



Free and Open Source Software for land degradation vulnerability assessment

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Nowadays the role of FOSS software in scientific research is becoming increasingly important. Besides the important issues of reduced costs for licences, legality and security there are many other reasons that make FOSS software attractive. Firstly, making the code opened is a warranty of quality permitting to thousands of developers around the world to check the code and fix bugs rather than rely on vendors claims. FOSS communities are usually enthusiastic about helping other users for solving problems and expand or customize software (flexibility). Most important for this study, the interoperability allows to combine the user-friendly QGIS with the powerful GRASS-GIS and the richness of statistical methods of R in order to process remote sensing data and to perform geo-statistical analysis in one only environment.

This study is focused on the land degradation (i.e. the reduction in the capacity of the land to provide ecosystem goods and services and assure its functions) and in particular on the estimation of the vulnerability levels in order to suggest appropriate policy actions to reduce/halt land degradation impacts, using the above mentioned software. The area investigated is the Basilicata Region (Southern Italy) where large natural areas are mixed with anthropized areas.

To identify different levels of vulnerability we adopted the Environmentally Sensitive Areas (ESAs) model, based on the combination of indicators related to soil, climate, vegetation and anthropic stress. Such indicators were estimated by using the following data-sources:

- Basilicata Region Geoportal to assess soil vulnerability;
- DESERTNET2 project to evaluate potential vegetation vulnerability and climate vulnerability;
- NDVI-MODIS satellite time series (2000-2010) with 250m resolution, available as 16-day composite from the NASA LP DAAC to characterize the dynamic component of vegetation;
- Agricultural Census data 2010, Corine Land Cover 2006 and morphological information to assess the vulnerability to anthropic factors mainly connected with agricultural and grazing management.

To achieve the final ESAs Index depicting the overall vulnerability to degradation of the investigated area we applied the geometric mean to cross normalized indices related to each examined component.

In this context QGIS was used to display data and to perform basic GIS calculations, whereas GRASS was used for map-algebra operations and image processing. Finally R was used for computing statistical analysis (Principal Component Analysis) aimed to determine the relative importance of each adopted indicator.

Our results show that GRASS, QGIS and R software are suitable to map land degradation vulnerability and identify highly vulnerable areas in which rehabilitation/recovery interventions are urgent. In addition they allow us to put into evidence the most important drivers of degradation thus supplying basic information for the setting up of intervention strategies.

Ultimately, Free Open Source Software deliver a fair chance for geoscientific investigations thanks to their high interoperability and flexibility enabling to preserve the accuracy of the data and to reduce processing time.

Moreover, the presence of several communities that steadily support users allows for achieving high quality results, making free open source software a valuable and easy alternative to conventional commercial software.