Cumhuriyet Üniversitesi Fen Fakültesi
Fen Bilimleri Dergisi (CFD), Cilt:36, No: 3 Ozel Sayı (2015)
ISSN: 1300-1949

Cumhuriyet University Faculty of Science
Science Journal (CSJ), Vol. 36, No: 3 Special Issue (2015)
ISSN: 1300-1949

Investigating and analyzing the waste collection system in rural areas

(The Case of Aqabad rural area)

Nahid AZMOON[1,*], Nazli AZMOON[2]

[1]*MA of geography and rural planning, PNU of Gonbade Kavos*

[2]*MA of geography and urban planning, IAU of shirvan*

Received: 01.02.2015; Accepted: 06.06.2015

Abstract. Due to the growing population and producing more diverse wastes in recent years, investigating the waste collection and management and disposal system is of great importance. Therefore, planning a proper waste management strategy and positioning to prevent environmental pollution in rural areas is essential. The aim of this study was to investigate and evaluate the waste collection system in the villages of Aqabad rural district. In this study, it was tried to collect required information from study population (Sarli Makhtoom and Totli Kochak villages) through completing surveys and questionnaires from selected households, then rural waste collection system was analyzed using spss software and gis software to locate waste disposal. Bottlenecks and solutions are provided in the swot table. In this study, awareness of the importance of recycling and waste separation, the selection of suitable disposal sites, replacing the new collection method for improving environmental conditions was studied. The results showed that awareness of the importance of recycling is too low and a proper disposal site has not been selected and also the new collection method is effective in improving environmental health.

Keywords: Waste, recycling, rural areas

1. INTRODUCTION

One of the problems already faced by developing countries is the lack of proper waste collection system that affects the health of village and its environmental degradation. Currently, there is no coherent management in the field of rural waste and wet wastes dominate dry wastes and also most of the produced wastes are non-recyclable (such as plastics, metals, etc.) and remain in the environment and destroys beautiful landscape of the village. The existence of political, social, cultural and economic issues prevent a proper waste management in the country and cause irreparable damage to the environment and the community and the accumulation of waste and not recycling waste and improper disposal is followed by great economic losses.

Environment includes all the things that surround human beings. The environment is not limited only to the physical world, but also includes the economy, society and culture. Therefore, people are not only interested in the physical world, but also in the overall environment. With the advancement of technology and industry, household and industrial waste entered into the environment and people's living area and polluting gases were scattered in space. First, the physical world could impose pollution but with the rise of industrialization, population growth and urban concentration, the society became more sensitive to the indirect costs caused by the increasing pollution imposed by environment, especially in large cities where air pollution was clearly visible, and had severe adverse effects on air quality (Abdoli, 1997: 22-24).

Environmental protection has become more important in recent decades. Considering globalization and regionalization of unpleasant environmental consequences including climate

* Corresponding author. *Email address: Nahid AZMOON*

Special Issue: The Second National Conference on Applied Research in Science and Technology

change and pollution of water and land resources has led to global conventions that the Islamic Republic of Iran has also joined some of them and also has undertaken the commitments.

In the third program also the government has been committed to maintaun the balance of environment by balancing the use of pastures, forests, preservation of genetic reserves and basic resources, applying integrated management, institutionalizing public participation, applying environmental criteria prior to the implementation of large projects and reducing air pollution in large cities and the direct and indirect intervention methods are used to achieve sustainable development (Karimi and Atri, 2003, 9-10).

The priority of planning for the resolution of waste from the source and healthy waste disposal is in villages located in environmentally critical areas, villages in the vicinity of rivers and seas, tourism and so forth. The joint projects between several villages and neighboring towns or villages is the priority (Hosseini, 2010:80).

The current status of responsible elements in the waste management system in the villages of the country includes the collection and disposal in land. The waste of the villages is collected by industrial tractors, motorcycles, Amico waste trucks, Nissan waste trucks, francolin tractor and wheelbarrow. It can be said that almost all of these machines have been given to villages with the help of the Ministry. Disposal of wastes in the land is done in the form of heap, heap and burn, and rarely landfill and soil cover as irregular and occasionally (Abdoli, 2011: 106 105).

Also the expansion of consumerism culture from the cities to the rural areas has led residents to get accustomed to consumption-oriented culture and this in turn leads to increased waste and problems in the environment and caused rural waste to change from corruptible to non-corruptible materials such as plastic, glass, metal, and so on. And on the other hand, the volume of waste has also increased.

Increased waste is also associated with issues regarding waste locating and the proper way of using waste as recycle. Waste locating is something special and includes different parameters that are not considered in Iran and in particular in rural areas. A series of factors affect the process of collecting the waste and its success rate; one of the factors is cooperation and public participation of rural areas' residents with executive agencies to collect waste that is very important.

