iJRASET
International Journal For Research in Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 4 **Issue:** I **Month of publication:** January 2016

**DOI:**

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

Volume 4 Issue I, January 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

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

Rim Sallem[1], Mohamed Jamel Rouis[2]
*Unit Of Oesearch Environmental Geotechnique And Civil Materials, Institute Of The Engineers Of Sfax, Road Sokra, Km3.5, B.P1173-3038 Sfax, Tunisia*

***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 $m^3$.

Volume 4 Issue I, January 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

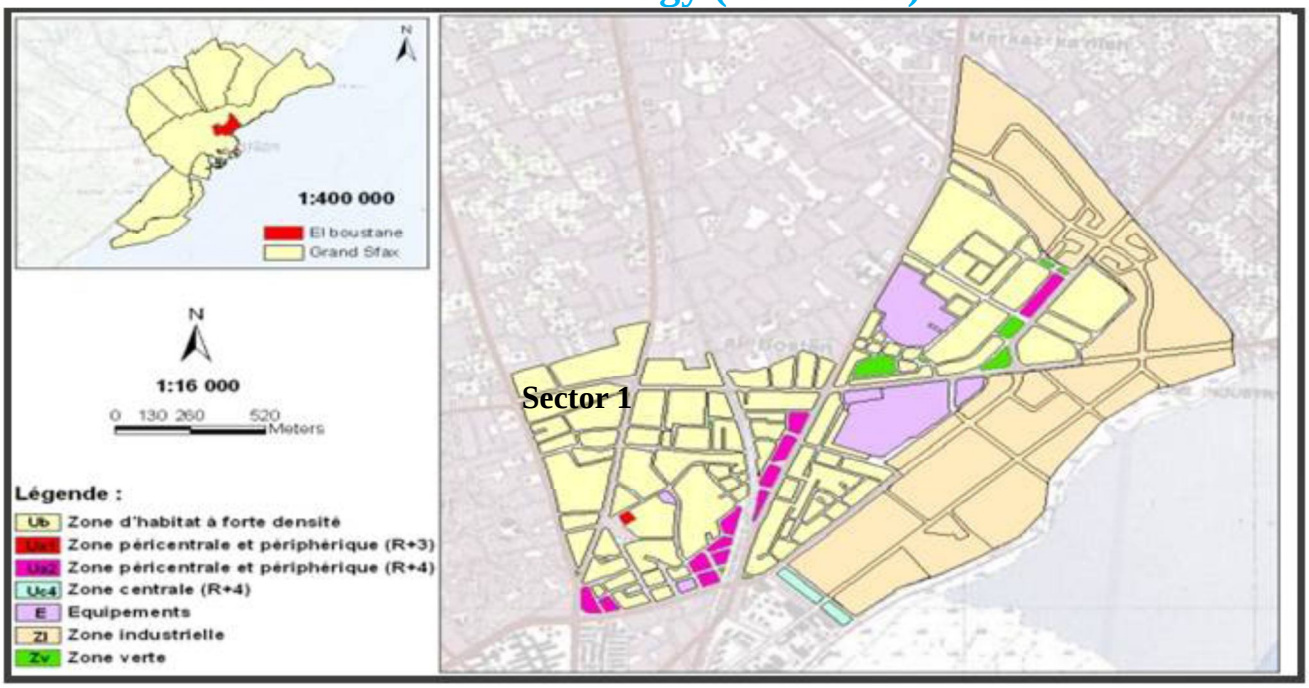



Figure 1. Map of borough El Bousten of commun Sfax

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 |

Volume 4 Issue I, January 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

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.

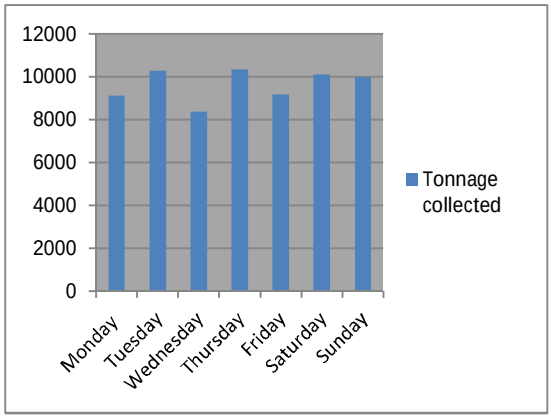



Figure2: Tonnages collected during one week in the sector n° 1of borough El Bousten

*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.

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

$\Sigma T_{D,j=}$ 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.

