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Increasing Solid Waste Generation in Sulaimania City as a New Challenge to the Environment of the City

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Abstract: Massive construction, as well as an increase in oil and cement companies with urban expansion in most of the cities in Kurdistan particularly in Sulaimania city are causing many serious environmental issues such as water, air, soil pollution and the increasing solid waste generation. Currently, Sulaimania city is facing gradual increment of solid waste generation and as a result, the huge area of Tanjaro, South of the city has been covered by highly heterogeneous (mixed) waste which ultimately has led to a considerable amount of Methane gas (CH4) to be generated due to the decomposition of biodegradable waste. In 2015, the total waste generation per day in the city center was estimated to be around 1200 tons/day and in the countryside it was around 2400 tons/day. Also, untreated leachate leaking from the Tanjaro dumping area which eventually finds its way into the surrounding water body (Tanjaro River) has caused a change in the chemical structure of the water. In addition, the burning of Tanjoro's waste by irresponsible people is another issue which is continually deteriorating the air quality of the city and can be observed as a haze throughout the south and southwest of the city. This study focuses on the waste generation ratio by different sectors in the city, waste composition, how the residents beside the dumping area think about the Tanjaro dumping area and stakeholders from the governmental side with private sectors like those companies that collect the waste from the city. Furthermore, the results from the survey showed that the highest ratio of waste generated in Sulaimania city is organic waste specifically food waste. Besides, some part of the medical waste which is mainly classified as hazardous waste generated from public and private hospitals is also dumped in Tanjaro area. Moreover, the result of the survey showed that the residential areas nearby the dumping area were also suffering from the odor generated from the degradation of the waste and more soil and agricultural land is being covered by waste due to the expansion of the dumping area. Another problem was any insect or other arthropod, rodent or other animal inside the dumping area were capable of transmitting the causative agents of human disease, or disruption of the normal enjoyment of life by adversely affecting the public health and wellbeing.

Keywords: Sulaimania City, Solid Waste Generation, Tanjaro River Pollution, Medical Waste Generation in Public Hospitals

1. Background of the Study

An increase in the world's population has resulted in a huge amount of solid wastes being generated. In 2000, the estimated global waste generation was 318 million tons of various types of solid waste and it is projected to increase to approximately 6% annually. In 2016, global MSW generation levels were approximately 1.3 billion tons per year, and are expected to increase and to be doubled by 2025 (Hoornweg et al., 2012). However, due to the lack of proper data collection in some of the parts of the world, the actual figures for worldwide waste generation are not available. Therefore, the accurate studies should be done by developing and underdeveloped countries towards having more precise and reliable data about solid waste generation.

At the country level, Iraq has no accurate data on the average solid waste generation per capita per day. Therefore, the study should start at the level of the cities and then will go for the country level. This study mainly focuses on the current scenario of solid waste generation in Sulaimania city. The economic growth has brought many benefits, such as raising standards of living and improving the life style across the Kurdistan region, but it has also resulted in the depletion of natural resources and the degradation of ecosystems. Developing the industrial sector in the Kurdistan region particularly in the south of Sulaimania city is likely to generate tons of different types of wastes including hazardous waste which will be dumped illegally without any proper treatment into the open dumping area (Tanjaro area). Also, the expansion in several areas of the economy and the entry of a huge number of international companies supporting many sectors like oil and gas, construction, transportation and health sectors in the region has brought a very clear negative impact on the environment in terms of water, air and soil pollution in many different ways. Furthermore, huge amounts of effluent discharged continually from oil drilling operations, pharmaceutical industries, hospital and municipal waste were being directed into the surrounding water bodies with the highly heterogeneous (mixed) solid waste into the dumping area in Tanjaro as shown in figure (1.1). Also, there was no use of integrated solid waste management such as recycling and reuse by both the public and private sectors and a lack of environmental experts to conduct researches in the field of environment has made the situation even worse.