Satisfaction of rural waste collection system depends on waste management of rural forums. Using the facilities, careful planning should be done in this area so that with proper management, the satisfaction of residents is achieved. Rural forums are obliged to provide clear and reasonable timetable for the storage and collection of solid wastes in the village or region. The program should inform all residents of the village and required trainings should be provided for rural residents for implementing waste collection programs.

The need for investigating rural waste collection systems is inevitable for planning and controlling environmental health and executive authorities should seek optimal solutions to remedy the existing problems in the field of waste collection.

Review of the literature suggests that several studies have been conducted in the field of rural waste including evaluating the potential of recycling rural waste in Hormozgan written by Mohammad Ali Abdoli, Mehdi Jalali Ghazizadeh, Reza Samii Fard and providing rural waste management strategy presented by AWOT (case study: Minab) written by Seyed Ali Jozi, Mohsen Dehghani, and Morteza Zaree.

This paper tries to propose solutions to achieve a proper waste collection system using descriptive and document methods and field visits. The main objective of this study was to assess the elements of the rural waste collection system and check the bottlenecks and

functionality of waste collection system and provide recommendations. However, the problem that is discussed in this paper is to determine how is waste collection system in the Aqabad village, which raised the following questions:

1) To what extent is landfill selected correctly in the villages under study?

2) To what extent are rural residents aware of the importance of recycling and waste separation?

3) What positive effects do substituting new ways of collecting waste have over traditional methods?

First hypothesis: it seems that the site of landfill is properly selected in the villages studied.

Second hypothesis: it seems that rural residents are not aware of the importance of recycling and waste separation.

Third hypothesis: It seems that replacing new method of collecting waste with the traditional collection method is effective in environmental health of the villages.

2. THE RESEARCH METHOD:

Awareness of waste collection systems is of great importance in rural planning, because it will determine the way of distribution and which parts have waste system and which parts are lacking. This study is descriptive-analytic research, and in terms of monitoring, it is a field study and data is collected through a questionnaire.

3. THE POPULATION AND SAMPLE:

The population is residents in the Aqabad village and simple random sampling was used because of the area of study and the two villages of Sarli Makhtoom ND Totli Kochak were determined and according to the last census, their population is 1466 people, 1225 people, respectively (Gonbade Kavos health center). Questionnaires were developed for this research. Since, population is usually of great geographical size and researchers cannot meet all of them, some of them were selected as sample and results were generalized. The research sample is obtained using Cochran formula as follows:

$$= \frac{\frac{t^{2pq}}{d^2}}{1 + \frac{1}{N}\left(\frac{t^{2pq}}{d^2} - 1\right)}$$

The number of households in the study sample was calculated according to the Cochran formula and 95% confidence level. Accordingly, the number of households in the sample was 70 families.

4. THE INTRODUCTION OF THE SCOPE OF THE STUDY:

The geographical location of the province

Golestan province is located between 53 degrees and 51 minutes to 56 degrees and 22 minutes east longitude and 36 degrees and 30 minutes to 38 degrees and 8 minutes north latitude in the northen part of the country.

Golestan province consists of 14 cities, 27 districts, 25 towns, 60 rural areas, 1008 residential villages and 47 non-residential villages. Golestan province is over 20438/7 square kilometers (1.3% of the total area of the country and No. 21 among provinces). Gonbade Kavos city with 5071/3 square kilometers (24/81% of the area of the province) is the biggest city and Bandargaz city with 239/31 kilometers (17.1% of the area of the province) is the smallest city of the

province. The relative density of the population in 2011 was 87 people in square kilometers and Gorgan city with 286 people and Marave Tape city with 17 people had respectively the highest and lowest relative density of population. (Www.golestan.gov.ir)

Gonbad city with a population of 325789 thousand people is located in East Golestan province. Aqabad rural area is located in the central part of the Gonbad city and has 26 villages and its area is 558.6 square kilometers. Aqabad rural area is neighbor to the East by Minoo Dasht city and to the west by Sultanali rural area and to the north by Grand rural area and to the south by Fajr rural area. The population of this rural area according to the 2006 census is 29,707 people (5931 households). Of these 26 villages, there are 4 main villages (Aqabad, center of the rural area), Ghare Mohammad Tape, Chai Ghushane Bozorg, Haji Ghushan and 18 satellite villages. There is waste collection system in 22 villages and 4 villages (Seyed Niaz, Gozni Tape, Chapar Ghoimeh, Amangol Tape) do not have waste collection system. (Gonbad-e-Kavus Health Center)

