Spatial Assessment of Landfill Sites Based on Remote Sensing and GIS Techniques in Thermi, Greece

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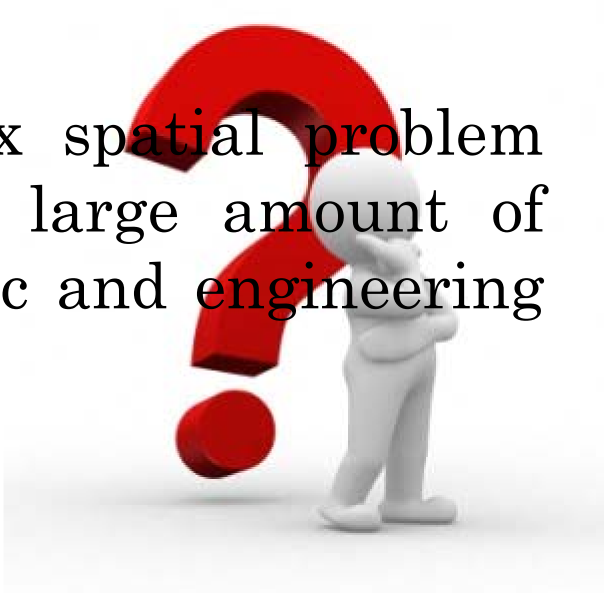
PROBLEM STATEMENT

- Landfilling is the lowest ranking waste management option in the waste hierarchy, but remains dominant method used in Europe.
- landfill site selection analyses have been carried out since the end of the last century but problem is still addressed by the literature related to waste management.
- Landfill siting is one complex spatial problem because its solution requires large amount of environmental, social, economic and engineering data.

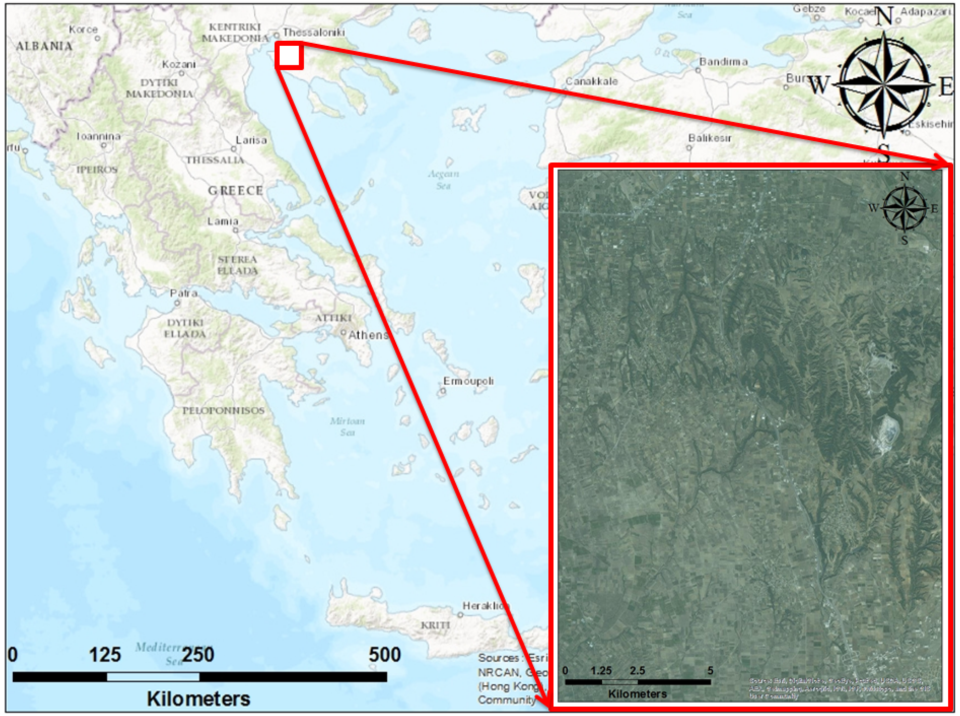


Study objectives

- The aim of the current research is to contribute towards wider application of the Geographic Information System and Remote Sensing techniques in the country by presenting their significant helpfulness in solving one specific spatial problem locating a landfill.