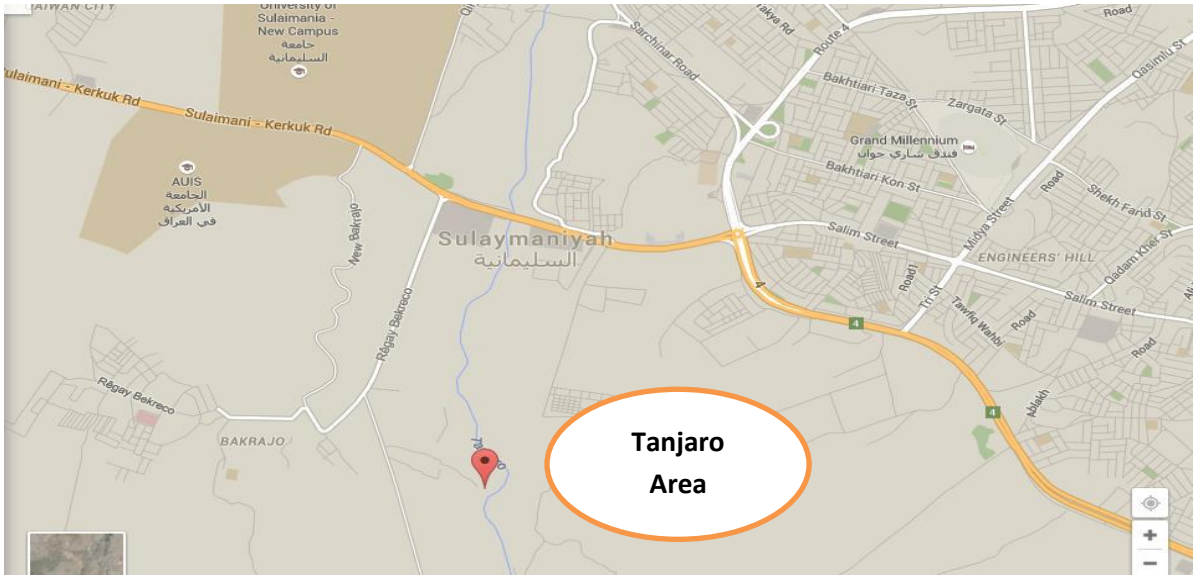

Figure 1: Scope of the study; Tanjaro area, South of Sulaimania City. Source: Google Maps

About 85% of the population of the Kurdistan Region of Iraq is living in the city, while the remaining 15% are living in the villages and countryside outside the city. In 2015, Sulaimania city had around 5500 factories of varying sizes. This alone has caused many environmental problems for the city such as groundwater pollution, because of the seeping down of leachates generated from the dumping area into the soil and finding its way into the groundwater.

More recently, Sulaimania city has faced new challenges like increasing waste generation rate and lack of available land for establishing new sanitary landfill (World Bank Report, 2015). Sulaimania governorate includes 76 municipalities within 10 districts and 50 sub-districts and many villages. The majority of governorate's solid waste is managed by private sectors. The main dumping area in Sulaimania is Tanjaro which is located approximately 10km south of the city and it is nearly saturated (World Bank Report, 2015).

A part of the dumped wastes in Tanjaro was burnt by irresponsible locals which was causing air pollution. According to the study from Sulaimania municipality (Environmental section), waste generation per capita in Sulaimania is around 1.2 kg and this ratio is expected to increase continually. Moreover, the Tanjaro dumping area is a place for new and more threats on Sulaimania's environment, which is mainly coming from the newly established industrial zone, where many factories are melting old tires to make oil (Nabil, 2014).

In The Kurdistan Region, every day nearly 4600 tons of waste is generated and disposed into the dumping area without any proper solid waste management. Each city has a different portion of total waste generation in KRG such as in Erbil, Duhok and Sulaimania, it is around 2400 tons, 1000 tons and 1200 tons respectively.

2. Literature Review

A population increase results in a larger demand for goods and services. It leads to the introduction of various products to cater the need of the consumer society (Odum and Odum, 2006). As a consequent, more resources will be discarded and disposed off as waste. In developed nations with appropriate technologies in place, the waste management system is maintained efficiently with minimum environmental impacts. Iraq is estimated to produce 31,000 tons of solid waste every day with per capita waste generation exceeding 1.4 kg per day. Baghdad alone produces more than 1.5 million tons of solid wastes each year (Alnajjar, 2016). In more environmentally-concerned nations sustainability is the main concept to be pursued in ensuring the harmonization between humans and the environment. However, in developing and under developed nations, improper waste management has caused various environmental problems particularly in urban areas (Salhofer et al., 2008). Rapid urbanization, changes in consumption pattern and lack of recycling activities resulted with the increase in waste generation. Waste management has been reported as one of the prominent environmental problems in many urban areas in the Asian region (Ngoc & Schnitzer, 2009). Similarly in other parts of the world particularly in the African cities (Rahji & Oloruntoba, 2009) improper waste management has led to serious detrimental impacts to the environment.