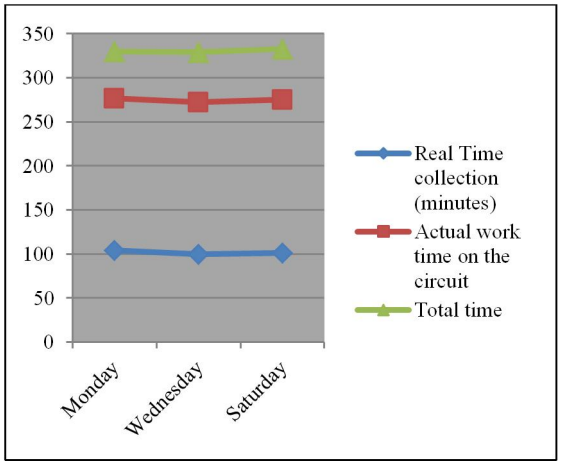



Figure 3 : Collection Time

Volume 4 Issue I, January 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

## 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

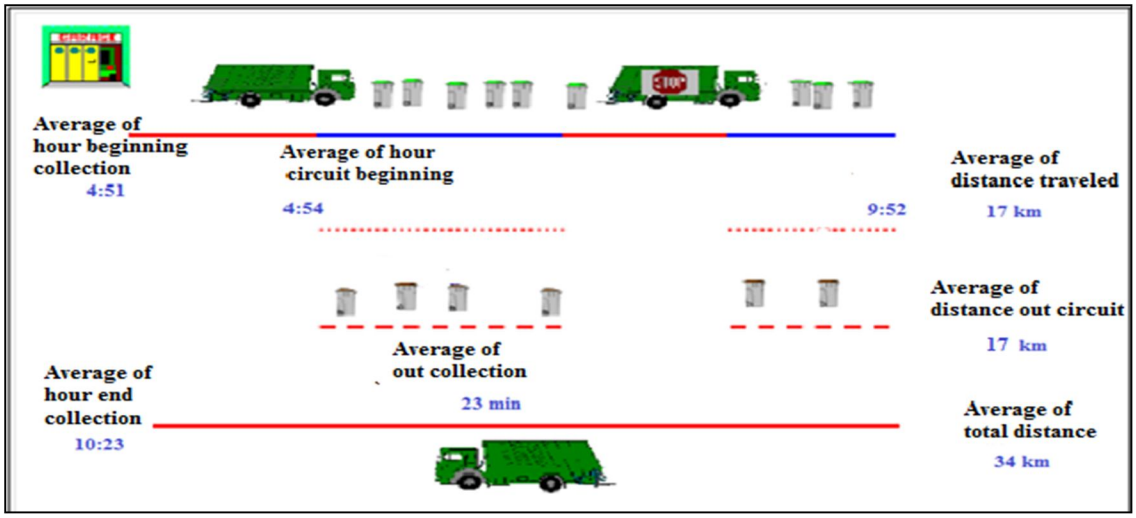



Figure 4: The characteristics of a tour of household wastes collecting in Sector n°1 for the day of 23 March 2011

## 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.

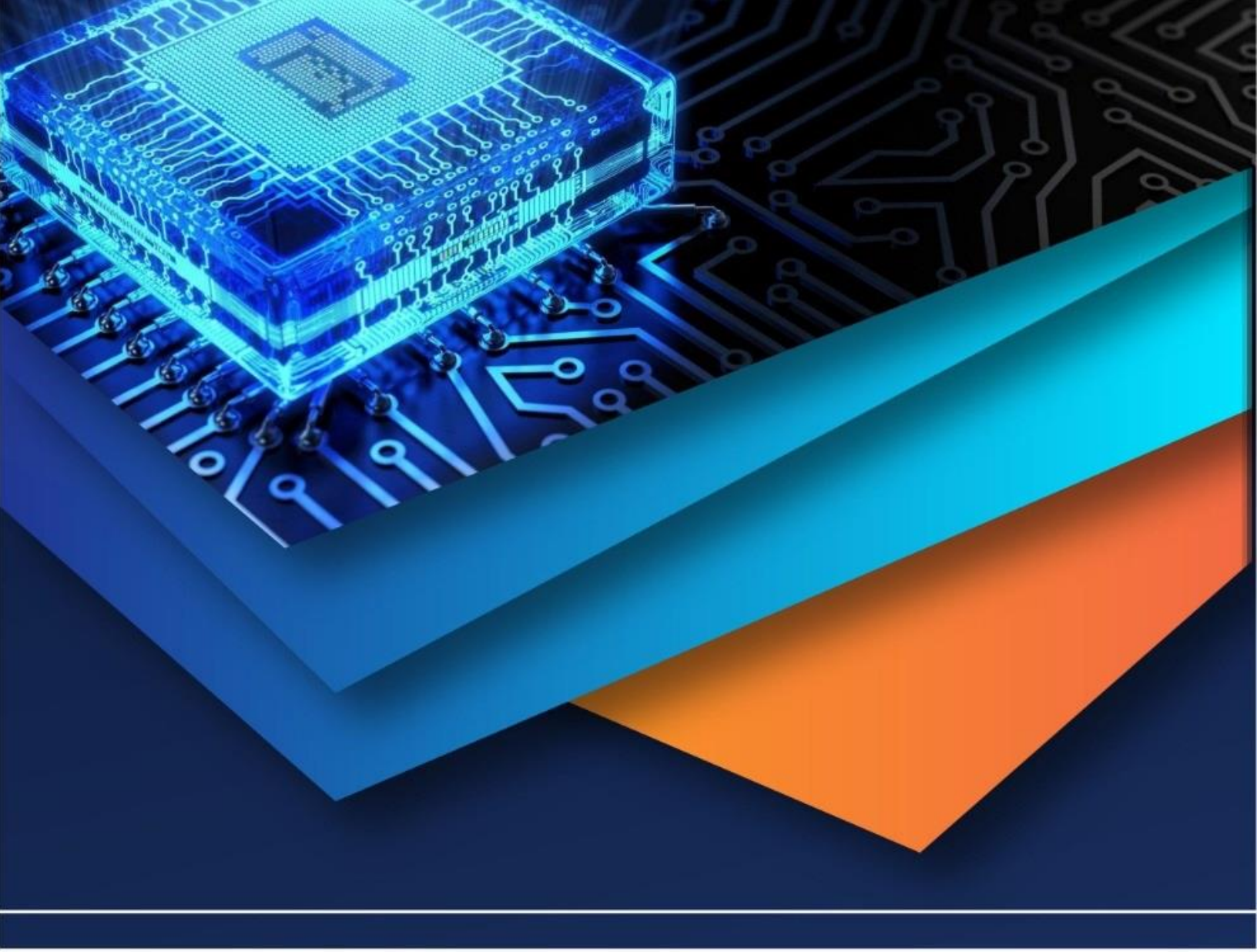
This research shows that a periodic monitoring of waste management through the use of key selected performance indicators may be successfully applied for evaluate and regulate technical and operational activity.

