Landfill Site Selection for Municipal Waste Materials using Analytic Hierarchy Process and Artificial Neural Networks (Case study: Gorgan City)

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1. Introduction

Urban development and growth has become an uncontrollable process in most countries across the world, as it can be claimed that more than half the world's population live in cities now. Urbanization has widely influenced the environment in local, regional, and global scale. Growing urbanization has caused some problems like landfill. Moreover, many cities in Asian developing countries face serious problems in landfill management. Thus, by growing number of people in developing countries, landfill management has become one of the major issues today. Finding an appropriate site for landfill makes an important part of the planning process. The growing rate of population and development of industrial and commercial activities and services have led to the production of vast amounts of waste in cities. Golestan province was separated from Mazandaran in 1997 to form a new province with the center of Gorgan. Since then, its population started to grow and landfill turned to be a major challenge among other things.

2. Literature review

Mirabadi and Husseinabadi (2017) studied Landfill Site Selection in Bukan using Analytical Hierarchy Process (AHP) and concluded that the regions between Bokan and Simineh in the southern part of Kani Shaqaq village is the best place for landfill. Ziarri et al. (2013) studied the best location of landfill using Analytical Hierarchy Process (AHP) in Jolfa city and concluded northwestern part of the city is the best place to landfill.
Celiker and Yildiz (2019), evaluated the site selection of solid waste landfill using multi-criteria decision analysis and geographic information systems in the Elazığ city, Turkey. The results revealed that the landfill suitability index values for the selected site range between 2.64 and 6.10. The major part of the landfill site has relatively low index values implying that the selected site is suitable for solid waste landfill.

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Al-Karadaghi et al. (2019) in Sulaymaniyah, Iraq, used multicriteria decision-making methods (WLC) and GIS for landfill site selection, and seven appropriate sites for landfill were suggested. All of these sites adopted the scientific and environmental criteria.

3. Method

Gorgan is a city located in northern Alborz heights which covers an area of over 10883 Hectares (Jahani Shakib et al., 2018) and it ranks 4th among the cities of Golestan province. In order to find a location for
After categorizing the factors, questionnaires were classified from 1 to 9 by experts. Number 1 had the lowest score and number 9 had the highest score. Then, expert choice was used for weighting the indicators in AHP Model. At the end, in Artificial Neural Networks (ANN), each of the indicators was fuzzied first, and then the artificial neural network was implemented.

4. Results and Discussion

Results show that according to experts, in AHP Model, slope and geology are top priorities and distance to fault, height, and distance from airport have the lowest priority. In AHP Model, areas in the North-east and parts of Southern area as well as areas located in the middle belt of the city tend to be more appropriate for locating landfill; because they are far from water wells, faults, villages, the city, airport and the river and the elevation of these areas are suitable for landfilling.
The previous site for landfill, located around Hezar Pich in Gorgan, has not been a suitable place according to AHP Model. According to ANN Model, Northern areas of Gorgan are inappropriate for landfill because they are both close to the city, village, airport, and surface water networks and are geologically improper for having young alluvium and alluvial fans. It must be noted that Hezar Pich is not an appropriate site for landfill according to ANN Model as well.

5. Conclusion

This study saught to locate the best site for landfill in Gorgan and had a look at previous site of the city as well. This was achieved using 11 criteria and geographical data focusing on AHP and ANN techniques.
Results obtained from 2 models AHP and ANN revealed that the most inappropriate sites for landfill were Northern areas of the city due to small distance from underground water wells, airport, cities, villages, asphalt roads and unsuitable geology. While appropriate sites for landfill, according to AHP and ANN, were areas in the North-west, North-east, middle belt of the city, and some Southern parts of the city. It is noteworthy that Hezar Pich area was improper for landfill used in the past. Waste material is currently buried in Western part of the province (Aq Qala). This factory is located 40 Kms away from center of Gorgan, somewhere between two cities of Aq Qala and Gamish Tappe, covering an area of 80 Hectares. These waste materials are transferred to the factory to be recycled and processed and finally converted to organic compost.

Keywords: Landfill, Gorgan City, Hezar Pich, AHP, ANN

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