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Analysis in household waste collection performance indicators: case of study borough El Bousten, commun of Sfax, Tunisia

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Abstract: Solid waste management is a challenge for the municipalities in developing countries mainly due to the increasing generation of waste, without planning. The present work focus on the analysis of collection's sectors of household waste using the real performances indicators, in a case study of borough El Bousten – commun of Sfax, Tunisia. It is useful to define "right" common parameters, which allow the definition of the circuits. The aim is to use "right and rigorous" indicators which characterize the sectors of collections. The resultant contributes that indicator effectively as a measure instrument must reflect the effectiveness of the collection and also provide good information to citizens.
Keywords: Household- Performance indicators- waste collection- Borought El Bousten

I.   INTRODUCTION

Household Waste Collection is a major and expensive task for local waste management authorities, thus efficient household collection is a necessity [14].

The collection service, provided by either the private or public sector, includes many activities and requires numerous collectors and equipment [13].

The quantity of the household, the type of equipment, and the distances the MSW transported as well as the labor required, are all major factors with significant effects on household waste collection [15] .

Inefficient household collection can rapidly deplete resources and energy [16].

Several studies have assessed the performance of waste collection or management programs in different countries [17].

The assessment of household waste services using performance indicators plays a crucial role for improving service quality. The proposed performance indicators, combined with a regular and systematic baseline data collection may be used as decision support-tool on future collection strategies, as significant different performance patterns among different circuits, type of containers, collection frequency or collection timetables are highlighted.

The case study was performed through a monitoring of household collection system in sector n°1 of borough El Bousten .Through the database collected, the indicators were computed.

These indicators allow the fine characterization of the study area.

The study area is borought of El Bousten, one of the seven most important districts of the commun of Sfax. It has a permanent population of 15707 inhabitants according to the census 2004 and a total area of 325 h. The borough El Bousten is empirically divided into three sectors (collection zones) for ease of operation, which collection and transportation takes place every day including Sundays.

The served equivalent population in Sector 1 is 8841 people, producing a waste total of 8,260 tn/day, according to the weighing sheets of the collection vehicles in the period 2011- 2011.

Household collection in the borough El Bousten is delegated to the private sector.

Waste collection is carried out mechanically using compaction trucks with capacity 16 m^3.

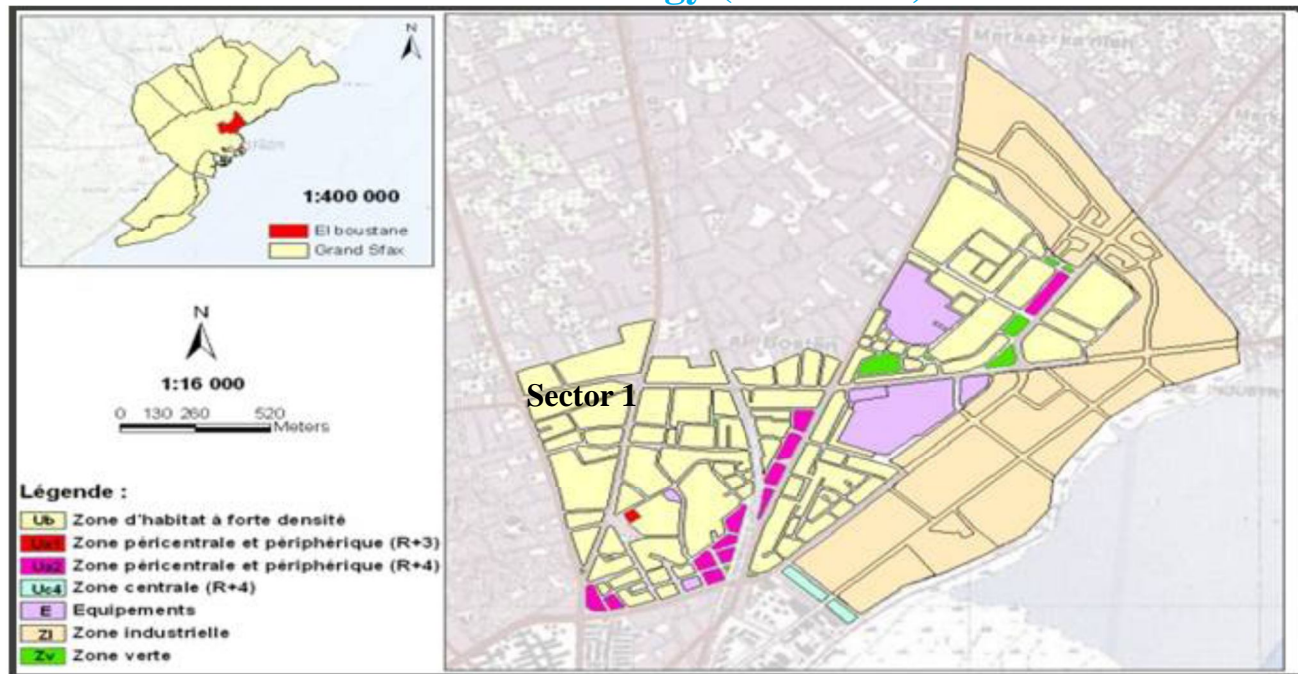# International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Figure 1. Map of borough El Bousten of commun Sfax

