and the weakness of horizontal and vertical coordination hinder the processes of socio-economic and physical space regeneration within a framework of sustainable development. In order to overcome these issues, it is paramount to understand the interactions among the above-mentioned policy tools and to base them on a territorial multisectoral and multidisciplinary knowledge (Conrad et al., 2011), able to integrate different aspects and sources.

In this framework a proper tool for promoting the ES provision and the custodianship role of agriculture should allow integrating competences and skills of: a) agricultural economists, who are mainly interested in the state end evolution of farms, but not in the bio-physical features of the space where farms are located; b) planners, who are mainly interested in the past, present and future land use, but are not interested in the drivers influencing land use evolution; c) ecologists, e.g. landscape ecologists, who are interested in agricultural spaces in terms of their ability to provide functions and ESs. These categories of scientists and professionals have different visions about the role of agriculture in spatial planning. These specific visions often determine conflicts while they should be integrated and reconciled through a tool able to manage and put in relation information and knowledge proper of each discipline. Consequently, a proper knowledge tool should be able to: 1) highlight the transformation that territorial and landscape equilibria are undergoing and will likely undergo in the mid-long term, 2) evaluate their quality, and 3) understand the socio-economic

[2] Fragmentation is defined as the situation in which a single farm consists of numerous spatially separated parcels (Demetriou, 2013)

[3] Provinces have been recently abolished