Iraq is one of the populous countries in The Middle East with a population exceeding 32 million. Rapid economic growth in some of the cities, high population growth, increasing individual income and sectarian conflicts have led to worsening the problem of solid waste generation in the country. In 2016, Iraq estimated to produce 31,000 tons of solid waste every day and waste generation exceeding

1.4 kg/capita/day (Alnajjar, 2016).

A rapid increase in waste generation production is putting tremendous strain on the Iraqi waste handling infrastructure which has been heavily damaged after decades of conflict and mismanagement. In the absence of a modern and efficient waste handling and disposal infrastructure most of the wastes are disposed in unregulated landfills across Iraq, with little or no concern for both human health and environment. Spontaneous fires, groundwater contamination, surface water pollution and large-scale greenhouse gas emissions have been the hallmarks of Iraqi landfills.

The total waste generation per day in the city center is nearly around 1200 tons/day and in the countryside it is 2400 tons/day. The type of the wastes found in Tanjaro is household waste, medical waste, hazardous waste and industrial waste (Hoornweg and Bhada, 2012). A lack of environmental awareness, lack of environmental law enforcement and punishment and bad-quality products will increase the amount of waste generated in the city. In addition, an increasing number of the population in the city along with an increasing number of Syrian and Iraqi refugees will bring uncontrollable satiation for KRG. At the beginning of 2015, there were 257000 Syrian refugees and 1,003,300 Iraqis migrated to the Region (Hoornweg and Bhada, 2012).

Some studies have been conducted on the pollution of Tanjaro River and its negative impacts on the surrounding environment. A study indicated that the Tanjro River had already been polluted and this pollution had a great effect on contaminating the surrounding soil with some heavy metals such as Cr and Ni (Majid, 2014). The concentration of heavy metals increased in soils irrigated with the water from Tanjro River which is polluted due to the direct discharge of the sewage collected from Sulaimania city. Perhaps another factor is dumping hazardous waste into the soil of the area without any proper treatment.

3. Research Methodology

This research was conducted in two different stages namely site visits, observation and data collection from different sources. The second one was conducting a survey and the distribution of questionnaires among people who are living nearby the Tanjaor dumping area in order to obtain the highest level of confidentiality about what exactly was happening in Tanjaro. It was also to check the level of environmental awareness among the residents nearby. The study was conducted in 2016 and took eight months to gather all the data from different sources. The questionnaire contained some questions about different issues such as solid waste generation, Tanjaro river pollution and finding the main source for the waste generation.

Furthermore, the waste sample was randomly collected from different trucks that brought wastes from different areas of the city to Tanjaro. This was to help identify the most effective methods for tackling the waste. Determining waste composition of the city will allow the authority and private sectors to think of placing priority on the essential elements of the integrated solid waste management.

4. Result and Discussion

Site observations were conducted many times to the Tanjaro dumping area and the expansion of waste disposal was very obvious on each site visit, more agricultural land was being covered by dumped waste. The leachates generated out of the waste decomposition process were continually

released into the Tanjaro River and surrounding land which eventually caused soil contamination as well. The result of the questionnaire showed that the majority of the residents nearby the Tanjaro dumping area believed this dumping area to be a serious problem for the environment of Sulaimanya city in terms of surface and ground water pollution, air pollution and soil contamination as shown in figure 1.2.

