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*Project Report*

# The Medalus project
# Mediterranean desertification and land use

## Manual on key indicators of desertification and mapping environmentally sensitive areas to desertification

ENERGY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

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European Commission

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## Manual on key indicators of desertification and mapping environmentally sensitive areas to desertification


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## 2. The Agri basin (Italy) ([1])

**F. Basso, A. Bellotti, S. Faretta, A. Ferrara, G. Mancino, M. Pisante, G. Quaranta**
*Università degli Studi della Basilicata, Dipartimento di Produzione Vegetale*

### 2.1 Application of the derived methodology

Based on the above methodology, four quality maps were produced for the Agri basin, as well as the final evaluation of the Environmental Sensitivity at basin level. All maps produced by the system have the final scale of 1:50 000; all values in the data base are continuous and the maps that follow are reduced in classes and colours for publishing reasons.

Fig. 34 shows the resulting soil quality layer; as we can see, the majority of the basin (65% of the area) has a low quality of soils (values > 9.6) even if a certain part of these soils have scores very close to the threshold value. A lower part of the basin has moderate quality (33%) and only a very little part can be assigned to the better quality (2%). This is resulting by the presence of large parts of areas with slopes greater than 18% (that cover about 62% of the area in Agri basin), an high presence of soils, having depth less than 30 cm (30% of the area) and an important presence of clays soils highly degraded, all factors that favour high erosion rates and occurrence of landslides in some cases. Better soils are mainly situated in the flat areas of the upper valley and along the main rivers.

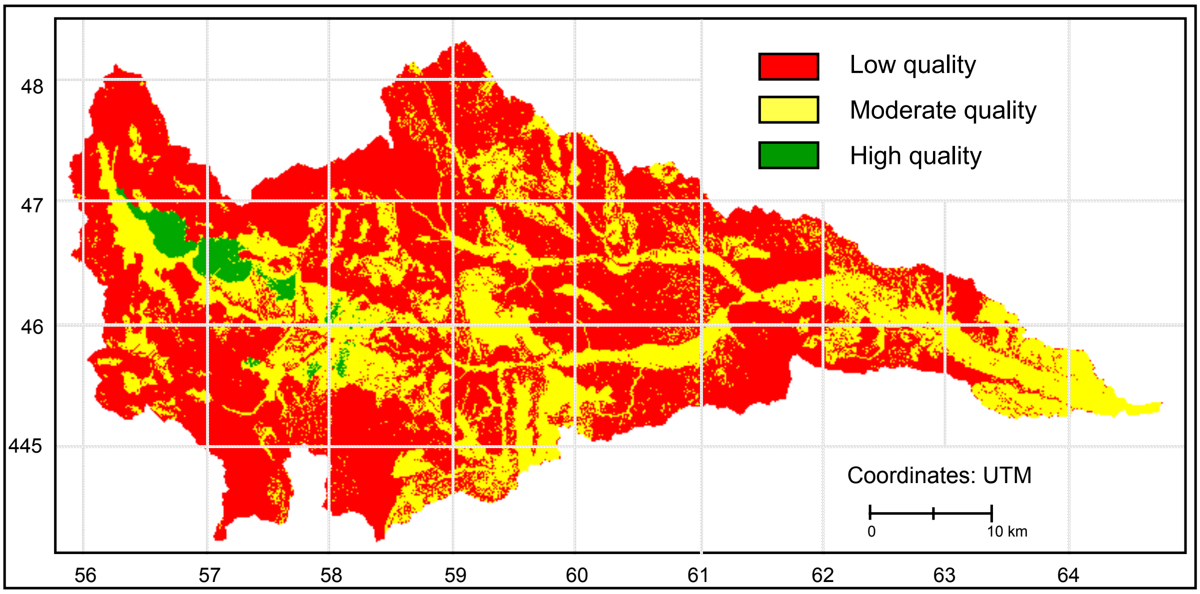


**Fig. 34. Soil quality map of the Agri basin related to desertification risk.**

[1] Research conducted with the aid of European Union funds "MEDALUS III Project. Basso and Pisante had mainly developed the agronomic aspects, Quaranta those socio-economic, Bellotti, Faretta, Ferrara, Mancino and Taberner the other aspects as well as the development and the application of the model.

