INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN 2278 – 0211 (Online)

Solid Waste Management: A Case Study of Tezpur Municipal Area, Assam

Dipam Saikia
Research Scholar, Department of Earth Science, School of Applied Science,
University of Science and Technology Meghalaya, Meghalaya, India
Manash Jyoti Nath
Assistant Professor, Department of Earth Science, School of Applied Science,
University of Science and Technology Meghalaya, Meghalaya, India
Charu Saharia Nath
Principal, Tezpur College, Tezpur, Assam, India

Abstract:
Tezpur is located on the northern landscape of the north eastern states of Assam, India. Tezpur is a tourist paradise but in last two decade higher rate of population growth, increasing rate of rural to urban migration accelerate the process of urbanization and generation of quantum of solid wastes. Generation of large quantum of wastes and inefficient management system is not only changing the urban scenario of this beautiful town but also responsible for degradation of environment and threat to public health. The present research aims to study the existing waste management system in Tezpur municipal area to face the future challenges.

Keywords: *Urbanization, solid waste, waste management, environmental degradation*

1. Introduction

Solid Waste Management is a vital, ongoing and large public service system, which needs to be efficiently provided to the community to maintain aesthetic and public health standards. Municipal agencies will have to plan and execute the system keeping in view the process of rapid urbanization and urban growth. As the quantity of generated wastes in all the urban agglomeration in India has increased considerably in last few decades, that produces enormous challenges to the municipal bodies for their effective management and disposal.

The city of eternal romance "Tezpur" is located on the northern bank of the mighty river Brahmaputra and almost at the heart of the Brahmaputra Valley. Surrounded by lavish green tea gardens, national parks and wildlife sanctuaries, beautiful natural landscapes, archaeological ruins and colourful cultural heritage makes the town a tourist paradise. But, in recent years, the heaps of wastes dumped along the sides of the major and busy roads, commercial places and in the residential areas have changed the urban landscape of this beautiful town. The accumulated wastes in the municipal area makes the problem of solid a serious one and responsible for environmental degradation and risk to the public health. The present research aims to study the existing waste management system and to develop sustainable management mechanism for future.

2. Materials and Method

2.1. Geographical Setting of the Study Region

The city of eternal romance "Tezpur" is located on the north bank of the mighty river Brahmaputra and almost at the heart of the Brahmaputra Valley. The absolute location of the town is $26^0 38^/$ N latitude and $97^0 48^/$ E longitude. The town is about 330 feet above the MSL. In the year 1894, the town was declared as municipal town with 2.75 square kilometres of area. At present, the town has extended over an area of 7.10 square kilometres.

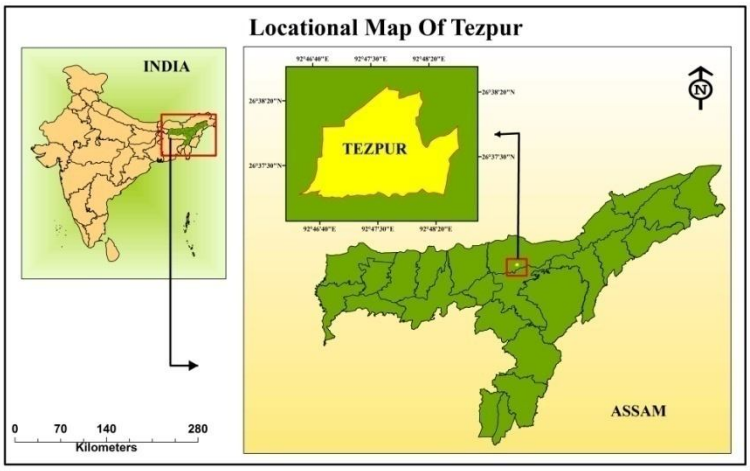

Figure 1. Location of Tezpur Municipal Area

The landscape of the town is little bit different from the surrounding areas of the Brahmaputra valley in terms of geological structure and geomorphological characteristics. Presence of some isolated hillocks along the southern margins of the town and parallel to the mighty Brahmaputra belongs to the Achaean ages makes the lithology and stratigraphy of the region unique in nature. These hillocks are considered to be the outliers of the Meghalaya- Karbi plateau and made of hard Precambrian granite and granitic gneiss. These stand evidence to the fact that Gondowana platform extends underground farther north and north east and these hillocks prop-up amidst alluvial cover (Taher and Ahmed, 1998). The average altitude of the area is 79 meters above the mean sea level but the hillocks are 140 to 18 meters in height.