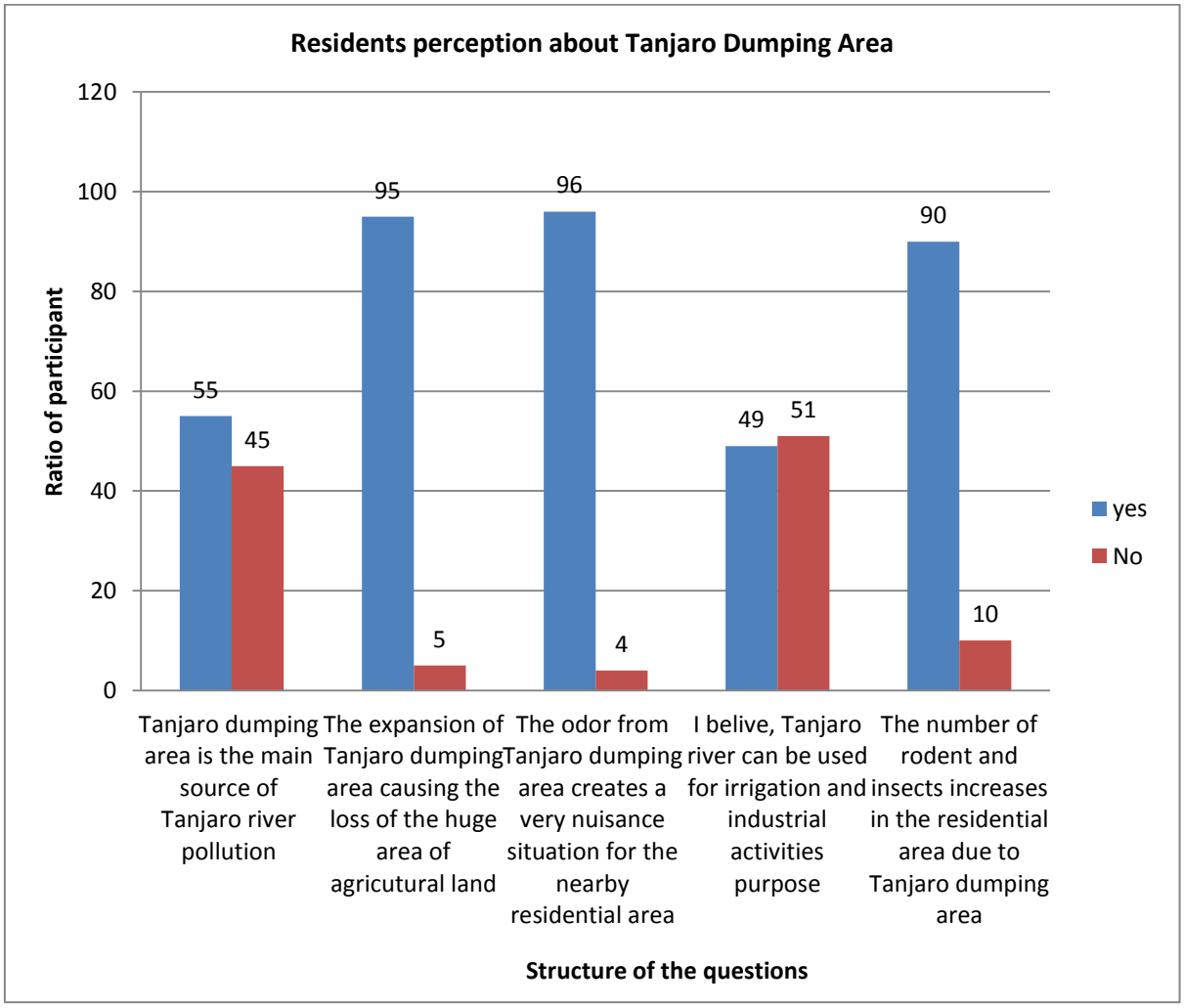

Figure 2: Residential's feedback on the negative impacts of the Tanjaro dumping area

In addition, the data from different private waste collection companies was analyzed. Each company covers some areas inside the city. The number of trucks and trips per day is also different from one company to another. The companies were namely Harem company, Shkar company, Uranus company and Khalid Shinky company. The figure (1.3) showed that how many tons of waste were transferred to the Tanjaro dumping area and how many trips were conducted per day by each truck.