Fig. 35 shows that a very great part of the basin is characterised by high (47%) and moderate climate quality (52%). Only a very little part (1%), near the Ionian sea, falls into low quality class. This can be mainly attributed to high rates of rain that occur in large parts of the basin. Rainfall is in fact about 2000 mm per year on Monte Sirino (west part of the basin) and 500 mm per year along the Ionian coast showing a consistent increase with increasing elevation. In addition, the average annual temperate is strictly related to elevation, ranging from 8 $^{o}$C on the mountains to 16 $^{o}$C in the middle and lower valley. Taking into consideration the Bagnouls-Gaussen aridity index, 48% of the Agri basin is characterised as moist with an aridity index less than 50. The rest of the basin is characterised as dry with an aridity index ranging from 50 to 125, and only 2% of the area has a very dry climate (aridity index 125-150). As for slope aspect, south-facing slopes are widely diffused creating favourable climatic conditions for land degradation and desertification. In the whole, the Agri Valley can be characterised as having a cool temperate mediterranean climate with a strong gradient from the coastline to the mountainsof the interior.

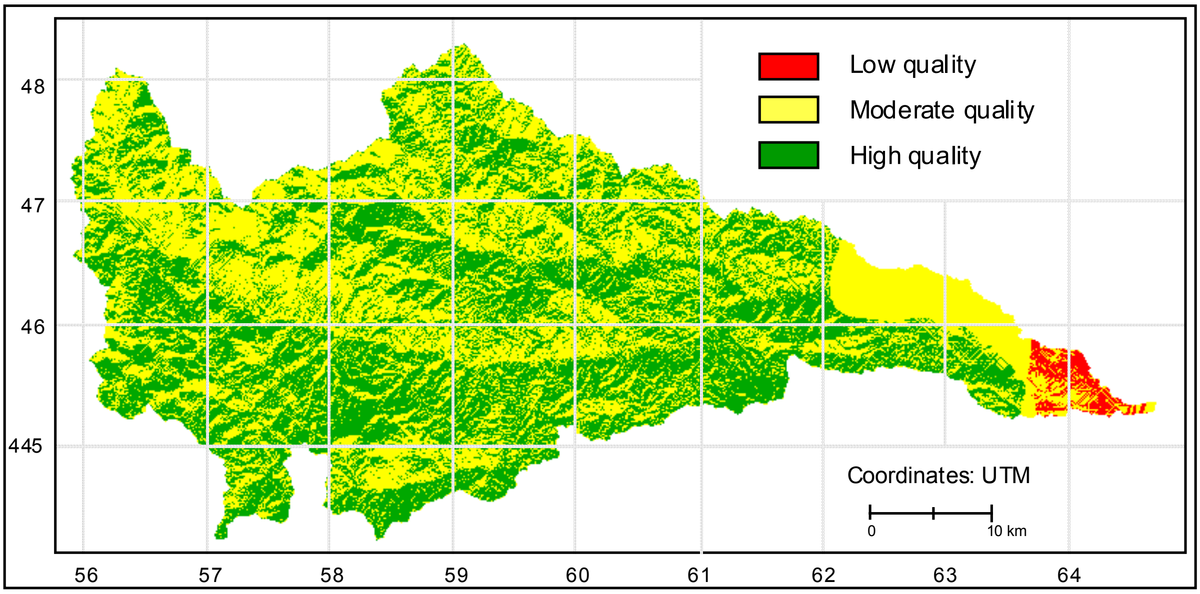


**Fig. 35. Climate quality map of the Agri basin related to desertification risk.**

Vegetation cover and vegetation physical structure are important factors concerning erosion. As Fig. 36 shows, a large part of the basin has a low quality vegetation (45%), another important part has a good quality (30%) and a minor part has moderate quality (25%). This is resulting by the fact that a significant part of the Agri basin has vegetation with very low ability in protecting the soil from erosion. This part corresponds mainly to areas cultivated with cereals or with a very low vegetation cover, in which we have more favourable conditions for overland flow and erosion and also an high sensitivity to drought. Fire risk seems to be a critical factor mainly in the lower part of the Agri basin, in areas prevailing covered by mediterranean macchia and pine forests. Considering also that vegetation cover is a crucial element in soil erosion control on slopping areas, a considerable part of the Agri basin (42%) has a vegetation cover less than 40% and it is subjected to very high erosion risk. Areas with vegetation cover less than 10% represent an important part 18% and are highly threatened for desertification, creating also serious flooding problems in the surrounding areas.