STUDY AREA

- Study area is located in Thermi municipality in the vicinity of the villages Tagarades, Trilofos, and Agia Paraskevi, prefecture of Thessaloniki, in North Greece.



SITE SIGNIFICANCE

- The landfill serves more than 1 million people from the broader area of Thessaloniki city. The waste load of the landfill is 1.368 tn/day. Lately, a firebreak took place and almost of 1500 m^3 of leachates then were released into a local stream network. The contaminated areas are principally used for agricultural activities.

Input Dataset

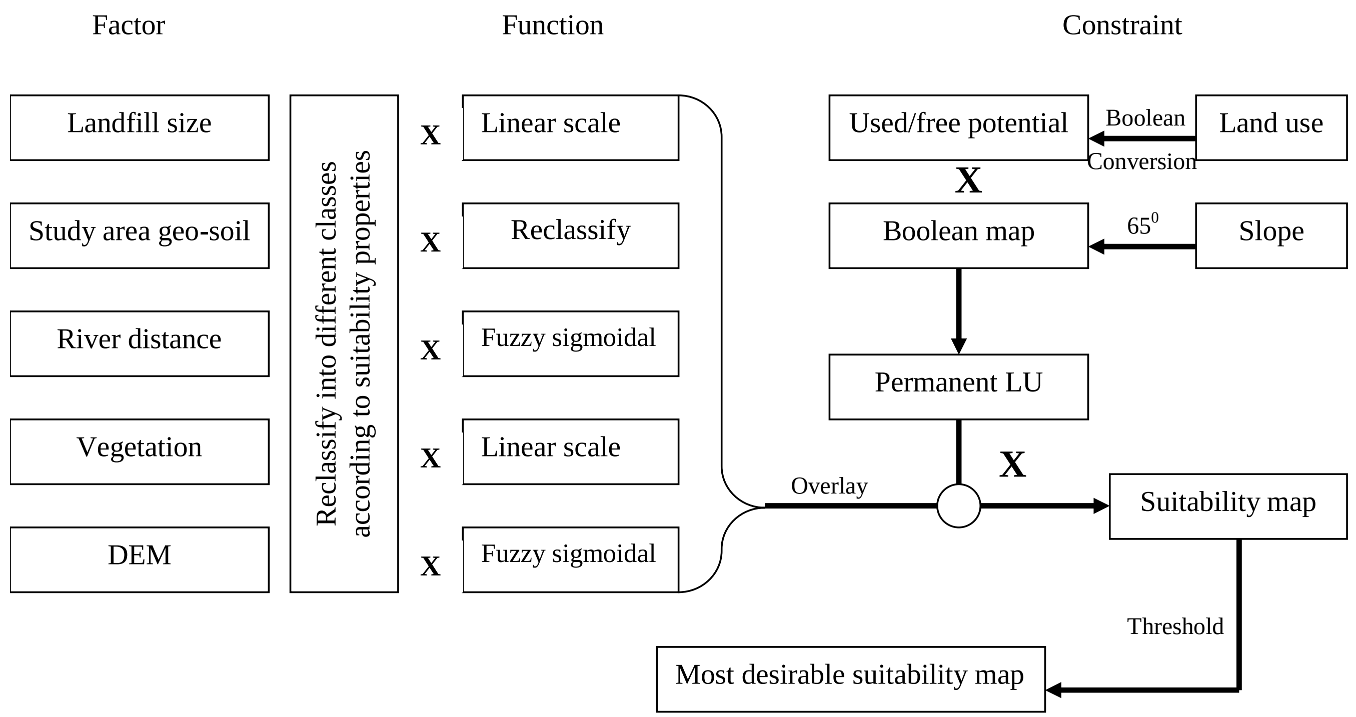
- Four topographic maps were registered and georeferenced to the GCS WGS 1984.
- Topographic maps in the scale of 1:25.000.
- Landsat 8 satellite imagery was acquired on June 2013.
- Digitizing a scanned paper geological map in scale 1:100 000.
- CORINE Land Cover 2006 data set was used to reclassify the existing land cover.

