Estimating the sensitivity to desertification of Italian forests

Riccardo Salvati (1), Luca Salvati (2), Piermaria Corona (3), Anna Barbatì (1),
Agostino Ferrara (4)

The present study assesses the level of sensitivity to desertification of forest types in Italy between 2000 and 2010 on a fine resolution scale using the Environmental Sensitive Area (ESA) scheme. The proposed methodology identifies and ranks the level of sensitivity of fourteen forest types and quantifies the changes in their level of sensitivity over time as a contribution to understanding of complex landscape-forest interactions in Mediterranean ecosystems. Only few forest types showed a relatively high sensitivity level, suggesting that forests may positively contribute to the mitigation of land degradation processes in the Mediterranean region. Forest types showing the highest sensitivity are native types mostly adapted to dry Mediterranean landscapes, introduced vegetation types and highly-fragmented and heterogeneous forest types. Results suggest that: (i) high-quality and biodiversity-rich forest types (e.g., beech, mountain pine forests) may act as vegetation buffer mitigating the increase of land sensitivity to desertification at the landscape scale; and (ii) the remaining forest types (especially highly fragmented, low-quality or low-biodiversity classes in areas with severe soil and climate conditions) may undergo increases in land sensitivity to desertification and should be protected through specific management measures as also implemented in the framework of the National Action Plans to Combat Desertification.

Keywords: Environmental Indicators, ESAI, Desertification, Forests, Mediterranean Basin, Climate, Soil

Introduction
Global warming, economic development, social disparities and population growth are considered key drivers of Land Degradation (LD) over large areas. Desertification is a worldwide LD process which affects about 40 per cent of the Earth’s surface, including large regions in developed countries such as United States, Australia and Europe (Johnson & Lewis 2007). Climate aridity, soil degradation, decreasing quality of the vegetation cover, along with the increasing anthropogenic pressure on land, are regarded critical factors for the intensification of LD processes especially in southern Europe (Salvati & Bajocco 2011). In the Mediterranean region, specifically anthropogenic stressors and biophysical factors usually go hand in hand in the development of LD phenomena (Drake & Vafeidis 2004, Costantini et al. 2009, Salvati et al. 2009).

The Annex IV of the United Nations Convention to Combat Desertification, specifically dealing with the Mediterranean region, highlights the two-fold position of forests as a land cover (i) potentially mitigating the severity of specific processes of land degradation, like soil erosion, and (ii) experiencing cumulative pressures that may lead to LD due to forest fires, overgrazing and wood overexploitation and climate change (Corona et al. 2006, Salvati et al. 2013a). As a matter of fact, forest land in the Mediterranean basin is, to a large extent, confined to remote and steep soils with low organic matter and low levels of aggregate stability; this produces a high risk of soil erosion when vegetation cover is scarce and water is a limiting factor, especially in dry climate regimes with intense rainfalls (Vallejo et al. 2006). Moreover, the rapid rate of current climate change has the potential to render many plant species unable to track variations in climate quality (Jump & Penuelas 2005); this is particularly true for tree species, as their long life-span does not allow for local adaptation to rapid environmental changes (Kolström et al. 2011).

Despite extensive research on LD and desertification in the Mediterranean basin, studies specifically addressing variability in sensitivity to desertification within large forest regions are lacking. In this regard, Italy is an interesting case, as nearly 52% of the territory is regarded to be at potential risk of desertification (Costantini et al. 2009), and over one-third is covered by forests and Other Wooded Lands (OWL, mainly represented by Mediterranean sclerophyllous shrubland - INF.C 2007). Furthermore, like other southern European countries such as Spain and Greece, Italy shows large socioeconomic disparities and, accordingly, displays different levels of anthropogenic pressure and forest management quality on a regional scale (Salvati 2012). Also differences in carbon accumulation and primary production are very high, both among and intra different forest types (Maselli et al. 2006, Manzini et al. 2009, Nolet et al. 2013). Thus, a combination of a great variety of biophysical conditions and of socioeconomic factors makes Italy a kaleidoscopic case study to analyze patterns of sensitivity to LD in areas covered by forests and OWL and their dynamics over time (Conacher & Sala 1998, Salvati et al. 2009).

Building on these premises, the present study is aimed at assessing the level of sensitivity to desertification of lands covered by forests and sclerophyllous vegetation in Italy at two points in time (early-2000s and late-2000s) using the Environmental Sensitive Area (ESA) methodology. Stratification of this target land cover class by fourteen vegetation types allows to deeply explore patterns of sensitivity to LD across space and time.

Material and methods

Study area
Due to its geographical position in the middle of the Mediterranean, Italy is characterized by a variety of climate regimes ranging from the Mediterranean dry climate to humid conditions.