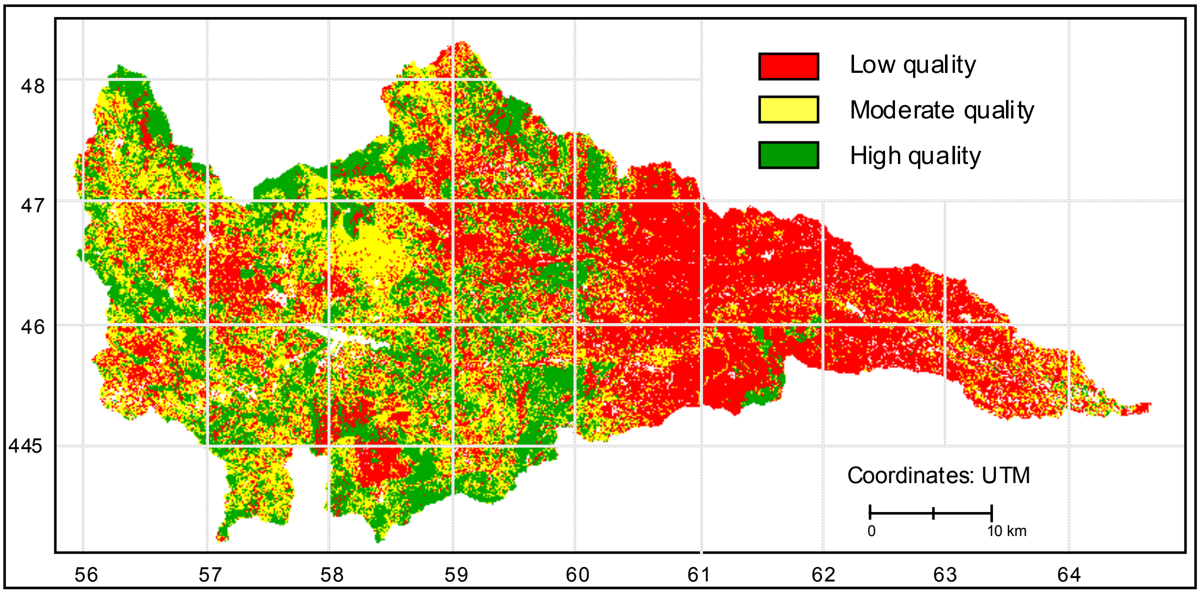


**Fig. 36. Vegetation quality map of the Agri basin related to desertification risk.**

Figure 37 shows the management quality of the basin. It must be noted that the basin, in the whole, is divided in two separate parts, one mainly corresponding to the upper valley and covering about the 48% of the surface, in which we have a moderate quality of the management indicators. The second part, that covers the remaining areas of the basin, and that presents a low quality of the management. This situation is mainly derived by the scarce enforcement of the management and the policies in relation to the environmental protection.