APPLIED CRITERIA

Constraints
Excluding aquifers, groundwater protection zones, watersheds and alluvial plains
Excluding national parks, historical areas, habitats of threatened and endangered species
1000 m buffer around intermittent or permanent streams, water bodies and wetlands
5000 m distance from utility corridors (electrical, water, sewer and communication)
2500 m distance from schools, hospitals, churches

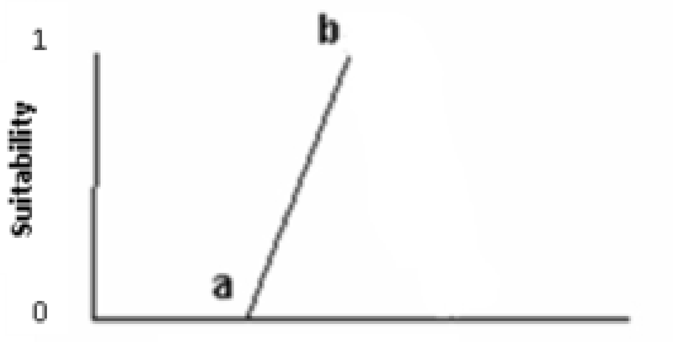
Factors
Landfill site with 50 ha surface (30 to 50 years life span)
1000 m distance from motorways, city streets, residential area, and sensitive area
Geological structure of the study area (classified)
6000 m distance from archaeological sites
Outside areas with more than 30 % slope

Methodological framework

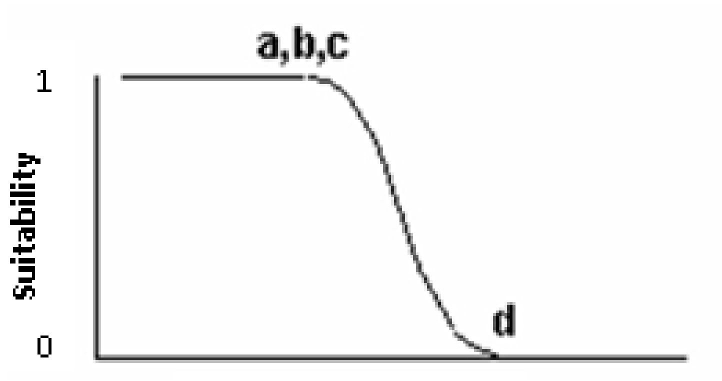


Fuzzy functions

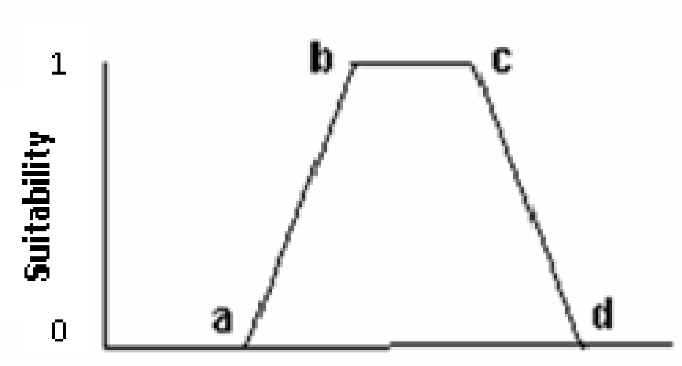
Linear function



Sigmoidal function



Trapezoidal function



RECLASSIFIED PARAMETERS

- **Elevation classes**

Elevation (m)	Class	Suitability	Area (ha)	Total area in %
< 600	1	Least suitable	7092	79.72
> 600 and < 629	2	More suitable	1651.52	18.56
> 629 and < 726	3	Most suitable	152.96	1.72

RECLASSIFIED PARAMETERS

- **Slope classes**

Slope (%)	Class	Suitability
> 20 % < 32 %	0	Excluded area
> 15 % < 20 %	1	Least suitable area
> 5 % < 15 %	2	More suitable area
< 5 %	3	Most suitable area

RECLASSIFIED PARAMETERS

- **Geological classes**

Deposits	Class	Suitability	Area (ha)	Total area in %
Diluvium-proluvial	1	Unsuitable	368.16	4.1
Alluvium	2	More suitable	8114.4	91.2
Quartz-sericite schist, muscovite chlorite schist and amphibole schist; Graphite schist and quartz-muscovite schist; Epidote-chlorite schist and amphibole schist; Mica schist and lepidolite.	3	Most suitable	416.64	4.7

RECLASSIFIED PARAMETERS

- **Land cover classes**

Land cover	Class	Suitability	Area (ha)	Total area in %
Non-irrigated arable land; Permanently irrigated land.	1	Unsuitable	7425.12	83.5
Broad-leaved forest; Complex cultivation patterns; Land principally occupied by agriculture, with significant areas of natural vegetation; Pastures	2	More suitable	1079.04	12.1
Discontinuous urban fabric; Transitional woodland-shrub.	3	Most suitable	396	4.4

RESULTS

- **Factors suitability**

Factors	Classified or buffered
Land cover – classified	Classified 1 - 3
Geology – classified	Classified 1 - 3
DEM – classified	Classified 1 - 3
Slope - classified	Classified 1 - 3
Commercial buildings	1000 m buffer
Manufacturing buildings	1000 m buffer
Industrial area	1000 m buffer
Local roads (connecting villages)	1000 m buffer
Path - buffered	1000 m buffer
Undefined roads	1000 m buffer

Results

- **Constraints suitability**

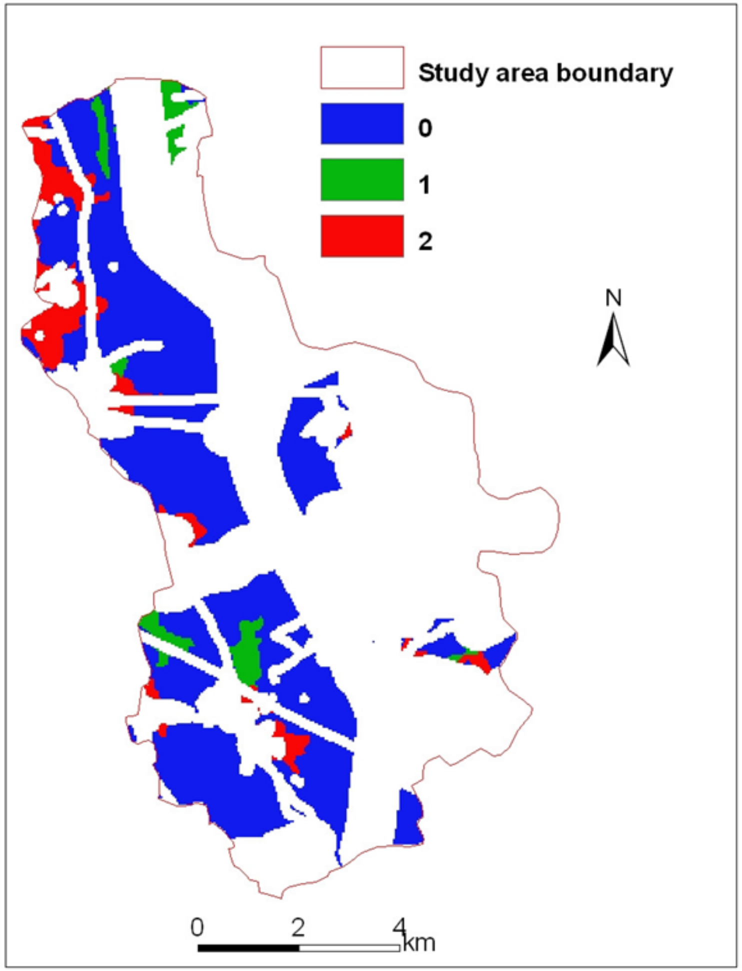
Constraints	Buffered
Regional roads	1000 m buffer
Channel – up to 5 m wide	5000 m buffer
Channel – 5 to 10 m wide	5000 m buffer
Channel – over 10 m wide	5000 m buffer
Wells	5000 m buffer
Piped wells	5000 m buffer
Water bodies	5000 m buffer
Water pumps	5000 m buffer
Permanent stream	5000 m buffer
Intermittent stream	5000 m buffer
Local roads – inside the village	1000 m buffer
Schools	1000 m buffer
Residential area	1000 m buffer
Villages	1000 m buffer

Results

- **Weighted overlay resulting classification**

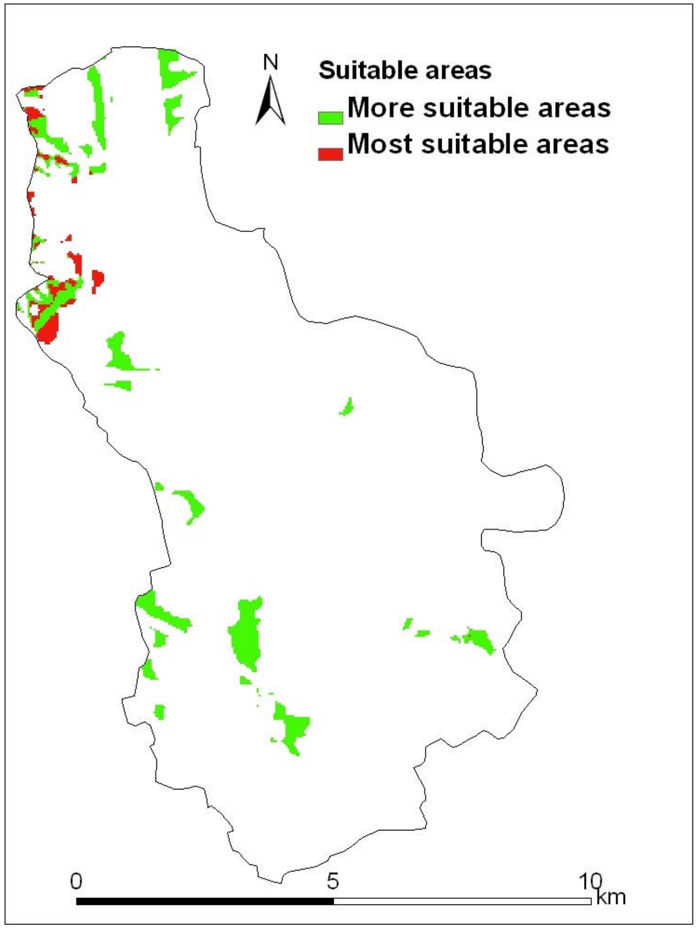
Description	Class	Area (ha)	Total area in %
Unsuitable	0	2614.88	29.39
More suitable	1	366.56	4.12
Most suitable	2	47.82	0.53

RESULTS



Weighted overlay - resulting map (masked) of the study area

RESULTS



Suitable areas for landfill sites in study area

CONCLUSIONS

- The findings suggested the optimal landfill location based on the least negative environmental impacts.
- It represent the elementary steps the environmental cost for optimizing a landfill location economically and socially.
- Examining the differences between a financially and economically optimized landfill location and a landfill location that is the most environmentally sound would also bring out the advantages and disadvantages of both locations.

Thanks for your attention