Economic Evaluation of the Preventative Strategy for Open Dumpsites in the Residential Area of Kabul city, Afghanistan

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1.Introduction

Open dumpsites are the most prevalent methods of disposal of municipal solid waste in Afghanistan especially in Kabul city the capital of the country. In the results of population growth, speedy urbanization and absence of proper planning and financial support a huge amount of municipal solid wastes is dumped in the open area without proper manner, collection facilities and environmental maintenance measurements. Management of MSW open dumps is one of the important environmental challenges in Kabul city.

In order to investigate the open dumpsites conditions in the residential area, a field survey was carried out in the study area District-12 of Kabul city of Afghanistan on May-2018. Before conducting the field survey, a satellite image was used to identify open dumpsites location. And by the combinations of fieldwork and satellite image, 115 open dumpsites were identified in the study area. Based on the analysis using GIS software and SfM, the estimated volume 11,034m3 and weight 5,554 tons of waste which were dumped at 103 dumpsites in the study area were estimated. Additionally, in order to prevent the open dumpsites in the residential area waste collection and treatments facilities were planned and the total cost of MSWM was analyzed in three scenarios, 1) current situation, 2) complete collection and landfill scenario, and 3) TS and MRF scenario.

2. Material and methodology

2.1 Study Area Description: The study area was set in the planned area in District-12 which has about 16 km² of an area with 117,992 populations and 16,856 households Fig1.

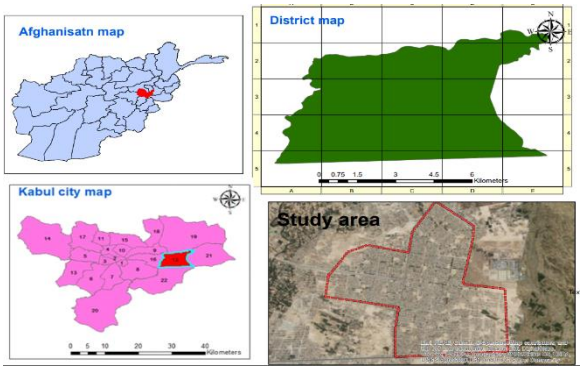

Fig1 Study area map

2.2 **Dumpsites identification:** Based on GIS software calculation and satellite image investigations for 103 dumpsites which were identifiable by satellite image, covered area and length were calculated, each site has ID numbers, Fig2 indicate dumpsites.

Fig2 MSW collection points

2.3 MSWM Cost Estimation: During fieldwork investigations, the author conducted interview with cases study area MSWM officer and asked questions regarding (1) the population (2) the amount of MSW generation and collection capacity per day, (3) MSW collection equipment's and vehicles (4) fuel consumption per truck (9) location of disposal sites; and (10) information regarding budget for SWM.

3.Result and discussion:

3.1 **Dumpsites identification and volume estimation:** In this study, the covered area of dumpsites was calculated with GIS software and categorized into seven groups based on the covered area size, as can be seen from the fig3. Additionally, the total covered area was 55,173m². According to this research results, the total weight and average height of waste which was dumped at 103 dumpsites were 0.2m and 5,554 tons' estimated.

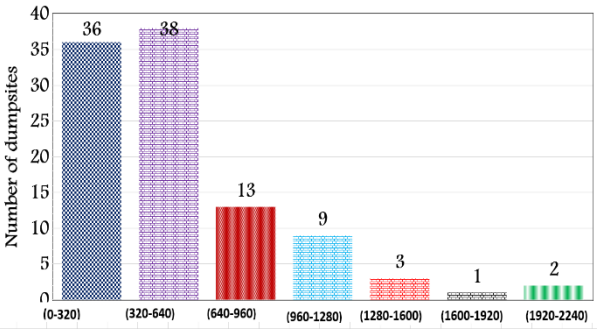

Fig3 Covered area categories with dumps

3.2 MSWM cost estimation: In this section for SW collection, treatment and transportation cost was estimated, in three scenarios, 1) current situation with 40-50% collection rate, 2) planned with a complete collection and landfill scenario, and 3) TS and MRF scenario. The amount of waste which is expected to be managed in three considered scenarios can be observed in fig4. Additionally, for two scenarios, the collection and transportation cost was estimated based on required trucks, containers, employees, fuel consumption, distance and time calculated to the designated destinations.