In this work, we start with the definition of three types of performance indicators characterizing the household waste collection in sector n°1 of borough El Bousten.

We deal in the second part the determination of performance indicators of the circuit based on the data collected during the monitoring of household collection.

II.   ANALYZE THE CHARACTERISTICS OF COLLECTION SECTOR

A.   Technical Indicators Collection

The definition of optimized collection circuits requires three types of data:

• Tonnage collected by trucks,

• Time taken by vehicles while on tour,

• Distance traveled by the truck.

Three performance indicators were selected:

Linear load (t / km)

Collection efficiency (t / h) is the ratio between the tonnage collected and the time required for the collection.

Waste generation rate (kg/cap.day).

B.   Temporal variability: a pace indicator of waste production household

The production of household in the study area approaches 3014.9 t per year, corresponding to a daily production of roughly 0.93 kg inbab day, same value to the borough El Bousten (table1). The quantities collected of household increases believe 15% during the summer season, the month of Ramadan and the days of Eid.

Table 1: Tonnage of household collected in 2011

	Waste Production (tons / year)	Waste generation rates (kg / inh./day)	Population
Sector 1	3014.9	0.93	8841
Borough El Bousten	5357.24	0.93	15707

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The average production of household per week in 2011 was 8.260 t.

Figure 2 shows the tonnages collected during one week in the sector 1 of borough El Bousten.

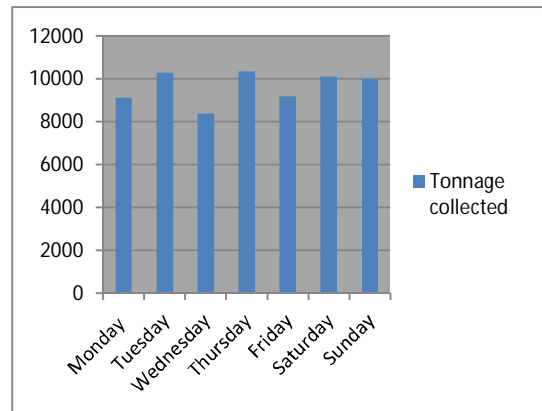We note that there is an uneven production of household waste at a collection week.

Figure2: Tonnages collected during one week in the sector n° 1of borough El Bousten

C. Variability of working time

The collection time is the time that the truck is in collection phase in the strict sense.

Three time collection was selected:

Real Time collection (it takes into account the time of the first collected trash and last without dropping to the processing unit)

Real time working on the circuit (this takes into account the real-time collection, the time of dropouts in the process unit and return the collection system and return the deposit),

Total Time (includes all previous indicators and the date or breaks).

Pure collection time

The sum of these time collection bins and travel time provides pure collection time to reflect sector.

Pure collection time = $\Sigma T_{D,j} + \Sigma T_{C,j}$

$\Sigma T_{D,j=}$ traveling time

$\Sigma T_{C,j=}$ collection time bins

Figure 3 shows the collection times. They are essentially the same in a week.

It is interesting that, for different workloads, the collection time are similar.
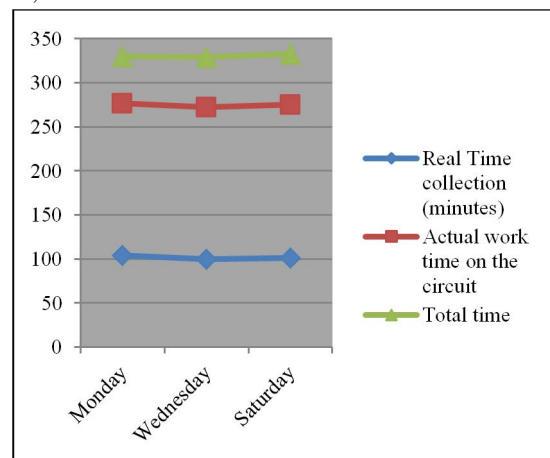