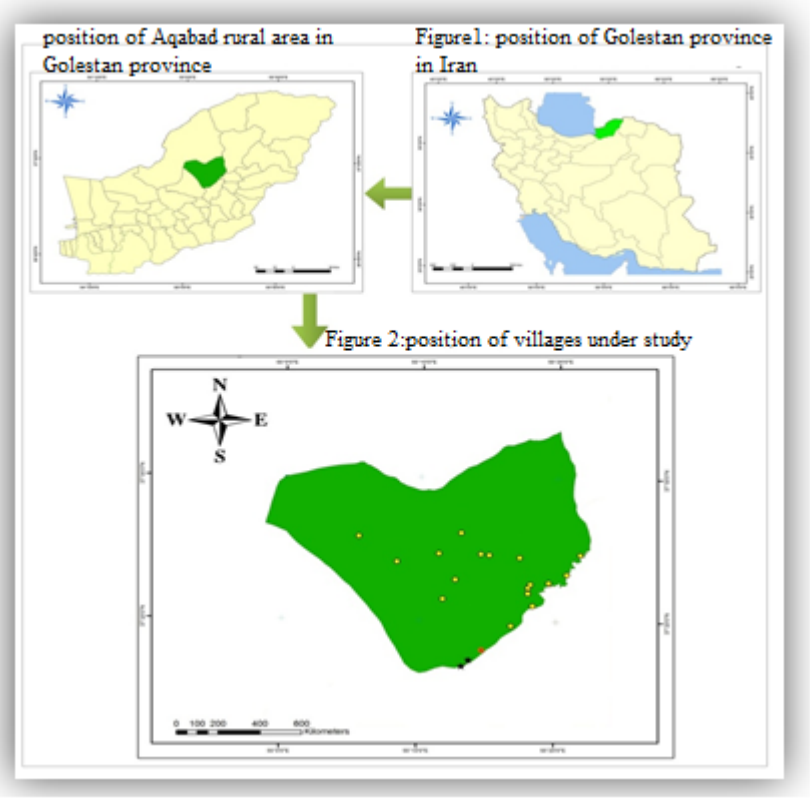


Figure 1. Position of Sarli Makhtoom and Totli Kochak villages.

The following table shows the population of Sarli Makhttom and Totli Kochak villages according to 2006 and 2011 Census.

Table 1. Population.

Village	Number of households	Percentage	Population	Percentage	Year
Sarli Makhtoom	260	14/55	1276	13/73	2006
Totli Kochak	188	10/52	1026	11/04	2006
Sarli Makhtoom	342	13/58	1466	13/21	2011
Totli Kochak	273	10/84	1225	11/04	2011

(Source: Gonbad-e-Kavus Health Center)

5.RESULTS:

Table (2) shows the evaluation of waste collection system history and mechanism in Sarli Makhtoom and Totli Kochak villages:

Table 2. Evaluation of waste collection system history and mechanism.

Village	Type of village	Year of establishment	Devoted by governorship	installing basket beside the gate	Truck	Time of collection	Capacity of the vehicle
Totli Kochak	satellite	2006	×	×	×	Every 2 days – 5 to 9 am	6 tons
Sarli Makhtoom	satellite	2006	×	×	×	Every 2 days – 5 to 9 am	6 tons

(Source: researchers' field information)

Table 3 and diagram (1) show that most occupational frequency is for workers and the minimum frequency is for employees and the other.

Table 3. Occupation.

Occupation	Frequency	Percentage	reliable percentage
Farmer	20	28.2	28.6
Worker	25	35.2	35.7
Driver	8	11.3	11.4
Employee	9	12.7	12.9
Other	8	12.6	11.4
Total	70	100	100

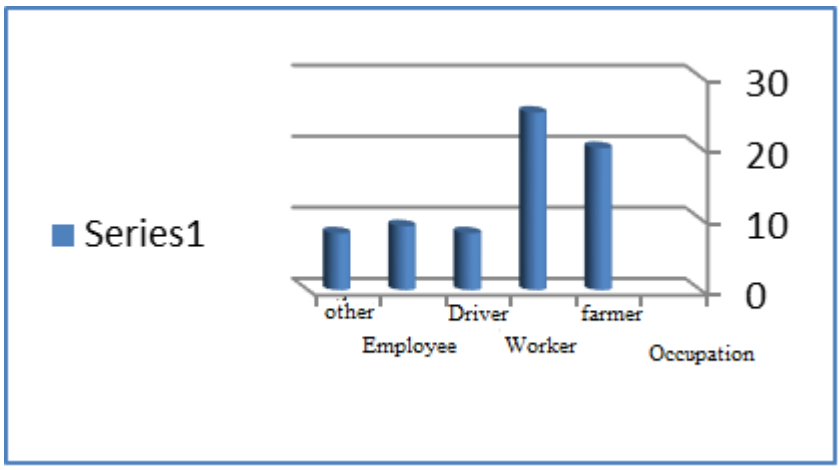


Diagram 1. Occupation.

Table 4 and diagram (2) show that the maximum age range frequency is 60-70 and the minimum frequency is 80 and more.

Table 4. Age range.

Age	Frequency	Percentage	reliable percentage
20-30	19	27.5	27.1
40-50	22	31.7	31.4
60-70	29	36.6	37.2
80 and more	3	4.2	4.3
Total	70	100	100

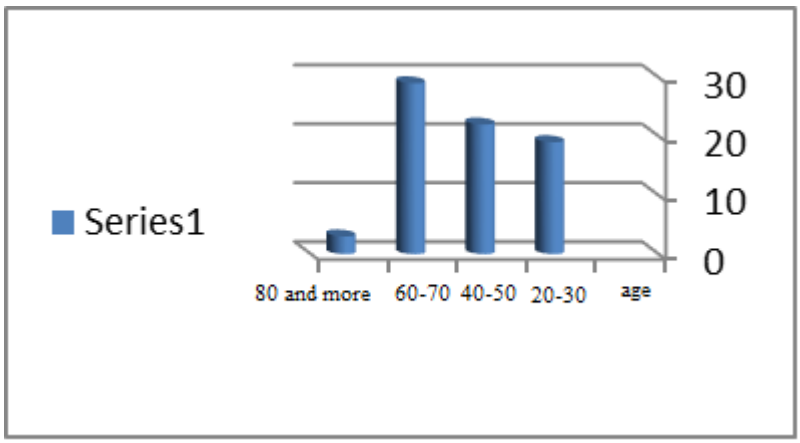


Diagram 2. Age range.

Table 5 and diagram (3) show that the maximum frequency of education level is guidance and the minimum frequency is high school.

Table 5. Education level.

Education	Frequency	Percentage	reliable percentage
Elementary school	20	28.5	28.6
Guidance school	29	41.8	41.5
High school	10	14.1	14.2
MA	11	15.6	15.7
Total	70	100	100

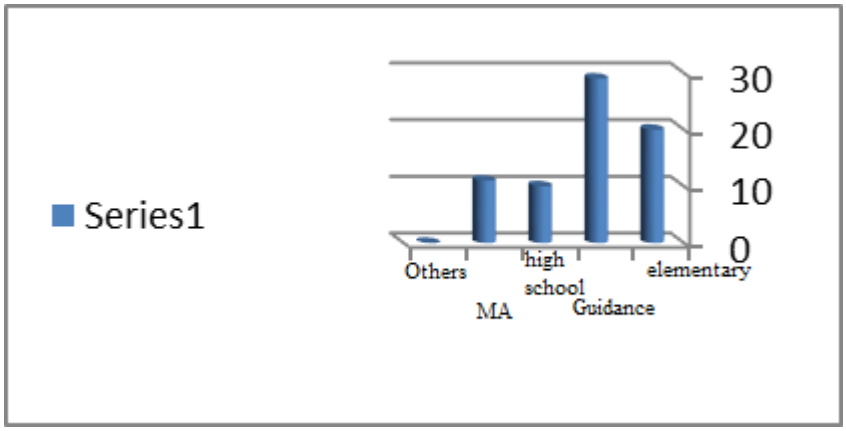


Diagram 3. Education level.

First hypothesis: it seems that the site of landfill is properly selected in the villages studied.

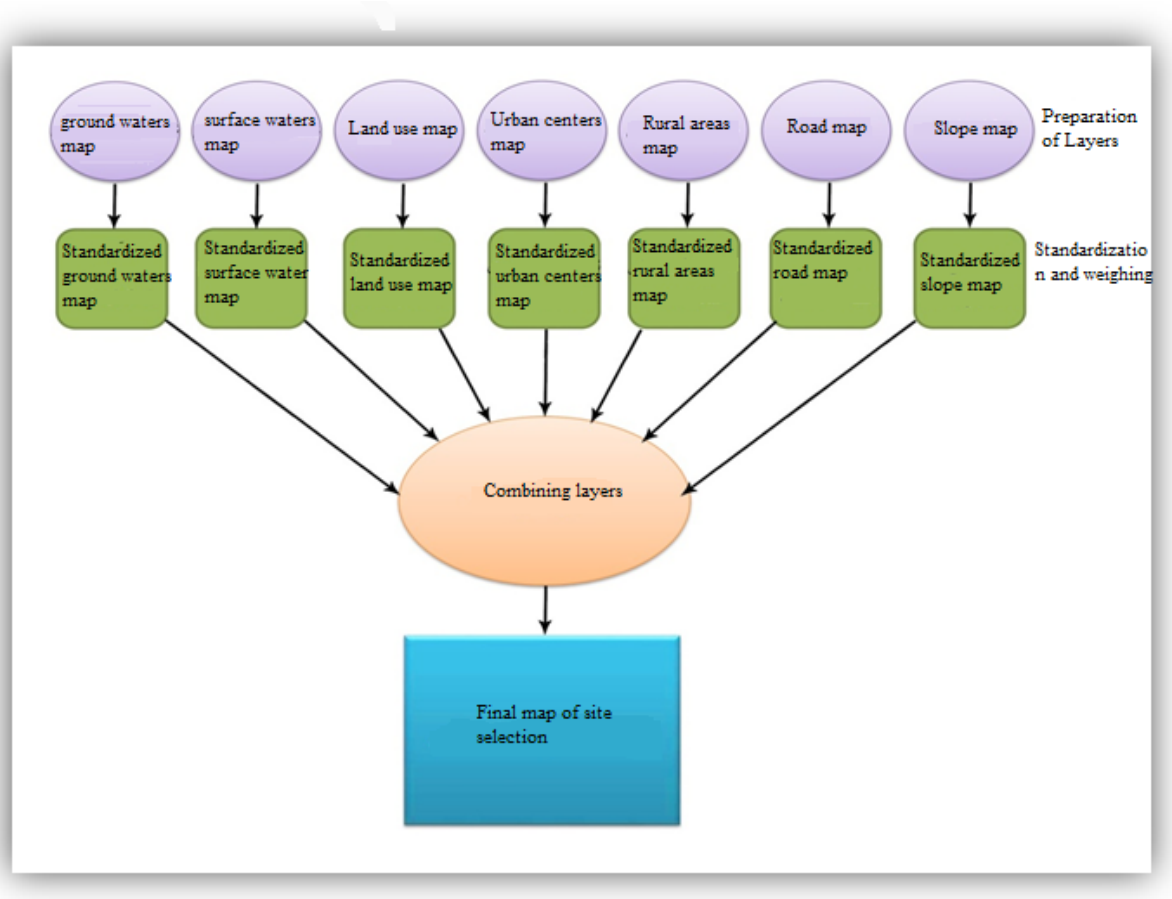
This is not a testable hypothesis and researcher has used field observations and gis software to confirm or reject it. Landfill has not been located in these villages and because of its proximity to the city waste is taken to Gonbad site. So the hypothesis is rejected. According to the rules and regulations for these two villages, waste landfill locating is never done for these villages, rather locating is designed for a rural area.

Landfill site selection was done using Geographic Information System (Gis) and the criteria used in the positioning are as table (6):

Table 6. Landfill site selection.

Criteria affecting site selection	The acceptable minimum for site selection	The effective percentage
Depth of groundwater	> 20 m	25%
Distance from surface water	> 800 m	15%
Height	300 m	14%
Distance from agricultural areas	> 2000 m	14%
Distance from roads	between 300 to 2000 m	12%
Distance from residential centers	between 3000 to 20000 m	11%
Slope	<15%	7%

The following figure shows the stages of site selection in this study (figure 2):



Aqabad rural area is located in a plain and low-height area, and only a small area of the North East of this rural area has more than 300 meters height; therefore, the height of nearly all part of the rural area is suitable for waste disposal (Figure 3: proper height).

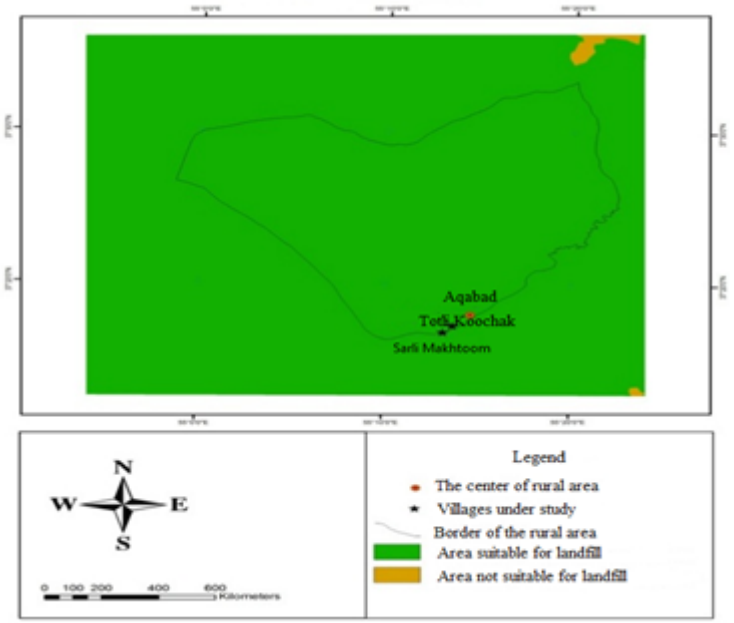


Figure 3. Proper height map.

The level of groundwater in the region is more than 20 meters and from this point of view, there is no limitation for landfill (Figure 4: Depth of groundwater)

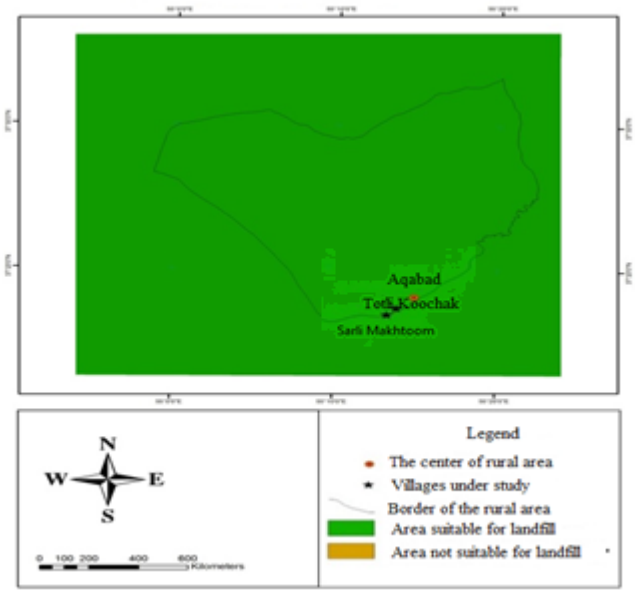


Figure 4. Map of proper depth of groundwater.

An area about 800 meters frontage has been considered for surface waters to landfill in the region (Figure 5: The proper distance from surface waters), and the map below shows the proper distance from roads (Figure 6: The proper distance from roads).

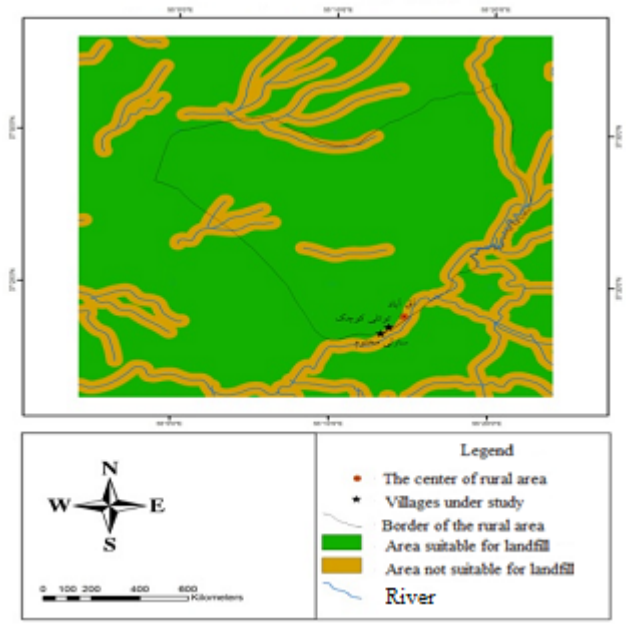


Figure 5. Map of proper distance from surface waters.

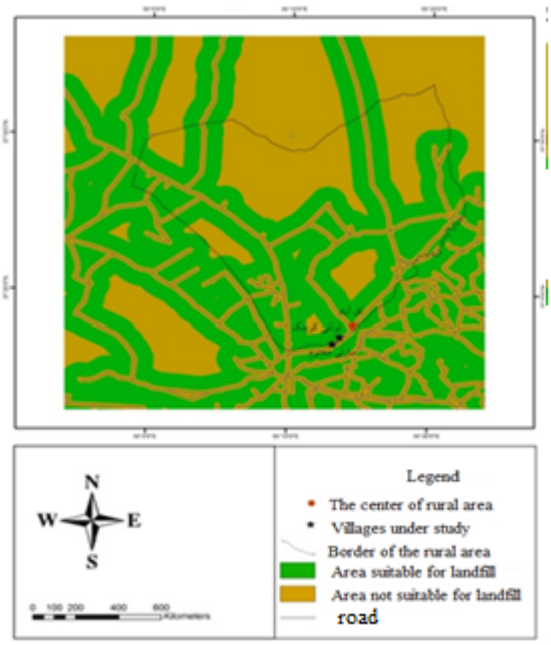


Figure 6. Map of proper distance from roads.

Using the topographic map, the map of digital elevation and slope map were prepared in two classes of slope of less than 15% and more than 15% and on the basis of the map, the West and South West of region is suitable for landfill (Figure 7).

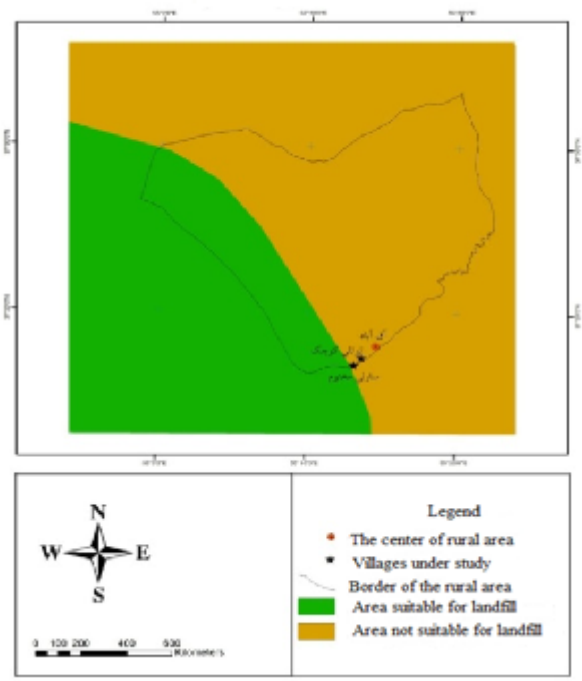


Figure 7. Map of proper slope.

In the land area, there are areas with agricultural use without restriction and dry land, pasture and wasteland and agricultural land use is not suitable for landfill and for this purpose, it is tried to use the barren and dry lands (Figure 8: Proper uses). Major residential centers are in the south and southeast regions where there are high-quality arable lands and for these centers an area of 3000 meters frontage were provided (Figure 9: Proper distance from residential centers).

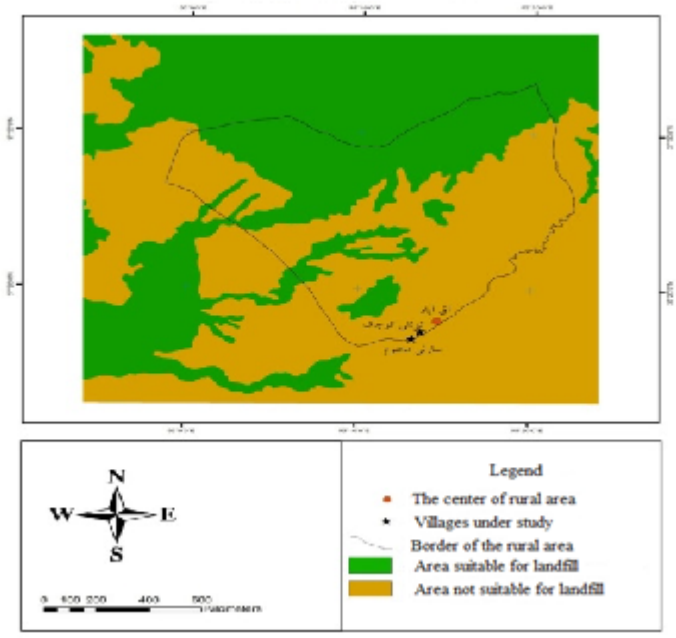


Figure 8. Map of proper uses.

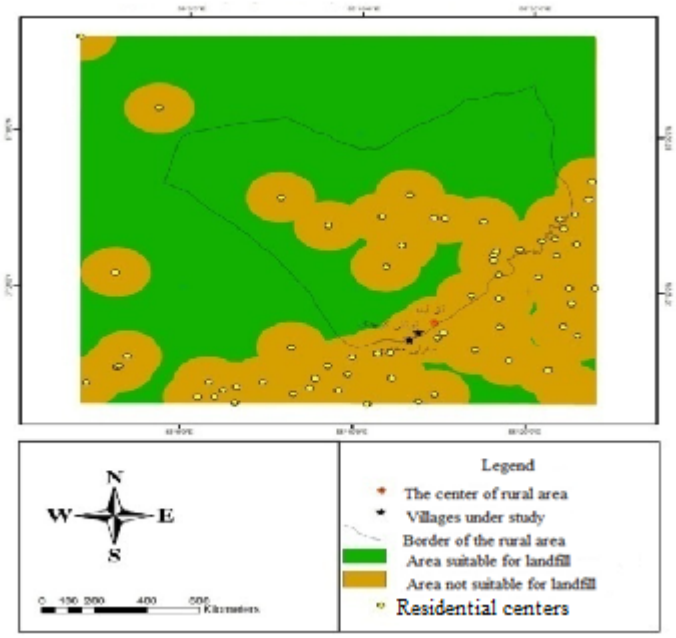


Figure 9. Map of proper distance from residential centers.

The results of site selection were classified in two proper and improper classes and final map was obtained and shows that the West and Southwest of rural area is proper to locate landfill (Figure 10: Site selection for landfill in the study area).

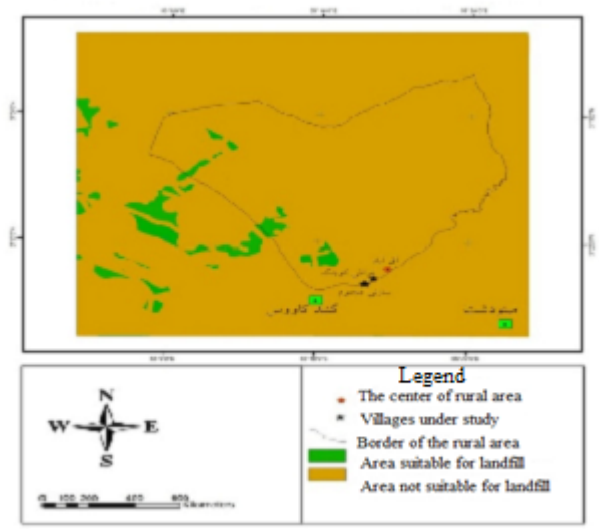


Figure 10. Map of site selection for landfill in the study area.

Second hypothesis: it seems that rural residents are not aware of the importance of recycling and waste separation.

To test this hypothesis, chi-square correlation coefficient has been used with regard to the level of measure of ordinal-nominal variables and researchers aim to measure the relationship.

Chi-square test results show that the correlation of these two variables is direct (0.0 / 0), but significant and hypothesis is confirmed (at 5% error level (95% confidence level)), as a result,

the null hypothesis (H0: Being aware of the importance of recycling and waste separation) is rejected and H1 that is the lack of awareness of the importance of recycling and separation of waste is confirmed. Therefore, according to villagers' response, they are not aware of the importance of recycling and waste separation.

Table 7. Awareness of the importance of recycling and waste separation.

	Separation	Awareness
Chi-Square	48.057[a]	58.514[a]
df	1	1
Asymp. Sig.	.000	.000

Third hypothesis: It seems that replacing new method of collecting waste with the traditional collection method is effective in environmental health of the villages.

level of measure of ordinal-nominal variables and researchers aim to measure the relationship.

Chi-square test results show that the correlation of these two variables is direct (0.0 / 0), but significant and hypothesis is confirmed and as a result, the null hypothesis (H0: Replacing new methods of waste collection) is confirmed and H1 is rejected. Therefore, according to villagers' response, replacing new method of waste collection affects the environmental health of the village.

Table 8. Replacing newmethod of waste collection.

	New method of waste collection	Improving health situation of the environment
Chi-Square	32.429[a]	51.429[b]
df	4	1
Asymp. Sig.	.000	.000

6.DISCUSSION AND CONCLUSION:

In rural areas, with the difference that these areas have with urban areas in terms of their way of life, due to changes in people's lifestyles, environmental pollution and thus endangering the health of the villagers a proper waste collection system is an important issue. Therefore, rural forums should obtain enough information on the appropriate waste collection system and by holding training classes, building a culture of waste separation and recycling for rural residents, especially women, take necessary actions to perform their plans.

Based on the data of gis software, it shows that proper location for waste disposal is West and South-West of Aqabad rural aresa. Hypotheses test results also suggest that residents are not aware of the importance of recycling and also replacing new methods of waste collection with traditional methods affect environmental health of the village. In connection with the storage and maintenance of waste, following points should be of concern for rural forums:

1. Solid wastes should not be kept in the intended containers or tanks prior to the planned time for waste collection.

2. In the case of wet and corruptible wastes; their leachate and additional moisture must be primarily be extracted and before placing them in trash containers, they should be wrapped in paper or put inside leak-proof bags (plastic bags)

3. No individual or entity should store or maintain his or its wastes for purposes other than health care and clean way and in accordance with laws, standards, regulations and national and local guidelines (provided by the authorities).

4. Alley trash collection and street-cleaning and cleaning rural areas and waste waters channels should also be considered within the program of waste collection.

5. Public education and vocational training for collectors and other people involved in the village are of the measures required to achieve the desired result.

Table following table analyzes and assesses waste collection system in Totli Kochak and Sarli Makhtom villages according to swot model:

Table 9. Analysis and assessment of waste collection system in Totli Kochak and Sarli Makhtoom villages according to swot model.

Classifying factors	Internal factors		External factors	
	Strengths	Weaknesses	Opportunities	Threats
Social – cultural	1. The cooperation and participation of the people in putting out garbage timely 2. the consent of residents of the time of garbage collection	1. Lack of knowledge of rural residents for separation and segregation of waste	1. Holding training and specialized workshops in the introduction of modern methods of waste collection system for rural forums 2. Building the culture of waste separation for rural residents	1. Lack of awareness of the importance of recycling 2. Lack of segregation of waste and resulting pollution in the environment.
Economic	3. Abandoning the traditional method of collecting and using new collection method 4. Donating transport vehicles for waste from the governorship	2. The lack of support of villagers by the government to invest in the field of composting workshops	2. Giving low-interest loans for creating composting workshops 3. Creating jobs in various areas to collect waste	3. Bringing the culture of consumerism from cities and producing more wastes 4. The lack of investment in private sectors in waste collection system
Physical-environmental	5. Placing baskets in the streets to collect waste and preventing environmental pollution 6. Planning for the use of compost in the near future	3. Lack of providing appropriate locations for waste disposal by scientific and engineering and geological principles	4. Planning for composting workshops 5. The construction of the recycling industry	5. The lack of fencing in the area of the Gonbad site and the release of wastes in the open space 6. Increase of harmful insects in the area of the Gonbad site
Managerial and administrative	7. Monitoring and managing of rural forums in waste collecting system	4. Failure to complete and organizing the site of Gonbad 5. The lack of systematic and integrated management	6. Giving containers to collect recyclable materials in all neighborhoods and encouraging residents to separate waste at source	7. Lack of proper and efficient planning for landfill

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