

Presenting a decision–making model for landfill site selection using analytical hierarchy process (AHP) (case study : landfill of Semnan Industrial Town,Iran)

S. Kamyabi^{1+*}, B. ghotbooe², M. hasanabadi³

¹ Department of Geography, Semnan Branch, Islamic Azad University-Semnan- Iran

² Department of Geography, Semnan Branch, Islamic Azad University-Semnan- Iran

³ Department of Industrial Management, Semnan Branch, Islamic Azad University-Semnan- Iran

Abstract. Several parameters have been involved in choosing a suitable landfill site. Various parameters have their own importance and limitation, but final aim should be ended to a site situation with the less environmental effects. A decision model base on AHP is represented to achieve a suitable place by using some decision methods like multi criteria technique. This model has been used in Semnan land fill site search. The research result shows that using this trend can put scientific ideas in priority for finding the best landfill site in Semnan industrial zone, also this choice can decrease the extra expenses caused by unsuitable site.

Keywords: site selection, landfill site, analytical hierarchy process, industrial zone, semnan city

1. Introduction.

Nowadays, one of the most considerable environmental problems in Iran is how to bury solid trashes to have less effect on natural resources like water & soil. Unfortunately current method has been based on gathering the staffs without any correct plan and suitable land fill site . This procedure can affect on sensitive circumstances seriously like our zone (Semnan industrial zone) , because it can destroy some natural facilities & potential resources. Semnan industrial zone is located at 8th kilometers southeast of Semnan and also it has fertile soil and enough water around .it has been produced so much trash increasingly because of industrial units growth and population increase. But there is no suitable burial procedure for trash yet and this zone is in lack of landfill site for solid trashes.It was a custom for industrial cities to gather their trashes nearby without any roof. This kind of disposal causes bad smelling and unsuitable condition for residents. Responsible offices like environmental guards and health & medical organization have condemned the situation. .chemical trashes has more serious effects on environmental than the others and responsible organizations has been faced complicated situation.

2. Material and procedures

2.1.Case study region .Semnan is located Iran (center of semnan province) at longitude of 53°, 23' and latitude 35°,34'. Its height to sea is 1130 meters.the distance between Semnan to Tehran (capital Iran) is 216 kilometers and it has been also connected to Mashhad Tehran railway.Semnan is an industrial city with a vast zone (2036.22 Hectares), located 8 kilometers far from the main road Damghan-Semnan.Industrial ground area is 1348.13 hectares. This area has been predicted for 2500 industrial units. Some units (around 821units) have

Corresponding author. Tel.: + (00 989126473622); fax: +(00982313337662).
E-mail address, saeidkamyabi@gmail.com & S.kamyabi@semnanuiou.ac.ir

been contracted, some others(around 376) are active , 66 units are installing their equipments and the others are in civil stage.



Figure1 –Case study situation

2.2. Analytic-hierarchy process

One of the most famous method in multi purpose deciding , which invented in 1970, by L.sati is analytic – hierarchy process (Memareyan & Azar ,1374,p.22). Using this method has two stages

- 1-structure design for hierarchy process
- 2- assessment (Alkhalili ,2002,p.469)

This process is based on 3 foundations: Model structure ,alternative criteria judgment , result priorities (Dagdoiren & others ,2009 p.8143)This method just can assess different alternatives according to their weights, but there is no ability to make a difference between acceptable and non acceptable alternative in hierarchy process.(Ghazinori & others ,2007,P.316) .Mutual comparison is used to weigh alternatives and criteria in hierarchy process .in this method relative weight has been calculated by mutual comparison between two different levels . Relative criteria weight and alternative final weight will be joined. By adding multiplication result of each certain in its alternative weight (Saedi & others, 1388,p.237)

2.3. Suggested model

It has been shown how every step for Suggested model can end to suitable landfill for Semnan industrial zone.