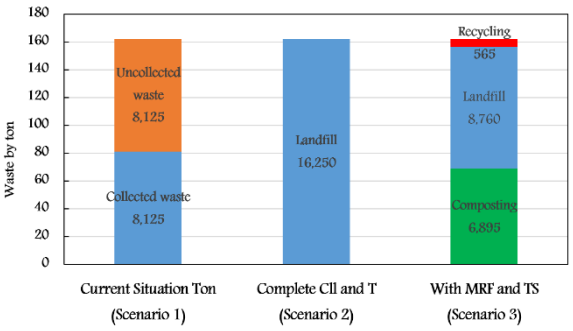

Fig.4 all MSWM flow

3.3 Transfer station cost estimation: According to the waste generation amount per day in the cases study area, it is expected that at the TS about 50-ton SW per day will be transported for processing and the remaining waste will be transported to the designated landfill. In this study, TS is planned close to the residential area to receive and hold waste from the primary collection to the TS for further processing and separation the recyclable materials, after compaction vehicles transport waste to the landfill. In Kabul city of Afghanistan, there is no TS, for this research TS cost was estimated based on developing countries. The TS cost includes establishment cost, operation cost, and maintenance cost, and unit cost per capacity was calculated. Operation and maintenance cost include electricity consumptions, water consumptions, pest control charges and salaries of cleaning staffs, supervisors, operators. Electricity consumption is a major portion of operation and maintenance cost, details of TS costs can be seen in Table1.

Table1 categories of per day cost of TS

S.N	Unit cost ($/day)	Capacity (TPD)	Average	Cost ($/day)
1	5.7	50-100	50	286.5
2	2.3	100-200	150	345.6
3	1.4	200-300	250	354.6

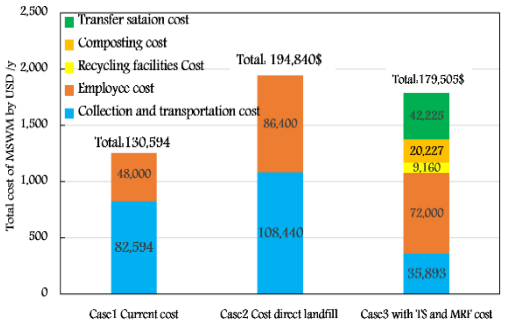

Fig.5 Total MSW costs

3.4 Total and unit costs estimation MSW using economic scale:

Approximate costs can be obtained if the cost of a similar item of different size or capacity is known. In this research, the author calculated the approximate cost for collection and transportation for three scenarios, namely directly landfill and with TS and MRT. On the other hand, the capacity of MRF is 100 tons per day and the focused area waste to be treated is 34 tons per day, in order to get the desired cost for small capacity the following formula was used.

$$Cn = Co\ (Sn / So)^{0.6} \quad \text{.....1}$$

where, Cn: the cost of equipment to be estimated Co: known cost, Sn: size of the new piece of equipment, So: the capacity of the existing piece of equipment, results of the calculations for total and unit cost can be seen from the fig 5,6.

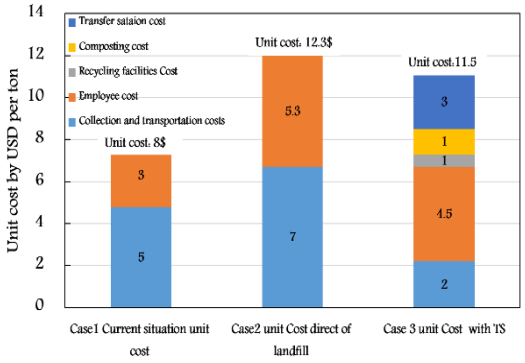

Fig.6 Unit costs of MSWM

4.Result of evaluations

According to this study results for cost estimation which was compared with three considered scenarios for MSWM, it is indicated that higher cost related to direct disposal and the unit cost is 12.3$ per ton. On the other hand, the third scenario looking appropriate comparatively to the second scenario, because the unit cost is slightly cheaper than direct landfilling and unit cost is 11.5 $ per ton. Additionally, the important benefits of the third scenario are: throughout recycling, we can get revenues and create jobs opportunity, reduce gas emissions throughout fuel consumption and prolong landfill lifetime by diverting organic and recyclable waste.

5. Conclusion:

Results of fieldwork investigations for dumpsites identification indicate that in the cases study area there was a huge amount of waste which was dumped in the open area. For proper waste collection, transportation and treatments, two scenarios were analyzed to at least minimize the costs of MSWM. In conclusion, according to understudied scenarios for MSWM, it is indicated that the TS and MRF for MSWM could be economically appropriate comparing to direct landfilling.