Land Use Policy 35 (2013) 155–162

Contents lists available at SciVerse ScienceDirect

Land Use Policy

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

Land use conversion in metropolitan areas and the permanence of agriculture: Sensitivity Index of Agricultural Land (SIAL), a tool for territorial analysis

Chiara Mazzocchi [a,*], Guido Sali [a], Stefano Corsi [b]

[a] Department of Agricultural and Environmental Sciences, Production, Landscape, Agroenergy, University of Milan, Via Celoria 2, 20133 Milan, Italy
[b] Department of Economics, Management and Quantitative Methods, University of Milan, Via Celoria 2, 20133 Milan, Italy

ARTICLE INFO

Article history:
Received 12 October 2012
Received in revised form 16 May 2013
Accepted 20 May 2013

Keywords:
Land use conversion
Territorial policies
Peri-urban agriculture
Farms

ABSTRACT

In the past few years, urban growth has affected vast agricultural areas, especially in some European regions (EEA, 2006). In peri-urban areas, land consumption is particularly intense, exposing agriculture to the risk of land loss. Assuming the action of different factors, both exogenous and endogenous, on the agricultural system, the potential risk of land use conversion is measured by the Sensitivity Index of Agricultural Land (SIAL), an innovative tool for territorial analysis. In the following paper, the SIAL will be presented with an application for a metropolitan area. In this case study, the exogenous variables of urban proximity seem to be those most involved in the processes of conversion from agricultural to urban land use.

Introduction

In Europe, in recent years, urban growth has been the main cause of the consumption of agricultural land in peri-urban areas. Urbanisation has grown at a higher rate than population increase, and simultaneously, cities have lost compactness due to the dispersion of settlements (EEA, 2006). This is reflected in the farming system, with the subsequent disintegration of morphological, ecological and social relationships (Mazzocchi and Giacchè, 2011).

The process of land use conversion is caused by different factors, both exogenous and endogenous to the agricultural sector, especially in peri-urban areas. In these areas, global exogenous factors, for example, urban pressure, encourage land conversion from agricultural to urban uses, while the structural weakness of agriculture enables easy conversion. Among the external factors to be considered, the first is the quantitative effect of the conversion of agricultural land considering that demographic projections show that by 2015 more than half the population of developing countries – approx. 3.5 billion people – will live in urban areas (ONU Population Division, 2009). This is likely to draw people to cities and concentrate their activities, creating pressure on the land and thus becoming a driving force of urban sprawl (Christiansen and Loftsgarden, 2011). Spatial factors, such as the proximity of agricultural land to cities could also be a significant indicator of urban pressure together with the population density of an area. Population density measures the pressure of the population on an area, in itself a negative factor for agriculture as it represents a threat to free space given the probable positive relation between population density and the request for new homes and services (Rajan and Shibasaki, 2001). A number of studies (Bell and Irwin, 2002; Carrion-Flores and Irwin, 2004) have found that the distance from an urban centre provides a relative measure of the influence an urban area may have on free surrounding space. It is assumed that the smaller the distance from the city, the bigger the urban pressure on the farm property (Huang et al., 2006).

The third factor is related to the economic mechanisms that control the value of agricultural land: the peri-urban zone is still one of the areas most subject to land consumption due to the limited soil resources in comparison with the pressure of urbanisation. The agricultural area surrounding a city is often more valuable for development, and thus farmers earn more by selling the land to developers. Agriculture is a low-profitability sector subject to gradual marginalisation in comparison with other economic sectors. This marginalisation also affects the relationship between agricultural rent and rent resulting from land uses other than farming (for example, residential or commercial). Thus, the low added value of primary sector production in the market for agricultural goods means they cannot be considered economic determinants in land use because their added value has absolutely no influence on the increase in value of peri-urban agricultural rent (Sali

* Corresponding author. Tel.: +39 02 50316473; fax: +39 02 50316486; mobile: +39 335 5746447.
E-mail addresses: chiara.mazzocchi1@unimi.it (C. Mazzocchi), guido.sali@unimi.it (G. Sali), stefano.corsi@unimi.it (S. Corsi).

0264-8377/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.landusepol.2013.05.019

et al., 2009). The value of residential buildings in a city could be an effective proxy for the trend to transform farmland into developed land, suggesting that land use policy is another external factor to be considered. Another reason for farmland transformation is the effectiveness of agricultural and urban policies in governing these changes. For example, in places where building is prohibited due to restrictive planning tools, the choice of changing land use for building purposes is not viable. As noted previously, endogenous elements related to the features of farms could also influence the land conversion process. The fragmentation of farm area is defined as the splitting of farm property into smaller units, reducing the efficiency of the enterprise (Kalantari and Abdollahzadeh, 2008). This fragmentation is related to the "qualitative" character of urbanisation and is a strongly negative factor for both farm production and the balance of the ecosystem (OECD, 2008). The "breaking up" of farm property creates numerous management problems: it leads to greater distances to cover, loss of working hours, and more difficult transportation of agricultural products (Bizimana et al., 2004). Therefore, agricultural functionality is to a great extent negatively affected by fragmentation, which results in a "scattering" of the farm elements across the land. Moreover, fragmentation is inversely proportional to the distance from the city, which means that it most likely occurs more frequently where the pressure of the developed area is greater (Carrion-Flores and Irwin, 2004). There is a further internal factor to be considered: the economic size of a farm. Farms with a sizable economic dimension are profitable enterprises with a high degree of professionalism, and it can be hypothesised that their interest in land use conversion is lower than that of farms with lower economic dimensions. Similarly, the farm agricultural area could influence the land use conversion process: assuming a larger farm area implies greater possibilities for agricultural production and potential diversification, which could slow agricultural land consumption. In addition to urban policies affecting land use conversion, the Common Agricultural Policy has a beneficial influence as an additional source of income for the farm (Nickerson and Lynch, 2001; Key and Roberts, 2006; Shaik and Helmers, 2006), increasing the potential earnings of the farm (Towe, 2008).