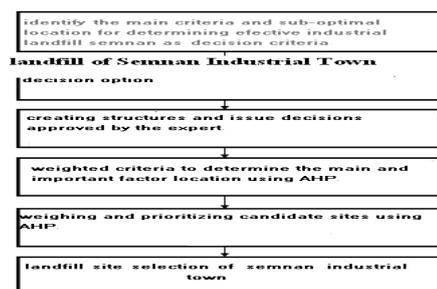


Fig 2-suggested model

2.4.Information elaboration

The first stage, the landfill site has been specified by library studying ,export consulting the results have been brought in table 1 .some maps , related to the criteria, Aerial photograph of the region have been shown in figure 3.

table1- effective criteria on specifying suitable landfill site for Semnan industrial zone

Comment	criteria
The best slope is between 3to 15percent	slope
Water network shows the underground water current. the more far , our site is from water network ,the less danger ,it is faced with	Hydrology
The distance Should be suitable not to take much time to convey Trashes and also not to near.	Distance from industrial units
When it rains. Solid trashes convert to liquid	Soil type
it is a must to select the site in a proper situation in road accessibility to lesson the expenses and time , to modify the transportation process. in other hand suitable distance up to regional roads.	Accessibility
Non penetrative or less penetrative stones with suitable chemical compound is better than high penetrative stone with unsuitable compound is trash brail.	Soil penetrative rate

Four candidate sites (BH1, BH2,BH3,BH4) has been shown in figure5. These site property are completely adjusted on our criteria. So these are the decision alternatives, the result of mechanical soil test for BH2 has been brought in table. S.P.T test is done according to ASTM: D1586 standard .this test shows some of the soil characteristic.

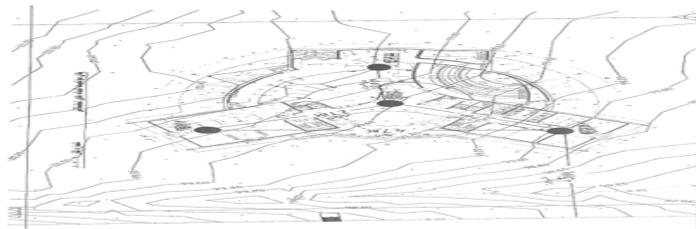


Fig3- four candidate site for trash disposal in Semnan industrial zone

In third stage , decision structure of hierarchy was designed and approved by the experts.(figure3) to review the decision system again:Level1:main aim in decision process:” choosing the best landfill in Semnan industrial zone .Level2: main effective criteria in choosing the site..Level3:sub criteriaLevel4:candidated sites

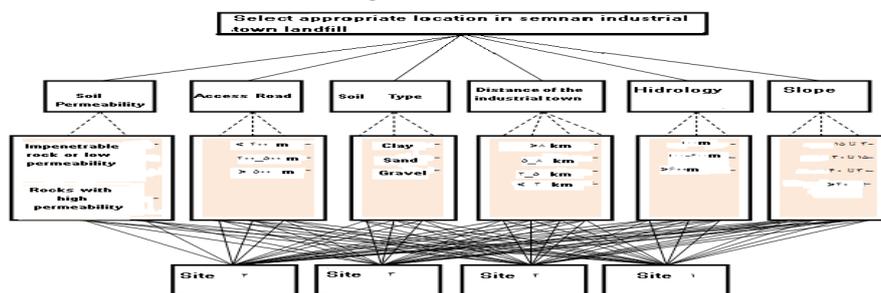


Fig 4- hierarchy process in site choosing landfill for Semnan industrial zone

In forth stage ,it should be specified the main criteria and sub criteria weights by analytic hierarchy process and query paper distribution among experts for mutual comparison . exported data will be entered in expert choice to analyze. Because of some limitation ,mutual comparison related to main criteria, decision aim , mutual

comparison in sub criteria due to the slope and mutual comparison among four candidates due to slope between 3-15 meter, All have been shown is figure6

Fig5: Mutual comparison in expert choice soft ware

The weight of main sub criteria have been brought up in table3

Table3- main and sub criteria based on analytic hierarchy process

weight	Unit	weight	Criteria
0.564	3- 15m	.0378	slope
0.269	15-30m		
0.115	30-40m		
0.052	More than 40m		
0.720	clay	0. 258	Soil type
0.215	sand		
0.065	sand		
0.15	Less than 100m	0.163	Hydrology
0.310	100-600m		
0.540	higher than 600m		
0.470	More than 8km	0.110	Distance from industrial units
0.305	5-8km		
0.125	3-5km		
0.1	Less than 3km		
0.597	Less than 400m	0.057	Accessibility
0.265	400-500m		
0.138	More than 500m		
0.782	Non penetrative stones with suitable chemical compound	0.035	Soil penetrative rate
0.218	High penetrative stone with suitable chemical compound		

Source: author calculation

In fifth step four candidate sites(decision alternative) have been assessed after expert judgments analyzing.

