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Agro-Environmental Risk Analysis at Landscape Scale: Limits for a Sustainable Land Management

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Introduction and objective of the paper

Research activities on optimal relations between agricultural development and environmental protection is one of the main agronomic challenges from the 80s ahead. Thenceforth production goals and claims for appropriate incomes for the farmers have been sided by the awareness that they cannot be split from environmental degradation risks. These risks result mainly from widespread pollution sources, intensification of agriculture, over-exploitation of resources, as well as from abandon in marginal areas. In this context we present a study aimed to integrate an agricultural system assessment with an agro-environmental risk analysis. Our focus has been to assess the agro-environmental risk at a landscape scale in order to identify the development limits in the study area. This has been done to support transformation processes of the current productive system toward a more "sustainable agriculture" (Bonari, 1995). The research has been carried out in the Grosseto Province (central Italy) where the environmental complexity have substantially affected the local socio-economical activities and, above all, the agricultural development (Pacciani, 2003).

Methodology

The methodology has been based on a qualitative assessment of the agro-environmental risk on the arable land of the Grosseto Province. Erosion and loss of organic matter have been assumed as principal parameters to characterize the risk. They have been chosen after a bibliographical analysis crossed whit the results from surveys to the stakeholders (cooperatives and producer associations). This preliminary phase of the research has pointed out soil conservation as the foremost environmental limit for the development of the agricultural system in the study area (Galli et al., 2007). The analysis has not estimated quantitatively these risks. We have studied, instead, their effect on agro-environmental opportunities and limits for farming activities. We have employed a rule-based model analysis also called "cognitive model" since rules are defined by expert knowledge of phenomena. These kind of models are used usually for regional studies, so on

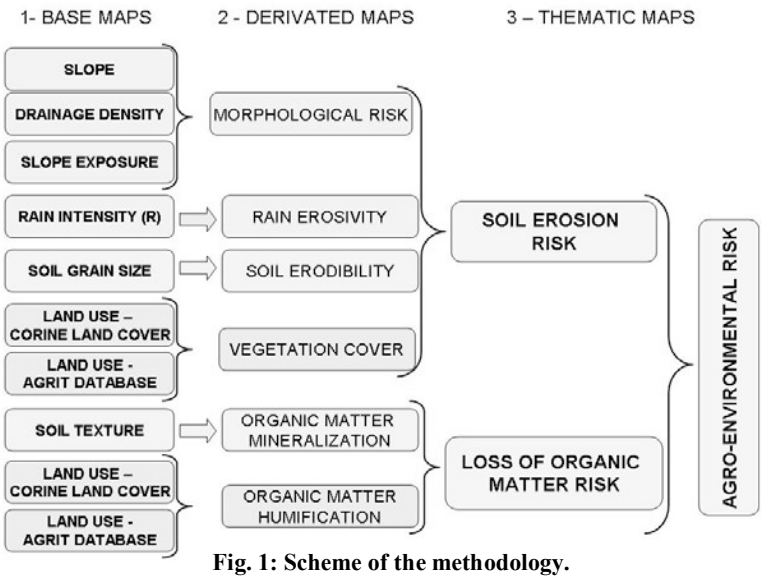

Fig. 1: Scheme of the methodology.

extensive spatial scale, where input data for quantitative modelling are not available (Kheir et al., 2006). In our study we have employed a hierarchical procedure (Fig. 1). Firstly, a set of "base" maps (1) of the parameters needed to analyse each risk has been classed and ranked as function of risk levels (2). Secondly, "derived" maps have been re-classed on five levels of increasing hazard (3) through the natural breaks method (Jenks, 1967); these levels have been defined in order to stress differences for environmental vulnerability within the territory. Finally, the outputs have been interpreted to locate "action areas" wherein proceed to design new development models.

Results

As shown in Fig. 2, the distribution of risk classes is not homogeneous on the territory, although there is a gradient moving from coast to internal hills area. Areas with no agro-environmental risk are as expected lower than the others; they cover only 3% of overall arable lands in the Province. The largest part of the territory can be considered at "low" or "medium" risk, whereas "high" and "very high" risk areas represent about 30% of the territory. Areas in fourth and fifth class are concentrated on mean and high hills zone, meanly on the south-east areas, where more than 35% of the arable lands has a very high vulnerability level. On these outputs we can distinguish four sub-areas with different risk classes distribution: the coastal zone, with a low/medium risk level; two hills areas (northern and eastern) with a medium risk level; the "Amiatine" hills with a high risk level.

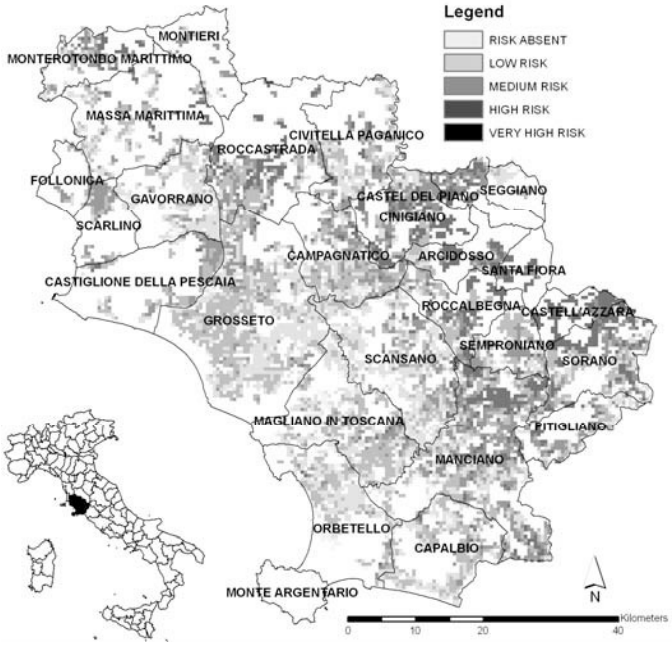

Fig. 2: Thematic map of agro-environmental risk in Grosseto Province.

Sub-areas	Null	Low	Medium	High	Very high
Coastal zone	3.2	38.9	44.0	13.1	0.8
Northern hills	3.8	28.9	35.0	22.1	10.2
Eastern hills	3.1	30.2	34.4	22.4	9.9
Amiatine hills	0.5	13.6	25.5	24.5	36.0

Tab. 1: Percentage distribution of risk classes in the sub-areas

Conclusions

The identification of four sub-areas through the assessment of the agro-environmental risk has provided a support to specify enhanced development models. In the sub-areas with lower risk intensive development models can be promoted achieving high quality productions (hard wheat, horticulture). On the contrary, areas with higher risk should be addressed toward conservative development models, providing alternations and recovering traditional productions (i.e. forage-livestock chain) thus improving the organic matter conservation.

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