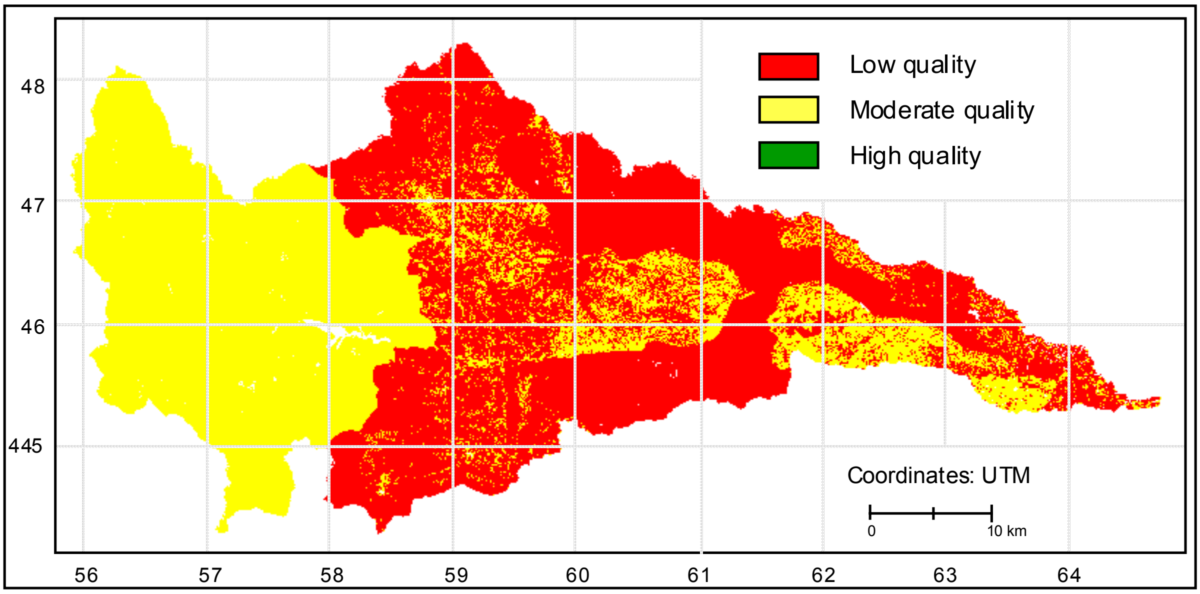


**Fig. 37. Management quality map of the Agri basin related to desertification risk.**

The map of Environmentally Sensitive Areas to desertification for the Agri basin is presented in Fig. 38. It clearly shows that a large part of the basin falls into the critical and fragile classes with a certain presence of potential or not threatened ones. 45 % of the basin is classified as Critical (with a mayor presence of C2 class), 34 % as Fragile (with large parts of the basin falling into F3) and only 4 % as Potential or Not Threatened.

The Critical areas (C1, C2 and C3) are mainly located in the middle and lower part of the basin and are mainly represented by Calanchi areas, and other areas in which the presence of clays, very low vegetation cover, high slopes, forest fires, overgrazing and low management quality produce a very high risk of soil degradation and a very high sensitivity to desertification.

The Fragile areas (F1, F2 and F3) are more widespread along the basin and are represented by zones in which management factors, quality of soils and climate are, in the whole, not very critical but in which little decrease of the quality of one of these factors can produce very critical situations.

The Potential and Not Threatened areas are mainly localised in the upper part of the valley and in any other parts where favourable climate and soil conditions (flat and deep soils with high annual rainfalls), good vegetation cover and efficient management are found.