Figure no.6 shows the priority of sites according to decision aim(choosing the best landfill site in industrial zone) in EC software.

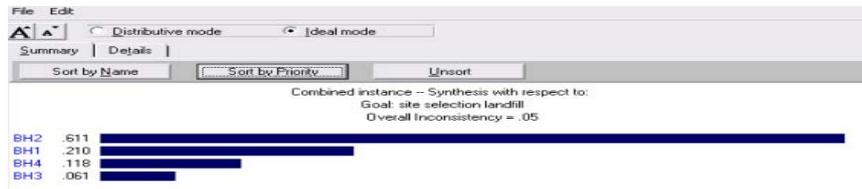


Figure6-classifying the sites base on their priorities according to decision aimby EC software

Finally ,BH2 was selected among four candidate sites because of its higher weight. So, this site will be the test landfill site in Semnan industrial zone (table3).

3. Conclusion

Assessing among four candidate for Semnan industrial zone has been done by suggested model as below: BH2>>BH1>>BH4>>BH3. First priority (BH2): this site is located on 4 kilometer far from industrial units and main roads with slope(around 15%) and it is near to one of railway branches. The site soil type is clay, suitable for trash disposal and also its area is vast enough to for being a landfill site. This alternative is chosen as our first priority by AHP method for Semnan industrial zone Second priority (BH1): second site had good slope (15%) , even nearer than “BH2” to industrial units but its soil type is not proper for landfill site. Third priority (BH4): this site slope is not as well as the first and second priorities .the distance to main roads is more than prior sites and also there is no enough distance to permanent or seasonal rivers. Forth priority (BH3): this site slope is between 15% to 20% .it is far from main road but nearer to the rivers than prior sites. Seasonal currents are 200-600 meter far from the site. The result of this research shows that using management decision in AHP can put expert ideas in priority by covering the criteria .this trend will end to a suitable landfill site for Semnan industrial zone and omit all extra expenses

4. References

- [1] Khorshiddost, Alimohammad, Adeli, Zahra, “How to use geomorphic parameters in finding landfill site”, Quarterly paper in Natural Geography, 2nd year, No.5, 2010. P63-72.
- [2] Saedi ,Mohsen; Abesi, Aziz; Sarpak, Masoud(2009), "Choosing suitable site for dangerous trashes by GIS techniques in site priorities & AHP science and environment technology" , 11th , No.1, spring version 2009,, P231-241.
- [3] Samadi , Mohammad taghi; Mortazavi, Seid Mohammad; Mohammad Taheri, Abolfazl; Fatehi, Arezo; Binavapor, Mohammad, Zare, Tahere; Mohammadi, Zohre(2007) , "choosing landfill by GIS software " , 10th national environmental issue symposium"
- [4] Majlesi, Monire; Daman afshan, Hojat(2009), "finding landfill for Dezfol by GIS", 12th national environmental issue, h. Beheshti university, Medical college 2010, P436-441.
- [5] Alkhalil.M (2002): Selecting the appropriate project delivery method using AHP, International Journal of Project Management, 20, 469-474.
- [6] Dagdviren .M ,Serkan.Y ,Kilinc.N (2009): Weapon selection using the AHP and Topsis method under Fuzzy Environment, Expert Systems with Application , 36 , 8143- 8151.
- [7] Ghazinoory .S, Aliahmadi ,A ,Namdarzangeneh,S ,Ghodsypoor.S.H (2007) : Using AHP and L.P for choosing the best alternatives based the gap analysis ,Applied Mathematics and Computation ,184 ,316-321.
- [8] Guiqin, W. , li, Q. , Guoxue,L. , Lijun, CH. (2009): landfill site selection using spatial information technologies and AHP, Environmental Management, 90, 2414-2421.

- [9] Mamat.N,Daniel.J (2007): Statistical analyses on tim copmlexity and rank consistency between singular value decomposition and the duality approach in AHP :A case study of faculty member selection ,Mathematical and Computer Modelling 46 ,1099 -1106.