

## Chapter 78

# Indicators of Land Degradation Vulnerability due to Anthropogenic Factors: Tools for an Efficient Planning

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### ABSTRACT

*Land degradation is one of the most impacting phenomena on natural resource availability, both in quantitative and qualitative terms. In order to provide efficient tools for territorial sustainable management in areas affected by land degradation, it is important to define suitable models and indicators able to identify exposed areas and their vulnerability level, so as to provide an effective support for decision makers in identifying intervention priorities and planning mitigation/adaptation strategies. This work is focused on the evaluation at high spatial detail of land degradation vulnerability due to anthropic factors, which is a crucial issue in areas devoted to farming practices. Vulnerability is evaluated by integrating a new indicator of the mechanization level the authors recently developed, with a set of census based indicators of land management. The new indicator is independent of census data being based on land cover data; thus, it can provide a better spatial characterization and a more frequent updating compared to commonly adopted indices that are evaluated at municipal scale. By analyzing data for the whole Southern Italy, such an indicator was integrated for the first time at full spatial resolution to obtain a final vulnerability index of land management. This comprehensive index enabled a more accurate estimation of the land degradation vulnerability due to anthropic factors allowing the discrimination of priority areas within the municipal areas.*

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## INTRODUCTION

A substantial part of Southern Italy (~25%) was found to be affected by high or medium-high vulnerability levels due to management factors. In particular, the heavy use of agricultural machineries and modifications of cultivated areas, mainly linked to land abandonment (~40%), represent the principal factors inducing vulnerability to land degradation in Southern Italy; thus management policies devoted to reduce intensive agriculture and promoting the requalification of abandoned areas are suggested to mitigate the territorial vulnerability of the investigated regions.

Land use planning is a fundamental discipline for the setting up of sustainable development strategies, accounting for the territorial development needs as well as for impacts induced, directly or indirectly, on the different environmental matrices: soil, water, vegetation and atmosphere. In recent years, the considerable growth of technologies, such as remote sensing and GIS software, enabled to noticeably increase the understanding of the environmental components, highlighting their peculiarities and criticalities. Geographically referred information on environmental and socio-economic components represent a heritage of knowledge which can be favorably exploited to identify vulnerable areas, distinguishing also different vulnerability levels. Such a possibility reaches even more relevance if we consider the increasingly significant impact of climate change and land transformation processes, consisting in rapid and frequent modifications of land use patterns (Hill et al. 2008; Simoniello et al. 2008; Lanfredi et al. 2004).

Among the phenomena able to deeply reduce the availability and quality of natural resources, a dominant role is accomplished by land degradation, defined as the “loss of actual or potential biological and economic productivity” (UN/FAO, 2003). It is the result of a non-sustainable resource exploitation associated with territorial structural

weaknesses related to soil, vegetation, and climate (EEA, 2005; Reynolds et al. 2007).

In the context of land degradation processes, climate or climatic change act as boundary conditions and human actions are fundamental to lead to degradation (Baartman et al. 2007). This is especially true for the developed countries where anthropogenic factors (e.g., population pressing, tourism growth, agriculture intensification, industrial development) represent the main cause of land degradation phenomena (EEA, 2005). Specifically, in the past 50 years the Mediterranean area has seen an increase in population which has had a direct effect in soil sealing due to urban development into productive lands (Brandt et al. 2003). Urbanization has had serious consequences in terms of loss of areas previously devoted to forestry or agricultural practices, decline in soil quality, increase in fire risk and in salinization/alkalinization phenomena (Garcia Latorre et al. 2001; Tanrivermis, 2003; Salvati and Zitti, 2007). In addition, Mediterranean agricultural techniques have been transformed to cope with the increasing food demand so favoring intensive agriculture especially in lowland areas (Trisorio, 2005). Intensive agriculture can be positively regarded in terms of crop yield increase and technical skill improvements, but it also produces significant unfavorable effects on soil and habitat preservation (Brouwer et al. 1991). Inappropriate practices, such as deep water drainage, large-scale irrigation, heavy pesticide/fertilizer use and heavy mechanization are directly involved in the degradation of agricultural and semi-natural areas across huge territories (European Commission, 2000). Moreover, six of the soil degradation processes recognized by the European Commission (water, wind and tillage erosion, soil organic carbon decline, compaction, salinization and alkalinization, contamination and soil biodiversity reduction) are identified as threats induced by agriculture (Gay et al. 2009). Also overgrazing is considered as a driving force in generating land degradation, particularly for many areas of Southern Europe it

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