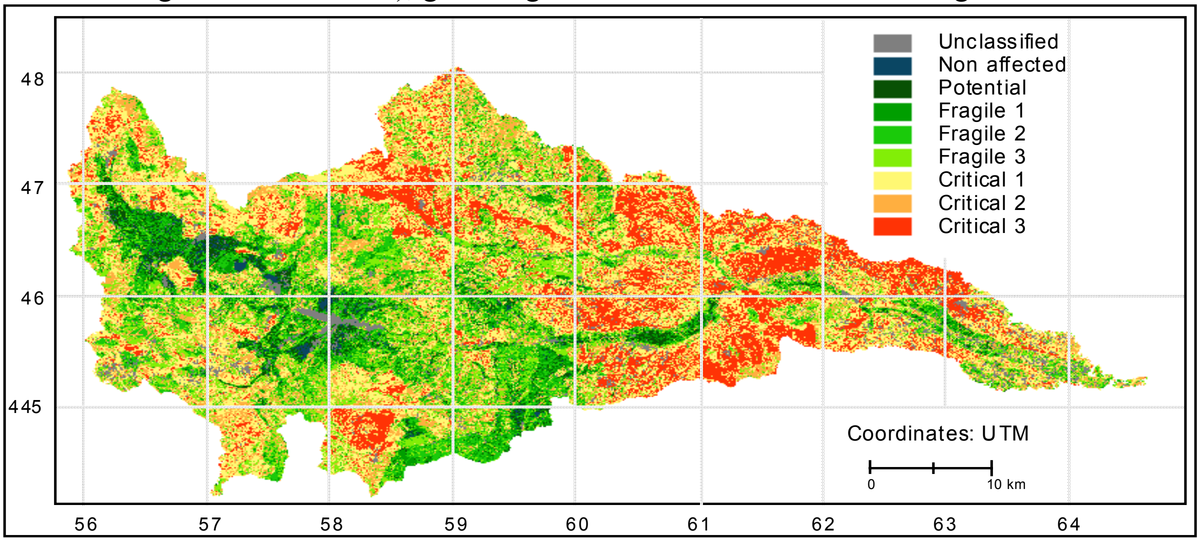


**Fig. 38. Map of Environmentally Sensitive Areas to desertification for the Agri basin**

## 3.2. An example of application of the ESAs estimate for land use management

Using the defined ESAs, a sensitivity analysis was conducted at municipality level. The following is an example of an analysis performed in the Agri basin on the different degrees of Environmental Sensitivity at Municipality level. The frequency of the different classes of all the used layers was considered for each municipality. A cluster analysis was applied on the obtained matrix of data, utilising the complete linkage and Euclidean distance methods. Figure 39 illustrates the resulting dendrogram.

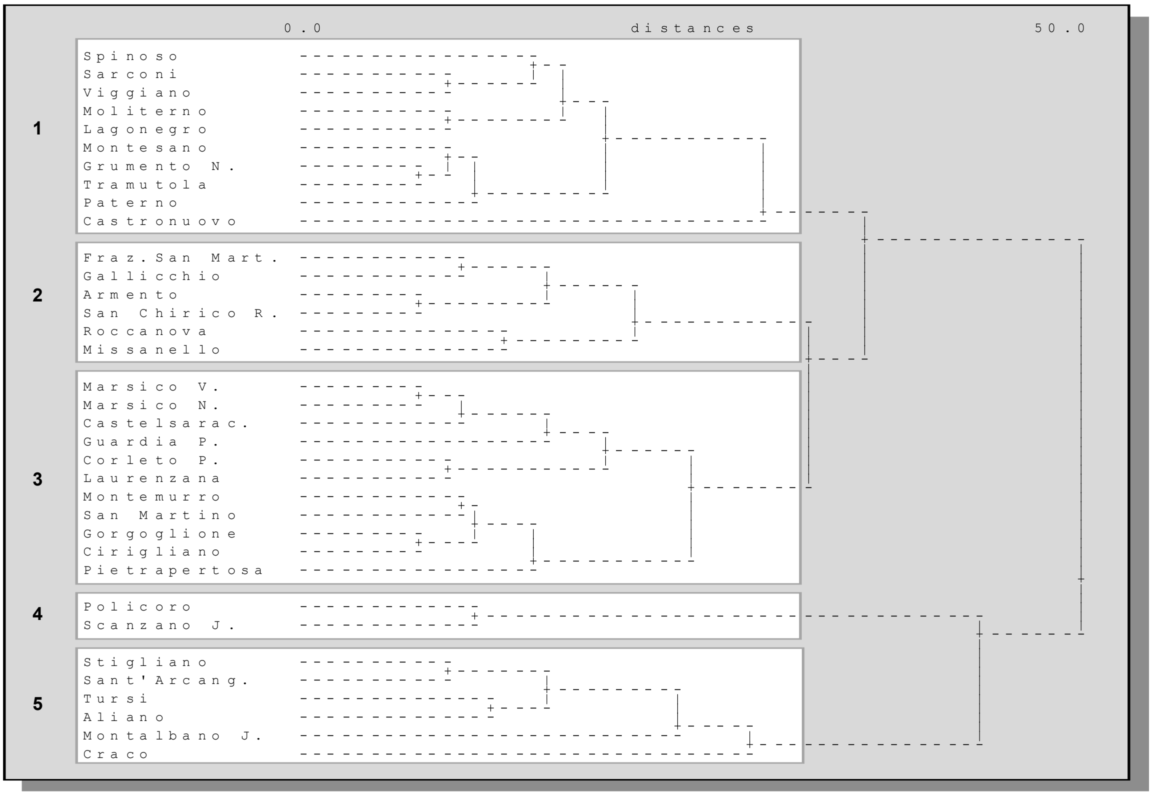


**Fig. 39. Cluster analysis (Municipalities of the Agri Basin); complete linkage method; Euclidean distance.**

By the analysis of the data reported in Fig. 39, it is possible to distinguish five sensitivity groups, or typologies, that correspond to five zones along the basin and represent five well defined environmental and socio-economic realities. Starting from these five groups it is possible to characterise the content of the different sensitivity grades through the analysis of the contribution that each layer gives (or groups of layers) to the definition of the sensitivity level. In this case the "quality level" has been chosen as an example to illustrate the kind of approach more simply.

