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Assessing the economic marginality of agricultural lands in Italy to support land use planning

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ABSTRACT

Agricultural marginality is a multifaceted issue, being related to place-specific socioeconomic contexts and highly-variable technological conditions. The coexistence of different classification systems of these variables makes hard any attempt to have a general definition of agricultural marginality. Moreover, the spatially explicit identification of marginal lands is still challenging mostly due to the lack of reliable data sources at both country and regional scale. Accordingly, this paper evaluates the degree of economic marginality of agricultural land, using Italy as a representative case study for southern Europe. A spatial analysis of farmland profitability and constraints for agricultural activities (topography and biodiversity conservation) is proposed to identify three classes of agricultural land, namely 'unsuitable', 'supramarginal' and 'marginal' lands. Results show that almost 39% of agricultural land in Italy can be classified as 'marginal'; its spatial distribution and characteristics are also analyzed and discussed in relation to different background conditions. The proposed approach provides a valuable methodology supporting land-use planning and decision-making under restricted geo-spatial data availability.

1. Introduction

Although the notion of "marginal land" is frequently used by policy makers, practitioners and researchers, there is not a common, clear and unambiguous definition of marginality (*e.g.* Dauber et al., 2012). Marginal lands are sometimes intended as a synonym for unused, degraded, abandoned, under-used, fallow and free land, often stimulating an animated linguistic debate and possible misunderstanding (Shortall, 2013). As a matter of fact, the definition of marginal land varies according to the aim for which this term is used and to the given background context to which it is operationally applied (Edrisi and Abhilash, 2016).

There are at least two groups of definitions for 'marginal land': those related to biophysical aspects and those based on socioeconomic conditions which turn out to be constraints for agricultural activity (*e.g.*, Edrisi and Abhilash, 2016). Looking at the biophysical aspects, marginal land features poor and badly drained soils, restricted nutrient and water availability and steep slopes, affecting (more or less intensively) the overall productivity level (Lewis and Kelly, 2014). This notion is consistent with what was proposed by Peterson and Galbraith (1932), which define marginal lands as the "margins of cultivation", where revenues are equal to (or lower than) the costs of production. Additional definitions have been provided by Rabbinge (1993) and Van Orshoven et al. (2013), respectively based on crop growth and biophysical constraints for agriculture. Land capability has also been used by earlier studies to identify and characterize marginal lands (Lewis and Kelly, 2014). FAO and UNEP (2010) have classified land supporting a yield of up to 40 percent of its crop potential as marginal. This implies a crop-specific definition of marginality. In addition, the distinctiveness of marginal land from degraded land was emphasized, the latter specifically referring to land/soil degradation phenomena (Salvati and Zitti, 2005) defined as "(…) any decline in ecosystem function and services over an extended period (…)" (MEA, 2005).

From a socioeconomic perspective, marginal lands are considered areas where "cost-effective production is not possible under given conditions, cultivation techniques, agriculture policies as well as macro-economic and legal settings" (Dauber et al., 2012). More precisely, earlier studies have provided a rigorous definition referring to

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the notion of 'economic sub-marginality' (Cullen and Pretes, 2000) with the aim to outline areas with serious problems of profitability (Cullen and Pretes, 2000; Monti and Cosentino, 2015): submarginal economic land resources would require a substantially higher commodity prices or a major cost-reducing advance in technology and management practices to reach a condition of economic viability. Economically marginal lands are in fact defined by Turley et al. (2010) as "less productive land closer to the break-even economic margin".

Under both biophysical and socioeconomic criteria agricultural marginality is a dynamic condition depending on the considered crop, the technological level and the specific background conditions (*e.g.* market accessibility, management practices, prices and producers' market power) in a given area (Soldatos, 2015). Therefore, land classified as marginal in a given place or time might be considered as non-marginal in different spatio-temporal conditions (Allen et al., 2016; Edrisi and Abhilash, 2016; Lewis and Kelly, 2014). Hence, a current non-marginal land could be classified as marginal (and vice versa), depending on *e.g.* commodity prices, market choices, planning regulations and technology development. Based on these premises, the concept of 'marginality' is intuitively referred to transitions from unproductive (unused) to productive (used) land, or from sub-marginal to supra-marginal land along spatially-varying background conditions.

A definition of marginal lands based on three marginality classes has been provided by Shortall (2013), who discriminates between lands unsuitable for food production, ambiguous (lower quality) lands, and economically-marginal lands. The latter class is particularly relevant in order to predict future destination of marginal land, including, for instance, land abandonment and multiple options for a cultivation shift to crop suitable for bioenergy production (Russi, 2008). A low soil production level is reflective of land where significant changes in allocation and use are most likely to be observed.

