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Land use changes and associated groundwater risk mapping in a protected coastal area

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Groundwater vulnerability and risk mapping is a relatively new approach for decision support purposes and integrated water management aiming in minimizing potential impacts from developmental activities. Land use changes and several anthropogenic activities such as agriculture often have detrimental impacts on aquifers' water quality, especially in karstic areas where physical attenuation is limited. Thus, several methodologies have been developed recently for vulnerability and risk mapping in different geologic environments including karst. The study area is Falasarna catchment in Crete Island, (southern Greece) where the protected habitat of Mediterranean Temporary Ponds lays over a calcareous aquifer in the coastal zone. In the particular area significant degradation has been observed during the last 30 years as a result of agricultural intensification, including cropland spatial expansion and increase in the number of greenhouses situated there. The purpose of this study is to use state-of-the-art methods such as remote sensing and GIS to quantify the alterations in the land use regime during the aforementioned period as well as to assess the changes in groundwater pollution risk. Aerial photos of the years 1970 and 2000 have been initially elaborated in Image Analysis software to produce the respective land use maps. The area's topographic map has been used in 3D Analyst (GIS component) to derive the catchment's DEM and the slope map while detailed geological and soil maps have been imported in Arcview package to develop thematic maps. These maps describe the concentration of flow in the study area (C map), the soil protective function (O map) and the precipitation regime (P map) according to the European approach for groundwater vulnerability and risk mapping. The combination of the above maps (COP map is the

vulnerability map) with the land use maps of 1970 and 2000 (hazard maps) provided the groundwater risk maps for the given periods. The results illustrated that cropland has increased by 34% during the study period while the forested areas have been decreased by 27% and the extent of the greenhouses has risen by 2071%. Respectively, the high groundwater pollution risk zone of the catchment has been increased by 50% while the low risk zone has been reduced by 31%. The produced groundwater pollution risk maps can be used by the local management authorities in order to enhance sustainable socio-economic planning and environmental management.