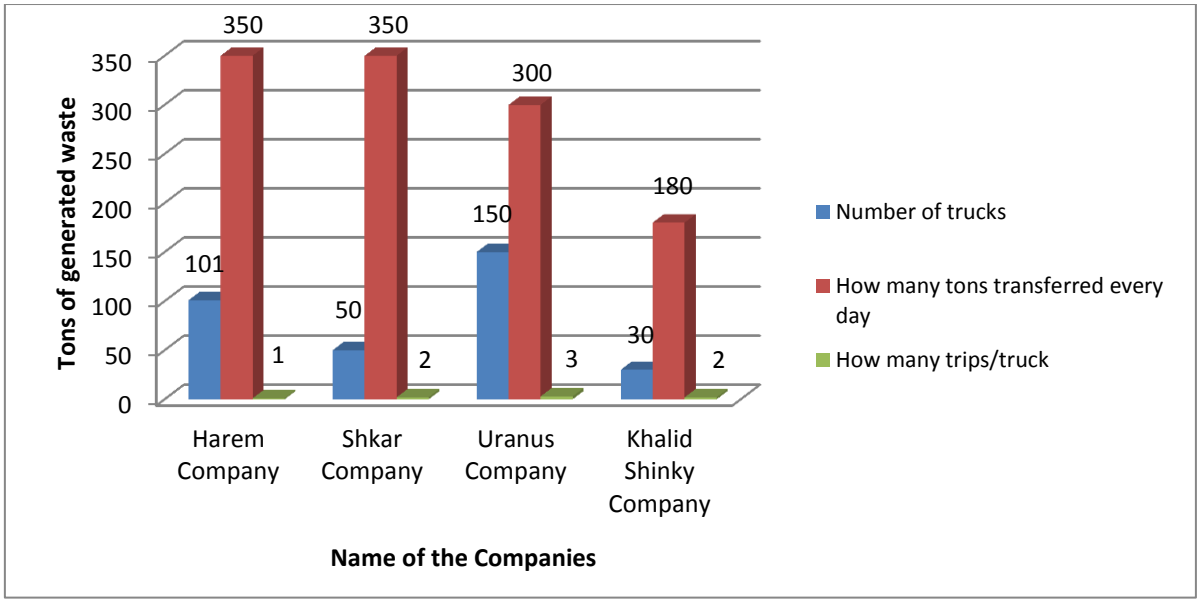

Figure 3: Different waste collection companies with how many tons of waste transferred per day

The companies based on their experience with transferring waste to the dumping area, categorized the composition of the collected waste as shown in the figure (1.4). The wastes were continually being collected by the companies from different areas during different seasons in order to find the fluctuation in the ratio of the waste category.

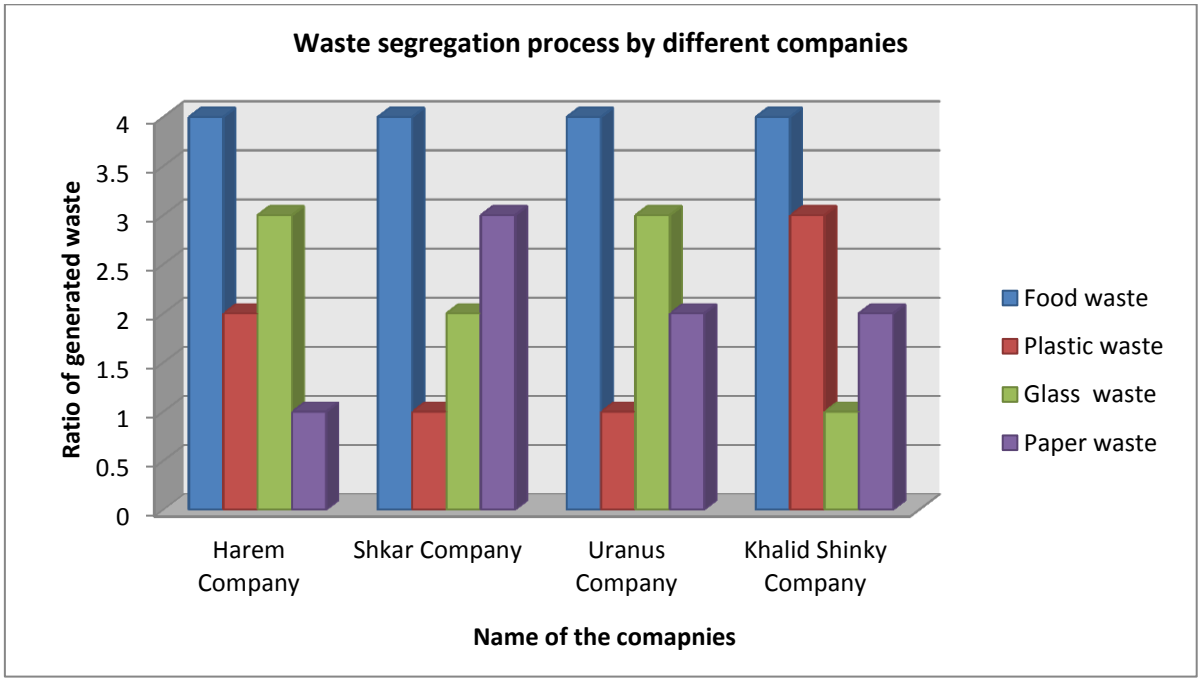

Figure 4: Waste segregation process conducted by different companies

Moreover, the waste composition study was conducted and the samples from different trucks which covered different areas in Sulaimania city had been taken on different days and times. The result showed that the average of food waste was the highest (75%) among all the types of the waste and textile waste was the second (9%) as shown in the figure (1.5). However, sometimes, the amount of plastic waste came as the second.