## V. ACKNOWLEDGMENTS

The authors would like to thank Mr Haj Taieb, Mr Nabil Said from the Municipality of Sfax for his valuable help in data collection phase of the study.

## REFERENCES

[1] Teixeira CA, Russo M, Matos C, Bentes I, “Evaluation of operational, economic, and environmental performance of mixed and selective collection of municipal solid waste: Porto case study”.
[2] Tulokhonova A, Ulanova O, “Assessment of municipal solid waste management scenarios in Irkutsk (Russia) using a life cycle assessment-integrated waste management model”.
[3] Carlos Afonso Teixeira, University of Trás-os-Montes and Alto Douro (UTAD), “Municipal Solid Waste Performance Indicators”.
[4] Antonion “Methodology to design a municipal solid waste generation and composition map: A case study”.
[5] Carlos Afonso Teixeira, Catarina Avelino, Fátima Ferreira, Isabel Bentes, “Statistical analysis in MSW collection performance assessment “C.A. Teixeira et al. / Waste Management 2014.
[6] Agboje Ifeoma Anestina, Adeoti Adetola, and Irhivben Bright Odafe, “Performance Assessment of Solid Waste Management following Private Partnership Operations in Lagos State”, NigeriaJournal of Waste Management Volume 2014 (2014).
[7] Xingpeng Chen , Jiaxing Pang, Zilong Zhang and Hengji Li, “Sustainability Assessment of Solid Waste Management in China: A Decoupling and Decomposition Analysis “ JOURNAL Sustainability 2014.
[8] Paula Mendes, Ana Carina Santos,Luis Miguel Nunes, Margarida RibauTeixeirac,”Evaluating municipal solid waste management performance in regions with strong seasonal variability “.
[9] V Sanjeevi and P Shahabudeen, “Development of performance indicators for municipal solid waste management (PIMS): A review”.
[10] Teixeira, C.A., Avelino, C., Ferreira, F. and Bentes, I. (2014, “analysis in MSW collection performance assessment” Waste Management 34(9), 1584-1594.
[11] Agunwamba, J. C. (2003), “Optimization of Solid Waste Collection System in Onitsha, Nigeria”Int. J. of Environmental Issues, 1(1), 124-135.
[12] Aremu, A.S., Sule, B.F., Downs, J. and Mihelcic, J.R. (2012); “Framework to determine the optimal number and spatial location of municipal solid waste bins in a developing world urban neighborhood”, Journal of Environmental Engineering, Vol. 138 (6), 645–653.
[13] Ojiako, G.U. and Nwosu, A.D. (1989), Optimal Strategy for Solid Waste Collection in Nigeria Urban Towns. A Case Study Proc. of Eng. Research for Develop., Sept. 25-28, p 38-43.
[14] Garcia-Sanchez, I.M, “the performance of Spanish solid waste collection”. 2008 Waste Management & Research 26 (4), 327e336.
[15] You-Ti Huang, Tze-Chin Pan, Jehng-Jung Kao, “Performance assessment for municipal solid waste collection in Taiwan”.
[16] Kao, J.J., Lin, T.I., 2002, “Shortest service location model for planning waste pickup Locations”. Journal of the Air & Waste Management.
[17] Alam, R., Chowdhury, M.A.I., Hasan, G.H.J., Karanjit, B., Shrestha, L.R., “Generation, storage, collectionand transportation of municipal solidwasteea case studyin the city of Kathmandu, capital of Nepal” .Waste Management.
[18] Woodard, R., Harder, M.K., Bench, M., Philip, M., 2001. Evaluating the performance of a fortnightly collection of household waste separated into compostables, recyclates and refuse in the south of England. Resources Conservation & Recycling 31, 265e284.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY