

Home > Journal > Earth & Environmental Sciences > JGIS

[Indexing](#) [View Papers](#) [Aims & Scope](#) [Editorial Board](#) [Guideline](#) [Article Processing Charges](#)

JGIS > Vol.3 No.4, October 2011

OPEN ACCESS

Using GIS-Based Weighted Linear Combination Analysis and Remote Sensing Techniques to Select Optimum Solid Waste Disposal Sites within Mafraq City, Jordan

PDF (Size: 3399KB) PP. 267-278 DOI: 10.4236/jgis.2011.34023

Author(s)

Ahmad Al-Hanbali, Bayan Alsaadeh, Akihiko Kondoh

ABSTRACT

Landfill siting was determined within Mafraq City, Jordan, through the integration of geographic information system (GIS), weighted linear combination (WLC) analysis, and remote sensing techniques. Several parameters were collected from various sources in vector and raster GIS formats, and then, used within the GIS-based WLC analysis to select optimum solid waste disposal sites. Namely, urban areas, agricultural lands, access roads, surface aquifers, groundwater table, fault system, water wells, streams, and land slope were considered in this research. Also, the trend of urban expansion within the study area was monitored using the Landsat data of 1989, 1999, and 2009 to support the selection process of disposal sites. It is found that about 84% of the study area was within "most suitable" to "moderately suitable" classes for landfill sites, while the rest of the study area was within "poorly suitable" and "unsuitable" classes. Based on the analysis of Landsat satellite data the urban area was expanded of more than 240% during the last three decades, mainly toward south, and southwest, except the villages near the existing disposal site, where the trend was toward east and northeast. Finally, three sites were suggested as alternatives to the existing disposal site taking into the consideration the environmental, biophysical, and economical variables applied in the GIS-based WLC analysis.

KEYWORDS

Solid Waste, Weighted Linear Combination, GIS, Remote Sensing, Jordan

Cite this paper

A. Al-Hanbali, B. Alsaadeh and A. Kondoh, "Using GIS-Based Weighted Linear Combination Analysis and Remote Sensing Techniques to Select Optimum Solid Waste Disposal Sites within Mafraq City, Jordan," *Journal of Geographic Information System*, Vol. 3 No. 4, 2011, pp. 267-278. doi: 10.4236/jgis.2011.34023.

References

- [1] B. Nas, T. Cay, F. Iscan and A. Berktaay, " Selection of MSW landfill site for Konya, Turkey Using GIS and Multi-Criteria Evaluation," *Environmental Monitoring and Assessment*, Vol. 160, No. 1-4, 2010, pp. 491-500. doi:10.1007/s10661-008-0713-8
- [2] O. Al-Jarrah and H. Abu-Qdais, " Municipal Solid Waste Landfill Siting Using Intelligent System," *Waste Management*, Vol. 26, No. 3, 2006, pp.299-306.
- [3] M. Zamorano, E. Molero, á. Hurtado, A. Grindlay and á. Ramos, " Evaluation of a Municipal Landfill Site in Southern Spain with GIS-aided Methodology," *Journal of Hazardous Materials*, Vol. 160, No. 2-3, 2008, pp. 473-481. doi:10.1016/j.jhazmat.2008.03.023
- [4] S. Sener, E. Sener and R. Karagüzel, " Solid Waste Disposal Site Selection with GIS and AHP Methodology: A Case Study in Senirkent-Uluborlu (Isparta) Basin," *Environmental Monitoring and Assessment*, Vol. 173, No. 1, 2010, pp. 533-554.
- [5] M. Sharifi, M. Hadidi, E. Vessali, P. Mosstafakhani, K. Taheri, S. Shahoie and M. Khodamoradpour, " Integrating Multi-Criteria Decision Analysis for a GIS-Based Hazardous Waste Landfill Siting in Kurdistan Province, western Iran," *Waste Management*, Vol. 29, No. 10, 2009, pp. 2740-2758.

[JGIS Subscription](#)

[Most popular papers in JGIS](#)

[About JGIS News](#)

[Frequently Asked Questions](#)

[Recommend to Peers](#)

[Recommend to Library](#)

[Contact Us](#)

Downloads: 135,205

Visits: 287,656

[Sponsors, Associates, and Links >>](#)