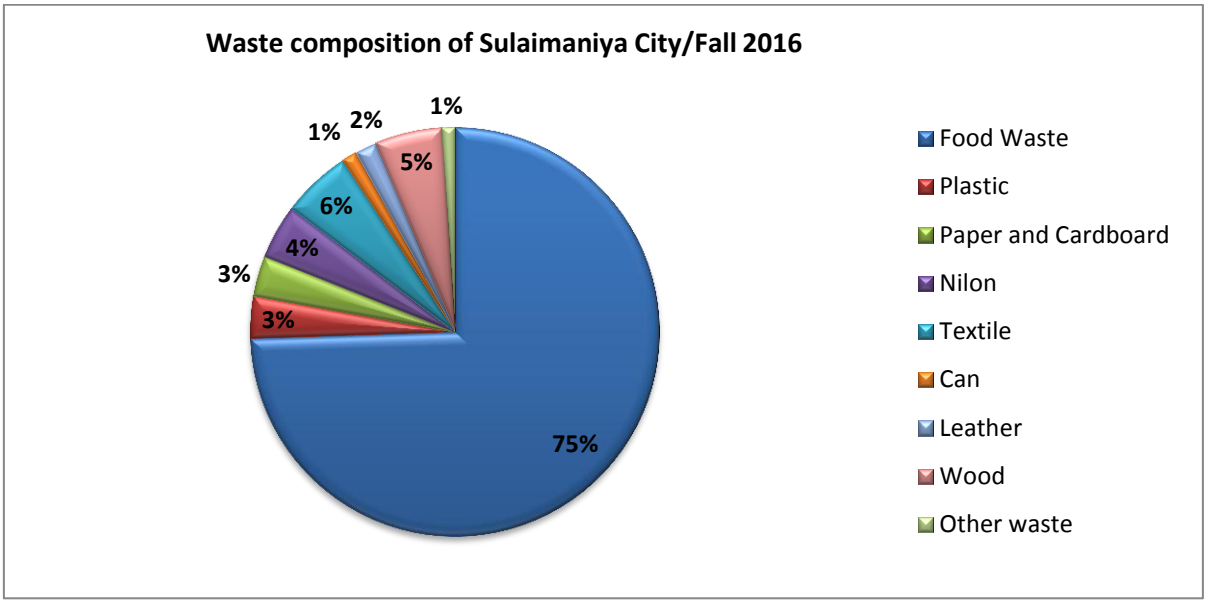

Figure 5: Waste composition of Sulaimania City in Fall 2016

Furthermore, the study of taking samples from different public hospitals inside Sulaimania city was conducted and the amount of waste generated was determined in order to find the average ratios of the waste per each hospital as illustrated in figure (1.6).

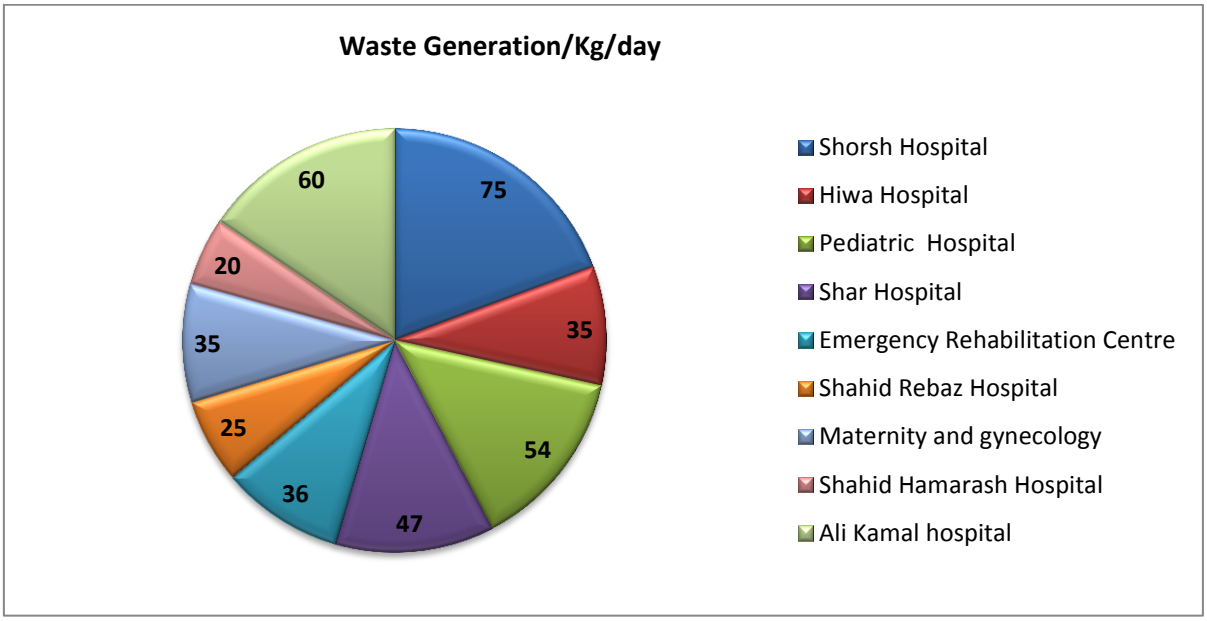

Figure 6: Waste generation ratio per each public hospital in Sulaimania City in one day