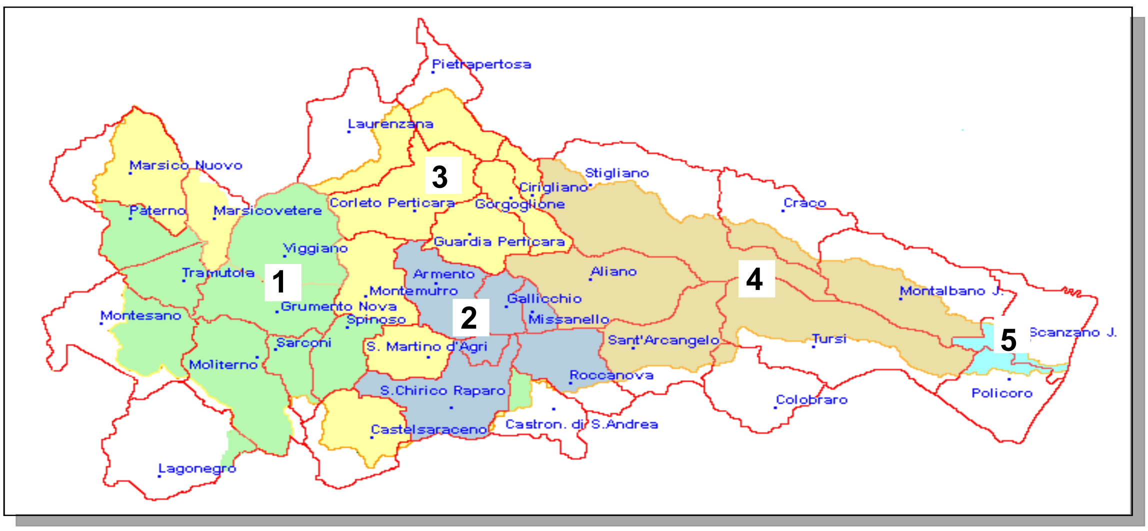


**Fig. 40. Location, along the basin, of the groups of Municipalities obtained by cluster analysis.**

Fig. 41 illustrates the graphs relative to the percentage of different Environmental Sensitivity grades of the four qualities and the municipality groups obtained by the cluster analysis. As we can see, it is possible to derive more and detailed information that can be used for management purposes by different levels of decision-makers. If we examine the graph on Fig. 41 we can see how the municipality groups 1, 2 and 3 have quite the same climate (all three are located in the Upper Val d'Agri). Group 1 differs for its criticality of socio-economic factors and a worse overall quality of soil factors, which need to be closely considered in this ambit; instead group 2, has better vegetation qualities associated to very critical socio-economic factors. Groups 4 e 5 differ, even though are similar from a geographical point of view: group 5 is characterised by a better level of socio-economic factors and by the worst climatic ones found in the basin, instead group 4 has worse vegetation conditions. In this ambit, supposing that sensitivity critical factor of an area is the 'vegetation' it is possible, in a very simple way, to define the characteristic, the priorities and the amount of interventions to mitigate the ongoing phenomena.

