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GIS-Techniques and AHP Method to Support Decision Making in the Selection of Landfill Sites for Solid Waste

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Solid waste management is a global problem in today's world. Urban solid waste management is considered as one of the most serious environmental problems due to the location of dumping sites in unsuitable areas. Landfill has been recognized as the cheapest form for the final disposal of municipal solid waste and, as such, has been the most used method in the world. However, siting landfill is an extremely complex task mainly due to the fact that the identification and selection process involves many factors and strict regulations. For proper identification and selection of appropriate sites for landfills careful and systematic procedures need to be adopted and followed. The siting process aims to locate the areas that will minimize hazards to public health as well as to the environment and will be financially efficient. The poor siting of landfills can result in environmental degradation and, often, public opposition. The role of Geographic Information Systems (GIS) in solid waste management is important for planning and for future monitoring programs.

In this study, we developed and applied, for the first time, a GIS-based landfill siting methodology to the whole Sicilian region (about 25,000 km^2). The method represents a Spatial Decision Support System (SDSS) Model that excludes areas from further examination in four different stages of analysis at different scale:
1. macroscale - locally unacceptable land use (LULUs): according to Sicilian, Italian and EU laws, there are unsuitable areas due to several criteria such as geology/hydrogeology, land use, height, distance from settlements, surface waters, roads and protected areas;
2. macroscale - locally penalized areas: areas unsuited for use as waste disposal areas because they are sensitive to geohazards such as landslides, flooding, seismic hazard and burning;
3. mesoscale - locally suitability areas: these areas are chosen with an analytical hierarchy process (AHP) for the determination of the relative importance weights of factors such as permeability, rainfall, slope, distance from settlements, rivers and roads;
4. microscale - locally high suitability areas: the methodology consider specific parameters such as wind direction, abandoned quarries, easy access, morphology.

Each criterion is represented as a shapefile and is collected in a geodatabase. The overlay of the layers used in stage 1 excludes 76% of the Sicilian region; the result of stage 2 is that 87% of the territory is considered as penalized area and just 13% of the region is suitable for landfills siting. In these areas, the AHP method [1,2,3] gives to a decision maker the possibility to choose the best site by stages 3 and 4. The AHP method considers a set of evaluation criteria, determines the relative importance of each criterion by pairwise comparisons and then generates a weight for each criterion according to the decision maker opinion. The decision making process in multiple criteria problems is a subjective process

depending on the decision maker. After finding the best area, studies need to be improved by field inspection and geological/hydrogeological/geophysical analysis.

References:

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