Also, the incinerations inside the hospitals for burning the combustible waste under a controlled environment was also studied and found that some of the hospital does not have this facility and some others are using it under controlled situation as shown in the table (1.1)

Table 1: The availability of the Incineration inside some of the Public Hospitals in Sulaimania City

Is there any Incineration for burning the waste inside the hospital? Do you burn the waste under controlled Environment? Do you put any filter for preventing the emission of the dangerous gasses resulted from burning?		
Name of Hospitals	Yes	No
Shorsh Hospital	√	
Hiwa Hospital	√	
Pediatric Hospital		√
Shar Hospital	√	
Emergency Rehabilitation Centre		√
Shahid rebaz Hospital		√
Maternity and gynecology		√
Shahid Hamarash Hospital		√
Ali Kamal hospital		√

The waste segregation process prior burning the waste was also only conducted in a few public hospitals as shown in table (1.2).

Table 2: Waste segregation process in the public hospitals

Is there any waste segregation process inside the hospital prior the burning process?		
Name of Hospitals	Yes	No
Shorsh Hospital	√	
Hiwa Hospital	√	
Pediatric Hospital		√
Shar Hospital	√	
Emergency Rehabilitation Centre		√
Shahid rebaz Hospital		√
Maternity and gynecology		√
Shahid Hamarash Hospital		√
Ali Kamal hospital		√

In addition to that, the waste composition for the hospitals was determined and the highest ratio in all of them mainly included Medical general waste and Bio-Medical sharp items generated as shown in the Table below (1.3).

Table 3: The Waste composition inside different Public Hospitals in Sulaimania City

What are the main types of Waste Generated in the Hospital?	
Name of Hospitals	Type of waste generated
Shorsh Hospital	Medical General waste, Infectious Hazardous waste, Non-degradable medical waste (saline Bottle), Bio-Medical sharp
Hiwa Hospital	Medical General waste, Infectious Hazardous waste
Pediatric Hospital	Medical General waste, Non-degradable medical waste (saline Bottle), Bio-Medical sharp
Shar Hospital	Medical General waste, Non-degradable medical waste (saline Bottle), Bio-Medical sharp
Emergency Rehabilitation Centre	Medical General waste, Bio-Medical sharp
Shahid rebaz Hospital	Needle, Glove, cotton, plastic syringe
Maternity and gynecology	Needle, Glove, cotton, plastic syringe, Drain Tube
Shahid Hamarash Hospital	Needle, Glove, cotton, plastic syringe
Ali Kamal hospital	Needle, Glove, cotton, plastic syringe, Napkin

Furthermore, the total amount of Medical waste that burnt in Sulaimania City per month for year 2016 was also determined as shown in table (1.4).

Table 4: Total amount of Medical waste burnt in Sulaimaniya city per month in 2016

Months	Medical Waste (Kg)
JANUARY	28,409
FEBRUARY	23,704
MARCH	21,000
APRIL	21,940
MAY	24,634
JUNE	7,846
JULY	7,776
AUGUST	13,380
SEPTEMBER	13,580
OCTOBER	16,910
NOVEMBER	21,332
DECEMBER	19,246

Moreover, in the second part of this study, environmental departments inside the governmental sectors were interviewed in order to have a clear understanding of the current environmental issues inside the city as shown in the Table (1.5). The environmental sector has an important role in enforcing the environmental law which was issued by the Kurdistan parliament in 2010. Since that time, many of the companies have been fined for violating the regulations and even some of the companies closed if their impacts on the environment were very severe. Furthermore, the sectors showed that the EIA team is working actively towards identifying the current and future negative impacts of the activities on the surrounding environment. Additionally, many official environmental NGOs are continually working through the conduct of many campaigns to spread the culture of being responsible towards protecting the environment and educating the public about the importance of having a clean environment.