Among the others, there is a rising interest around marginal land potentially available for bioenergy production, minimizing – as much as possible – the competition between food and non-food land-uses. In this context, identifying and characterizing marginal land according to its best potential in relation to the competitive use for food *vs* bioenergy production, contribute to design policies that may prevent indirect land-use changes (Kluts et al., 2017; Soldatos, 2015). These issues are relevant in Europe, and especially in southern European countries like Italy, where (i) land abandonment is particularly relevant and increasing over time in the last decade (Pagliarella et al., 2016), (ii) national harmonized datasets or maps identifying and classifying marginal land are still missing or covering only small areas of the country (Allen et al., 2016), (iii) assessment of marginal land could effectively support the implementation of policy strategies such as those on the "Less Favored Areas" for the allocation of CAP-RDP (Common Agricultural Policy-Rural Development Policy) incentives, or on the bio-based economy policy of the EU (*i.e.*, the Renewable Energy Directive (2009/28/EC)).

Lewis and Kelly (2014) have described the evolution of marginal land evaluation under continuous improvement in Geographical Information Systems (GIS) and remote sensing techniques, which also allow spatially-explicit identification of land characteristics and estimation of the potential supply of woody biomass (*i.e.*, in Italy, Maesano et al., 2014). Land suitability for biomass production was also investigated through comprehensive approaches based on multiple working hypotheses, criteria and thresholds (Lasserre et al., 2011), at local scale. Particularly, Lewis and Kelly (2014) find differences depending on the scale of application and the aim for which the analysis of land marginality was carried out, which in turn affect data availability and the use of specific criteria and thresholds (*i.e.*, crop specific) hampering data comparability at broader spatial scales (*e.g.* from regional to country). At the same time, methodological and conceptual constraints to standardized, consistent and reliable approaches to marginal land evaluation have been extensively discussed (Lewis and Kelly, 2014). Accordingly, further research is required to increase reliability and replicability of the proposed operational frameworks (*e.g.* improving definitions, factors and thresholds used to discriminate among different conditions of land marginality), technical accuracy (*e.g.* data consistency over time and space, and with the main analysis' objective) and standardization, allowing comparability among empirical studies (Salvati and Zitti, 2011). These improvements will respond to specific demands and needs for which these information are produced.

Based on these premises, the present study evaluates the degree of economic marginality of agricultural land in Italy in a spatially-explicit framework. These information are useful to support land use planning (*i.e.*, the assessment of potential land availability for bioenergy production and for other non-food uses of agricultural biomass). We specifically refer to an economic marginality notion using the Average Value of Agricultural Land (AVAL), a detailed, place-specific information collected and updated by the Italian Revenue Agency at provincial level in Italy for any type of farmland (available at http://www.agenziaentrate.gov.it/wps/content/Nsilib/Nsi/Schede/FabbricatiTerreni/omi/Banche+dati/Valori+agricoli+medi/?page=fabbricatiterrenicitt). These data are used in any official transaction (*e.g.* compulsory purchases) as reference land values. AVAL is then an official detailed measure of farmland capital values that in our study, are used as a proxy for land profitability, introducing additional evaluation criteria (*i.e.* topography and protected areas) which allow for a better characterization of land resources under different regulative and physical constraints. We considered Italy a representative case study for southern Europe offering general remarks in order to make the proposed approach replicable in other contexts with limited availability of large-scale harmonized data. Results are discussed according to the peculiar socioeconomic conditions of the investigated land, highlighting the importance to provide reliable maps and spatially-explicit datasets forming a base to decision-making.

2. Methodology

2.1. Economically-marginal land in Italy

Italian territory presents high climatic, topographic, geological, and ecological variability (Falcucci et al., 2007). Italy extends nearly 300,000 km^2, mainly dominated by cropland (33% of the national territory) and forests (32%). Urban settlements covers about 7% of the national territory (Pagliarella et al., 2016), one of the highest percentage within the European Union, still increasing despite the demographic shrinkage recently observed in Italy (ISPRA, 2016) and expanding primarily into high productivity agricultural land (Rivieccio et al., 2017). Mountains cover about 28% of the country's area (Sallustio et al., 2014). However, according to the current national legislation framework – originally referring to mountain areas as "less favorable" (and possibly marginal) areas – the formal definition of "mountain" was extended to nearly 59% of the national territory. This formal definition was adopted in order to assign economic incentives and subsidies to candidate rural districts through dedicated development strategies implemented at national and regional scales (Salvati and Carlucci, 2011). More recently, a National program called "National Strategy for Inner Areas" (Lucatelli, 2015) was implemented with the aim to promote permanence of specific population segments in inland, peripheral rural and mountainous districts (the so called "inner areas"), while promoting their socioeconomic development. Even in this case, the concept of inner areas could be someway referred to that of socioeconomic marginality, but without a specific mention to agricultural land-use. Hence, in this case, the distance from the nearest urban centre with upper functions (a hospital, a secondary school and a train station of national relevance) was used to characterize Italian municipalities: at the end of the selection phase, almost 60% of the country's territory was defined as "inner areas", mostly represented by municipalities in mountain areas and at considerable distance from