



Operational modelling of peri-urban farmland for public action in Mediterranean context

Esther Sanz Sanz*, Davide Martinetti, Claude Napoléone

Institut National de la Recherche Agronomique (INRA), Unité de recherche Ecodéveloppement, France



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ABSTRACT

Awareness of peri-urban farmland multi-functionality and social concern for food security have prompted public action for the preservation of farmland around cities. A growing literature on peri-urban farming characterises its dynamics and quantifies urban pressure and farmland consumption by urban sprawl. However, such research requires expensive surveys and comprehensive databases that are usually inaccessible to planners and public-policy analysts.

This paper presents an analytical framework for peri-urban farmland characterisation that is operational for public action. Based on in-depth analysis of a Mediterranean local case study using surveys, on-site landscape reading, remote sensing analysis and interviews, we classed peri-urban farming into spatial units of peri-urban agriculture (USAPU). The classification obtained over seven municipalities was later used to train a fractional regression model, which was then tested on the rest of this French *département* (similar to NUTS-3 level), to predict the presence and actual proportion of each USAPU in the total agricultural land of each municipality. Furthermore, we drew up categories of municipality according to USAPU distribution that open perspectives for public action on peri-urban farming. We discussed whether such a model could be used as an instrument for decision-making on food planning, rather than simply for fairly reliable future predictions. This work is the starting point for the development of a methodology characterising complex peri-urban areas, simple to handle and hence operational for policy-makers and planners.

1. Introduction

1.1. Context

Growing cities are encroaching onto farmland all over the world, especially in developing countries. This is particularly true in the Mediterranean basin, with new and promising opportunities to trade land for urban development (Chanel et al., 2014; Darly and Torre, 2013; Gant et al., 2011). In addition, urban growth can influence peri-urban farms' structure by providing opportunities to specialise in short food supply chains for urban consumers (Aubry and Kebir, 2013a; Filippini et al., 2016). Furthermore, proximity to the city has an impact on farmers' lifestyle, since greater pluri-activity tends to decrease the agricultural intensity of labour (Ilbery, 1991; Lange et al., 2013; Primdahl, 1999).

From the perspective of land-use planning, metropolitan farmland

contraction has precipitated social demand for preserving productive peri-urban agriculture. On the one hand, agriculture's multi-functionality is credited with providing tangible benefits for ecological and economic territorial dynamics, at both local and regional levels (Fürst et al., 2010; Guillaumin et al., 2008; Helming and Pérez-Soba, 2011). On the other hand, social concerns over food security (Sonnino, 2016; Morgan, 2009) legitimate interest in peri-urban farmland preservation. This is both a valid and a valuable question, expected to have major relevance for land-use planning and management¹ in peri-urban landscapes, where land-use trade-offs are proving urgent and especially difficult to resolve (Geneletti et al., 2017; Scott et al., 2013). Cities are beginning to assume a key policy role, especially concerning food issues (Sonnino, 2016).

Mediterranean landscapes and agri-food systems are intrinsically complex and diverse (Barton et al., 2010; Ortiz-Miranda et al., 2013), and meeting social expectations from land-use regulation requires a

* Corresponding author at: Institut National de la Recherche Agronomique (INRA), Unité de recherche Ecodéveloppement, 228 route de l'aérodrome, CS 40509, Domaine St Paul - Site Agroparc, 84914, AVIGNON Cédex 9, France.

E-mail address: esther.sanz-sanz@inra.fr (E. Sanz Sanz).

¹ Land-use planning refers to a future desired vision of an area, while land-use management is the process of managing the use and development of land resources. Land-use planning often leads to land-use regulation, which typically encompasses zoning to regulate the types of activities that can be accommodated on a given piece of land. On the other hand, land management practices describe the way that land is managed, the means by which a land use outcome is achieved.

suitable methodology. Our aim here is to define a methodological framework usable by public bodies to characterise peri-urban agriculture for purposes of spatial and strategic planning. We are focusing our approach in the occidental and European part of the Mediterranean basin. Going beyond the Mediterranean context, we seek to test a prototype of a tool that could, with minor adaptations, be applied to other similar territorial contexts.

In most European countries, land-use planning tools are principally based on zoning provisions (Healey and Williams, 1993; Reimer et al., 2014). However, planning in itself –by means of zoning arrangements– is not effective in preserving farmland near cities (Abrantes et al., 2016). Moreover, suburbanisation and reduced urban density are worldwide phenomena (Angel et al., 2010). In Europe, urban areas have increased 80% over the last 50 years, roughly twice faster than population growth (EEA, 2006). Hence, urbanisation mainly occurs on farmland (Chanel et al., 2014), and it is particularly alarming in Europe, since cities are historically located in fertile regions (Ceccarelli et al., 2014; Greene and Harlin, 1995). For instance, 318,000 ha of agricultural land were lost in France between 2000 and 2010,² with peri-urban areas developing four times faster than urban zones (Piorr et al., 2011). “It is evident that physical land-use plans do not prevent urban intrusion and are not sufficient if productive farmland is to be preserved” (Paül and McKenzie, 2013, p. 96). There needs to be a sustainable food strategy and farmland preservation plan (Bousbaine and Bryant, 2016; Jarrige et al., 2009), where short supply chains and food production to feed cities can play a role. Thus, scientific research on food production is moving its focus from agriculture and rural development to also embrace consumption and urban areas.