Figure 3 : Collection Time

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III.   RESULT AND DISCUSSION

Table 3: Summary of data collected

Raw data	Monday	Wednesday	Saturday	Sum	Average
Kilometer (total)	35	34	36	105	35
Kilometer (collection in the strict sense)	15.8	15.6	15.7	46.8	15.6
Tonnages	8.35	8.26	8.10	24.71	8.23
Real Time collection (minutes)	104	100	101	305	101.6
Actual work time on the circuit	277	272	275	824	274.6
Total time	330	329	333	992	330.6
Number of containers	53	53	53	53	53
Average volume of container removed small capacity	0.36	0.36	0.36	1.08	0.36
Average volume of container removed large capacity	0.75	0.75	0.75	2.25	0.75
Total volume(m3)	111.63	111.63	111.63	334.89	111.63
Population				8841	
Housing				2063	
Households				1529	

All data collected in the field during the monitoring of collection household as well as indicators comparing are summarized in the tables 3 - 4.

Through this table, we tried to define types indicators to reflect the reality on the ground and possibly reorganize tours. These indicators, if implemented across all sectors, will promote knowledge of the sectors and facilitate their rationalization.

Figure 4 shows the characteristics of a tour of collecting household waste in study area for the day of 23 March 2011.

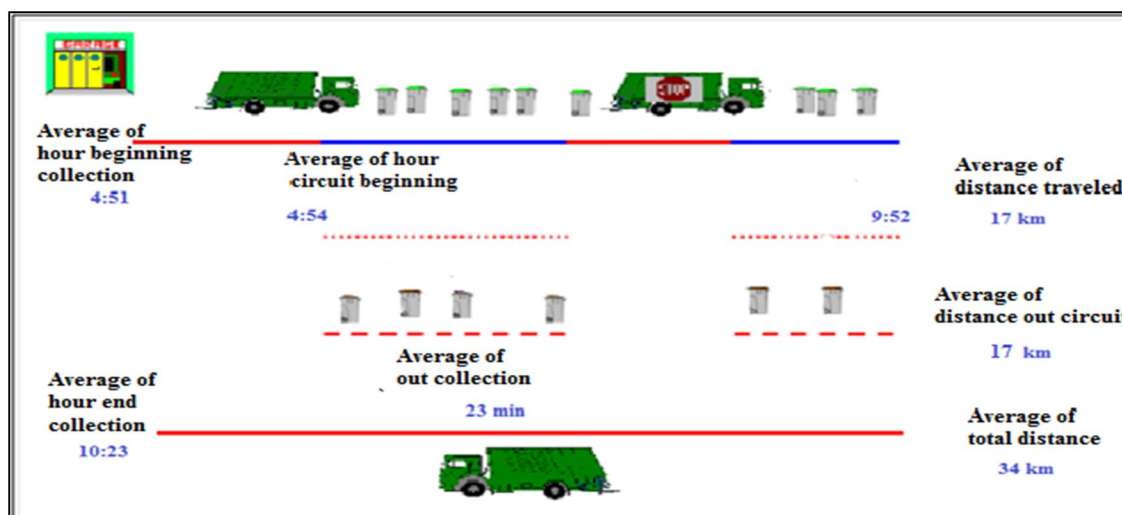| Comparison indicators	Monday	Wednesday	Saturday	Sum	Average
Linear load (tonnes / km)	0.52	0.53	0.51	1.56	0.52
Yields of collection (tons / hour)	4.81	4.95	4.81	14.57	4.85
Quantities collected per capita (kg / capita / day)	0.94	0.93	0.91	2.78	0.92

Table 4.Indicators of circuit

Figure 4: The characteristics of a tour of household wastes collecting in Sector n°1 for the day of 23 March 2011

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IV. CONCLUSION

Indicators performance applied in sector n°1of borough El Bousten allows evaluation and improving collection household waste and contribute to an effective benchmarking analysis and assessment database. This study suggests new insights concerning the proactive short term control of the efficiency of waste collection circuits, based on the statistical comparison of distributions instead of simply comparing location or dispersion parameters such as mean values and standard.

The indicators application revealed useful information which supports effective route collection based on relevant elements.

This research shows that a periodic monitoring of waste management through the use of key selected performance indicators may be successfully applied for evaluate and regulate technical and operational activity.

V. ACKNOWLEDGMENTS

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