Finally, the interface between rural and urban areas has structural features of its own and leads to a type of farming with special characteristics (Heimlich and Anderson, 2001). According to the definition of multi-functionality proposed by the OECD,[1] agritourism and direct selling activities must be considered: in this sense, multi-functionality is an activity of diversification that may represent not only a further revenue for the farm. In a peri-urban context, it also contributes to drawing the town population closer to rural areas, creating a network of consensus and relationships that function to preserve agriculture in the area.

This study provides a tool for territorial analysis as an aid for peri-urban land management policies, which could allow policy makers to investigate the phenomenon of land consumption in strict relation to farming. In the section "Metropolitan areas and land use policies in Europe", examples of European land use policy best practices are examined; the section "Methodology" covers material and methods for analysis; the section "Results and discussion" concerns the same; and the last section summarises the conclusion.

Metropolitan areas and land use policies in Europe

Because the market is not able to provide effective control of land consumption due to the existence of externalities typical of agricultural activity, public authorities should be tasked to offer adequate support. However, throughout Europe, the request for regulatory or restrictive policies still goes unheeded.

According to Piorr et al. (2011), most of the future development in Europe will occur in peri-urban areas. Such areas are growing four times faster than urban areas, and at a rate that would double their total area of 48,000 km^2 in 30–50 years. The highest share of peri-urban areas in Europe is along the 'pentagon' of London–Paris–Frankfurt–Munich–Milan, with the highest concentration in Greater London and the Benelux countries (Piorr et al., 2011). One of the most important negative consequences is the consumption of land, in particular the loss of high-production agricultural land. The phenomenon of land consumption is an issue that involves the entire Old Continent and affects not only the metropolis but also the smaller urban centres (EEA, 2006).

Since approval of the European Spatial Development Perspective (1999), the European Union has needed to establish policies to tackle regional differences through polycentric models. The Lipsia Chart on Sustainable Cities (2007), produced by the Ministers of Territory of the member states, focuses on the necessity of strong integration among urban policies through innovative forms of institutional governance and the involvement of local economic and social forces (PIM, 2009). The "Green paper on territorial cohesion" (EC, 2008) advises checking the growth of urbanisation as the primary tool for balanced territorial development. Land use management in peri-urban areas is an issue that involves European metropolitan areas having similar characteristics in their agriculture structure. These areas need unitary action, but a specific European directive does not as yet exist. Some countries have begun to introduce legislative instruments to counter land consumption. For example, in the Netherlands, where the rate of urbanisation, which removes fertile agricultural soil, is very high (Van Der Krabben, 2009), the concept of the Randstad Green Heart (RGH) is the basis for spatial planning and land use policies: the goal is to maintain farmland and green spaces around the main urban centres. As early as the 1950s, the concept of RGH was introduced to protect a single large agricultural–natural space interposed between dense urban cores. Currently, the policies are aimed at the preservation of RGH to encourage forms of development based on recovering brownfields rather than using green fields, such that at least 40% of new buildings should be built in no longer or badly used urban areas (Van Der Krabben, 2009).

Another interesting example is Paris; with approximately 12 million people, it is one of the most populated metropolitan areas in Europe. At the same time, the agriculture of the Ile de France – even if threatened by urban expansion – includes approximately 500,000 hectares, essentially half of the area of the region (48.1%). The metropolitan area of Paris has state policies for managing dispersed urbanisation, guided by the "Planning of Vast Areas" statute: the law 99-586, 12/07/1999, called "Simplification et reinforcement de la coòperation intercomunale"[2] that regulates and promotes voluntary cooperation between municipalities. One issue in particular with this law is strictly related to the problem of land use management and because of its three simplified types of associations: *Communautés Urbaine*, for the organisation of big municipalities generally near the city; *Communautés d'Agglomeration*, for small municipalities; and *de Communes*, for rural ones. The main innovation is that all of these associations have their own tax system: the

[1] "The key elements of multi-functionality are: (i) the existence of multiple commodity and non-commodity outputs that are jointly produced by agriculture and (ii) the fact that some of the non-commodity outputs exhibit the characteristics of externalities or public goods, with the result that markets for these goods do not exist or function poorly." (OECD, 2001, p. 13).

[2] Simplification and strengthening of inter-municipal cooperation.