Urban food planning calls for spatial and food-chain integration as well as a holistic approach to peri-urban farming, including environment, economics, quality, recreational activities, and so on (Moragues-Faus, 2016). Yet there are still few operational frameworks considering all the issues specific to peri-urban agriculture and practices (Galli et al., 2010). Peri-urban agriculture is usually considered in terms of distance from city-centres, in a gradient inspired by Von Thünen’s conceptual model (Sinclair, 1967; Bryant, 1992) where the relationship with the city is correlated with distance (Nahmias and Le Caro, 2012). But distance alone is not enough to characterise peri-urban agriculture, which is diverse, plural and dynamic (Bryant, 1997; Paül Carril, 2006; Soulard et al., 2016).

1.2. State of the art

Research in several fields has analysed peri-urban farming in Western Europe. Furthermore, scientific knowledge provides manifold frameworks for agriculture modelling and assessment oriented to environmental evaluation for land use planning (Burel and Baudry, 2004; Helming and Pérez-Soba, 2011; Schaldach and Priess, 2008; Termorshuizen and Opdam, 2009) and rural development (Groot et al., 2009; Lardon, 2012; Véron, 2003; Waldhardt et al., 2010; Wiggering et al., 2006). Nevertheless, agriculture has rarely been considered in interaction with urbanised zones, even if research started addressing ecosystem-services issues in peri-urban planning for food (Tedesco et al., 2017). Nevertheless, attempts to build a peri-urban agriculture typology are rare. Some economic studies are based on Von Thünen’s model of agricultural land-use, which classifies farming in four rings depending on distance from city-centre (Von Thünen et al., 1826). According to this rationale for land-use distribution and spatial-economic relationships, adjacency to the urban market determines the profitability of agriculture, measured in terms of transport cost and locational rent, hence the location of each farming type. In addition, geographers have described diverse dynamics and typologies from the

analysis of case studies, focusing on the heterogeneity and dynamism of peri-urban farming (e.g. Jones and Bryant, 2016; Marraccini et al., 2013) or on the relation between farming activities and landscape changes (e.g. Kizos and Kristensen, 2011). They show that different forms of agriculture coexist on the urban-rural fringe and can be divided into two main categories: a) “independent” farms that are not constrained by the urban influence to define their business strategy; and b) farms that are functionally linked to the city or that have appeared with it. In the first category (a), we can further distinguish two major typologies: a.1) profitable and non-dependent on the local market, historical farms that have become peri-urban because of nearby urban expansion (Pérés, 2007); and a.2) stable farms with long-term intensification and/or specialisation strategies, aware of marketing strategies, selling on both long and short supply chains, and dependent on international pricing rather than on the urban market (Aubry and Kebir, 2013b). Within the category of farms under urban influence (b), we can distinguish four major types: b.1) those specialised in high value-added products selling mainly on short supply chains (Zasada, 2011; Zasada et al., 2013b) sometimes oriented to public canteen food supply (Darly and Aubry, 2014; Morgan and Sonnino, 2010); b.2) farms with a short-term extensification strategy based on opportunities offered by subsidy policies (e.g. subsidies to durum wheat under the Common Agricultural Policy, CAP) and which cultivate a variable number of temporarily available land plots, usually pending their conversion from agricultural to developable land-use (eg. residential, commercial, etc.), a situation of extreme insecurity for farmers concerning cultivable land-plots availability (Geniaux et al., 2011; Jouve and Napoléone, 2003; Soulard, 2014); b.3) farms with diversification and pluri-activity strategies seeking additional sources of income to compensate for lack of profitability from an intersectorial strategy (Lange et al., 2013), offering services that respond to the urban demand for recreational and environmental farming (Bailey et al., 2000; Ilbery, 1991; Wilson, 2007), including : b.3.1) horse-keeping and equine services (Elgåker, 2012; Zasada et al., 2013a), b.3.2), the so-called “lifestyle farming” best known in its part-time form (Primdahl, 1999; Zasada, 2011) and b.3.3) agri-tourism or accommodation facilities (Sharpley and Vass, 2006; Yang et al., 2010); and finally, b.4) small and medium-sized unstructured, non-dynamic and non-competitive farms, often devoted to retirement farming and hobby farming (Busck et al., 2008; Præstholm and Kristensen, 2007).

These studies are based principally on thorough field-work and interviews, combined with statistical analysis of census data. As such, they usually require major financial and time investments, which limits their potential as a support for planning usable by policy makers and stakeholders. An alternative approach proposed by urban economists is to implement accurate peri-urban farm location models based on exhaustive databases and complex mathematical tools (Cavailhès and Wavresky, 2007; Geniaux et al., 2011). The drawback of this approach is that it requires highly detailed (plot-level) databases that are usually unavailable in most countries, and analytical skills that are beyond the reach of many public non-research institutions. Furthermore, aggregated patterns discovered in *département*-level (similar to NUTS-3 level) agricultural census data cannot encompass the great diversity of individual farms, so that substantial amounts of valuable information are missing (e.g. Clark et al., 2007). Moreover, simplified models are unable to disentangle diverse farming strategies, which are not mutually exclusive and can be related to different adaptation strategies (Smithers et al., 2004). Field-work and interviews are therefore still key to understanding farming dynamics at *département*-level.

The key research objective of this paper is to define a systemic and generic methodology, operational for public land-use managers and landscape planners and potentially usable in different peri-urban areas. Here, agriculture is considered in its productive dimension and not only as open green space, as is often the case in landscape planning.

We propose in Section 2 a methodology to situate, characterise and represent peri-urban agriculture that aims at integrating agricultural

² http://agriculture.gouv.fr/sites/minagri/files/documents/pdf/140514-ONCEA_rapport_cle0f3a94.pdf.

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