Name of the Governmental Sectors	Number of Employees	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Sulaimania Governorate	815	Water pollution, Air pollution, Solid Waste generation, Soil pollution	YES	YES	Money fines, Taking back the licenses, Not renewing the licenses	No	YES	37
Sulaimania Municipality	4000	Water pollution, Air pollution, Solid Waste generation, Soil pollution	YES	No	Money fines	No	YES	45
Sulaimania Environmental Administration	89	Water pollution, Air pollution, Solid Waste generation, Soil pollution	YES	YES	Money fines	No	YES	192
Comments					The money fines start from (60000ID to 600000ID)			They complain that most of the Environmental NGOs are not active

Table 5: Stakeholder's perception on the current environmental issues inside the city. (The detail of the questions were shown in the Appendix part)

5. Conclusion

This study has inferred that the public in The Kurdistan Region, particularly in Sulaimania City has relatively a lack of knowledge on the current environmental issues including the danger that rises from increasing solid waste dumping into the Tanjaro area. Also, the majority of residents nearby were suffering from odor coming from the Tanjaro dumping area and increasing rodents were clearly observed as well. Moreover, a further study on the leachate generation should be conducted and the negative impacts of the level of toxicity of the leachate on the aquatic life in Tanjaro and Sirwan Rivers should be well observed, identified and analyzed.

On the other side, the authorities in the government are not aware about the environmental issues, and the environmental laws were not properly enforced. As a result, many legal and illegal established companies were continually dumping hazardous and non-hazardous waste into the Tanjaro dumping area. Some of the companies have been fined for violating the regulations in the past, but this was not reaching the level that minimized the risk of increasing waste generation on the environment of the city.

Furthermore, the governmental sectors do not have enough experts to work on the environmental issues in order to tackle it. Also, the environmental NGOs in the city are not active enough to educate the public about the importance of practicing integrated solid waste management.

However since the highest portion of the generated waste in Sulaimania City was organic, therefore bioconversion methods will be one of the best choices for treating the waste at different scales which were either household such as vermicomposting or the larger scale of composting and Bio-gasification process. For non-biodegradable wastes like plastics and paper, recycling will be an effective method towards minimizing the dumping ratio of the Tanjaro dumping area.

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References

Alnajjar, A.Y. (2016). Solid Waste Management in Iraq. Retrieved from http://www.ecomena.org/swm-iraq/

Hoornweg, D., Bhada-Tata, P. (2012). What a Waste: A Global Review of Solid Waste Management. Urban development series; knowledge papers no. 15. World Bank, Washington, DC. World Bank. https://openknowledge.worldbank.org/handle/10986/17388 License: CC BY 3.0 IGO.

Kurdistan Region of Iraq: Economic and social impact assessment of the Syrian conflict and ISIS crisis. (2015). Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/21597/940320KRG0Econ0Box0385416B00PUBLIC0.pdf?sequence=1

Majid, S. N. (2014). Bioaccumulation, Enrichment and Translocation Factors of some Heavy Metals in Tanjro area along the Stream. Sulaimani. *Journal of Zankoy Sulaimani*- Part A, 16 (4).

Nabil, M. (2014). Updates From The Waterkeeper. Retrieved from http://www.natureiraq.org/news/category/waterkeeper

Ngoc, N., & Schnitzer, H. (2009). Sustainable solutions for solid waste management in Southeast Asian countries. Waste Management 29, 1982–1995.

Odum, H.T., & Odum, E.C. (2006). The prosperous way down. Energy 31, pp. 21-32.
Salhofer, S., Obersteiner, G., Schneider, F., & Lebersorger, S. (2008): Potentials for the prevention of municipal solid waste. Waste Management 28, pp. 245-259.
Rahji, M.A.Y., & Oloruntoba, E.O. (2009): Determinants of households' willingness-to-pay for private solid waste management services in Ibadan, Nigeria. Waste Management and Research May 2009, 1-6.

APPENDIX

Q1: Our section is monitoring the environmental issue such as:

- o Water pollution
- o Air pollution
- o Solid waste generation
- o Soil pollution
- o None of them

Q2: Our section conducts environmental impacts assessment (EIA) for the new establishing infrastructures.

- o Yes
- o No

Q3: Our section is enforcing environmental law which is issued by the Perelman of KRG and fining those companies that are violating the rules.

- o Yes
- o No

Q4: What are the types of fines that are implemented against who violated the environmental laws by this section?

- o
- o
- o

Q5: Do you agree with the level of greenery area inside Sulaimaniya city?

- o Yes
- o No

Q6: Is there any replantation plan for now in Sulaimaniya city?

- o Yes
- o No

Q7: How many environmental NGOs officially registered till 2016?