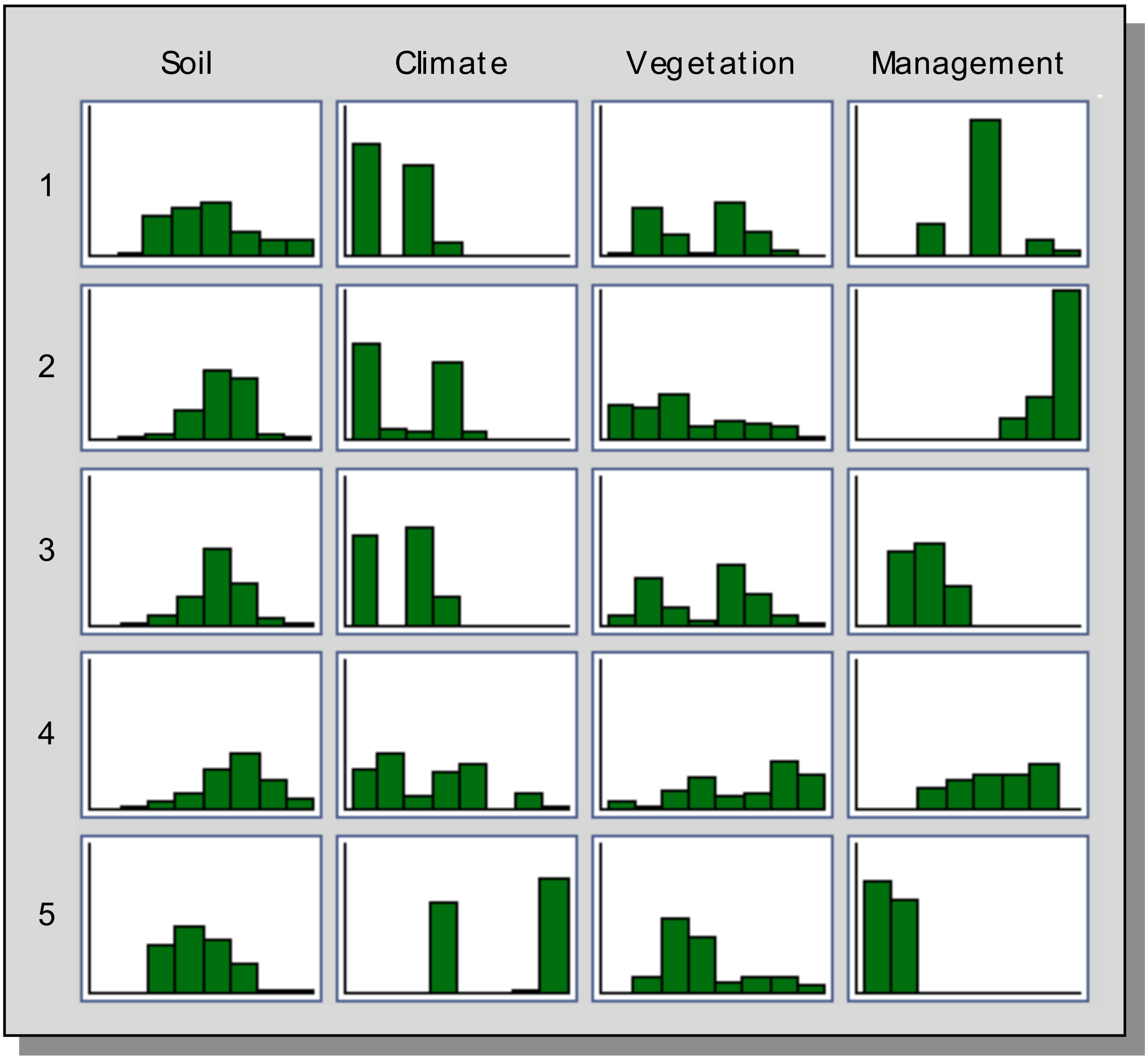


**Fig. 41. Sensitivity profiles of the municipality groups in the Agri basin. The profiles are expressed in ES level frequency percentages in function to the single qualities. (X-axis from 1.1 - 1.8; Y-axis from 0 to 75 %).**

These examples illustrate the applicability of this flexible method, diversified and efficient that gives broader investigation possibilities and the capacity to precisely evaluate the situations in progress as well as defining the more opportune strategies to reduce the overall environmental sensitivity of a given area. The use of cross analysis techniques in the proposed system, applied to pre-existing information, with other *ad hoc* collected data, can also be used to easily and efficiently point out specific degradation or environmental sensitivity phenomena. Furthermore, this approach not only allows the identification of different degrees of environmental sensitivity, at the same time allows the analysis of the factors that cause the evolution in progress.

European Commission

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This publication, prepared within the framework of the EC funded MEDALUS project, presents a methodological approach to identify and map environmentally sensitive areas to desertification, based on a choice of appropriate indicators at relevant scales. Targeted areas in Greece (Lesvos Island), Italy (Agri basin) and Portugal (Alentejo region) have been used to test and improve the methodology. This publication may be used as a manual for the identification of environmentally sensitive areas to desertification in other Mediterranean areas.