- [6] M. Z. Siddiqui, J. W. Everett and B. E. Vieux, " Landfill siting Using Geographic Information Systems: A Demonstration," *Journal of Environmental Engineering*, Vol. 122, No. 6, 1996, pp. 515-523. doi:10.1061/(ASCE)0733-9372(1996)122:6(515)
- [7] S. J. Baban and J. Flannagan, " Developing and Implementing GIS-assisted Constraints Criteria for Planning Landfill Sites in the UK," *Planning Practice and Research*, Vol. 13, No. 2, 1998, pp. 139-151. doi:10.1080/02697459816157
- [8] G. Tchobanoglous, H. Theisen and S. A. Vigil, " Integrated Solid Waste Management, Engineering Principles and Management Issues," McGraw-Hill, New York, 1993.
- [9] R. L. Church, " Geographical Information Systems and Location Science," *Computers & Operations Research*, Vol. 29, No. 6, 2002, pp. 541-562. doi:10.1016/S0305-0548(99)00104-5
- [10] A. Murray, " Advances in location modeling: GIS Linkages and Contributions," *Journal of Geographical Systems*, Vol. 12, No. 3, 2010, pp. 335-354. doi:10.1007/s10109-009-0105-9
- [11] H. Voogd, " Multicriteria Evaluation for Urban and Regional Planning," Pion Limited, London, 1983.
- [12] J. Malczewski, " GIS-Based Land-Use Suitability Analysis: A Critical Overview," *Progress in Planning*, Vol. 62, No. 1, 2004, pp. 3-65. doi:10.1016/j.progress.2003.09.002
- [13] A. Yalcin, " GIS-Based Landslide Susceptibility Mapping Using Analytical Hierarchy Process and Bivariate Statistics in Ardesen (Turkey): Comparisons of Results and Confirmations," *CATENA*, Vol. 72, No. 1, 2008, pp. 1-12. doi:10.1016/j.catena.2007.01.003
- [14] J. Malczewski, " GIS and Multicriteria Decision Analysis," John Wiley & Sons, New York, 1999.
- [15] V. R. Sumathi, U. Natesan and C. Sarkar, " GIS-Based Approach for Optimized Siting of Municipal Solid Waste Landfill," *Waste Management*, Vol. 28, No. 11, 2008, pp. 2146-2160. doi:10.1016/j.wasman.2007.09.032
- [16] T. D. Kontos, D. P. Komilis and C. P. Halvadakis, " Siting MSW Landfills with a Spatial Multiple Criteria Analysis Methodology," *Waste Management*, Vol. 25, No. 8, 2005, pp. 818-832. doi:10.1016/j.wasman.2005.04.002
- [17] H. S. Sudhira, T. V. Ramachandra and K. S. Jagadish, " Urban Sprawl: Metrics, Dynamics and Modelling Using GIS," *International Journal of Applied Earth Observation and Geoinformation*, Vol. 5, No. 1, 2004, pp. 29-39. doi:10.1016/j.jag.2003.08.002
- [18] C. Weber and A. Puissant, " Urbanization Pressure and Modeling of Urban Growth: Example of the Tunis Metropolitan Area," *Remote Sensing of Environment*, Vol. 86, No. 3, 2003, pp. 341-352. doi:10.1016/S0034-4257(03)00077-4
- [19] A. M. Dewan and Y. Yamaguchi, " Land Use and Land Cover Change in Greater Dhaka, Bangladesh: Using Remote Sensing to Promote Sustainable Urbanization," *Applied Geography*, Vol. 29, No. 3, 2009, pp. 390-401. doi:10.1016/j.apgeog.2008.12.005
- [20] Y. Kurucu and N. Christina, " Monitoring the Impacts of Urbanization And Industrialization on the Agricultural Land and Environment of the Torbali, Izmir region, Turkey," *Environmental Monitoring and Assessment*, Vol. 136, No. 1, 2008, pp. 289-297. doi:10.1007/s10661-007-9684-4
- [21] R. B. Potter, K. Darmame, N. Barham and S. Nortcliff, " Ever-Growing Amman, Jordan: Urban Expansion, Social Polarisation and Contemporary Urban Planning Issues," *Habitat International*, Vol. 33, No. 1, 2009, pp. 81-92. doi:10.1016/j.habitatint.2008.05.005
- [22] Department of Statistics (DOS), 2010. <http://www.dos.gov.jo>.
- [23] Department of Statistics (DOS), " Iraqis in Jordan Their Number and Characteristics," 2010. http://www.dos.gov.jo/dos_home/dos_home_e/main/Iraqis%20in%20Jordan.pdf.
- [24] Ministry of Environment (MoEnv), 2010. <http://www.moenv.gov.jo>.
- [25] H. A. Abu Qdais, " Techno-Economic Assessment of Municipal Solid Waste Management in Jordan," *Waste Management*, Vol. 27, No. 11, 2007, pp. 1666-1672. doi:10.1016/j.wasman.2006.08.004
- [26] M. Chopra, D. Reinhart and W. Abu-Al-Shaar, " US- Jordan Municipal Solid Waste Management Collaborative Research," The National Science Foundation, Wilson Boulevard, Arlington, 2001.

- [27] Z. Al-Ghazawi and F. Abdulla, " Mitigation of Methane Emissions from Sanitary Landfills and Sewage Treatment Plants in Jordan," *Clean Technologies and Environmental Policy*, Vol. 10, No. 4, 2008, pp. 341-350. doi:10.1007/s10098-008-0145-8
- [28] Y. Abu-Rukah and O. Al-Kofahi, " The Assessment of the Effect of Landfill Leachate on Ground-Water Quality-A Case Study. El-Akader Landfill Site-North Jordan," *Journal of Arid Environments*, Vol. 49, No. 3, 2001, pp. 615-630. doi:10.1006/jare.2001.0796
- [29] National Geospatial-Intelligence Agency (NGA), 2010. <http://geoengine.nima.mil>.
- [30] Japan International Cooperation Agency (JICA), " Basic Design Study Report on the Project for Improvement of Solid Waste Management in Major Local Areas in the Hashemite Kingdom of Jordan," Final Report, Japan International Cooperation Agency, Tokyo, 1996.
- [31] US EPA, " Solid Waste Disposal Facility Criteria," EPA530-R-93-017, US EPA, Washington, DC., 1993.
- [32] E. Tagaris, R. E. Sotiropoulou, C. Pilinis and C. P. Halvadakis, " A Methodology to Estimate Odors around Landfill Sites: The Use of Methane as an Odor Index and Its Utility in Landfill Siting," *Journal of the Air & Waste Management Association*, Vol. 53, No. 5, 2003, pp. 629-34.