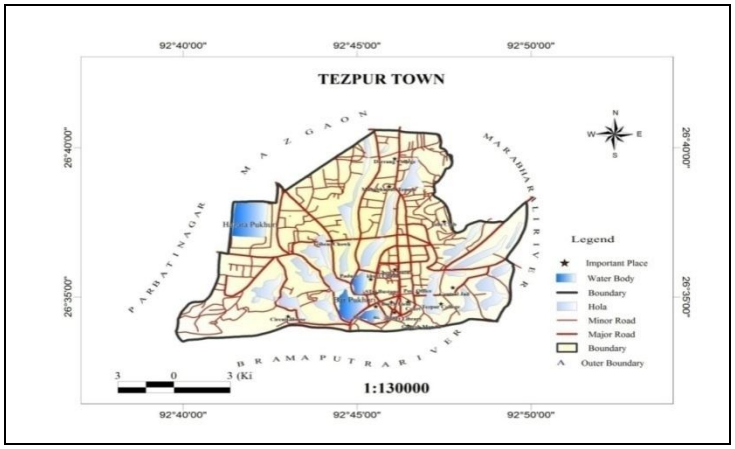

Figure 2: Tezpur Town

2.2. Climate

Being a part of the Brahmaputra valley the region enjoys typical tropical monsoon type of climatic condition with hot and humid summer and cool and dry winter months. The mean average temperature and rainfall of the study area is estimated at 24.2 ^{0}C and 1600 mm respectively. Rainfall pattern is seasonal in nature and about 70% of the total rainfall received during the monsoon season while the rest in the other seasons. The monsoon season sets in during mid part of June and continues till the mid part of September.

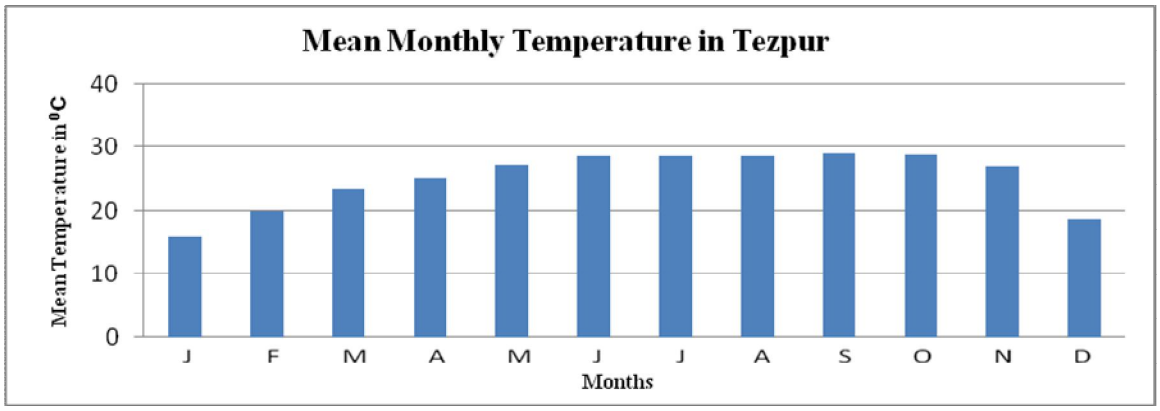

Figure 3: Mean monthly temperature of Tezpur municipal area

2.3. Population

As per Census report, the size of the population in Tezpur town was 80,575 in 2001. Using the Linear Growth Function Equation the projected population of Tezpur for 2011 was estimated at 1, 00,477 with a decadal growth rate of about 25%.

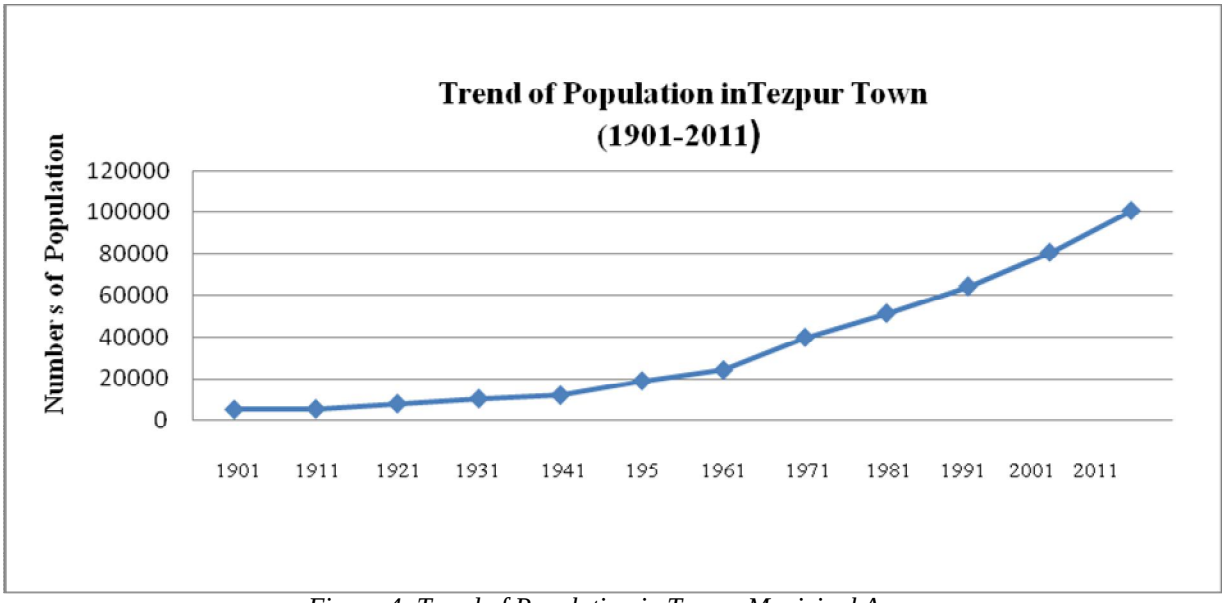

Figure 4: Trend of Population in Tezpur Municipal Area

2.4. Research Methodology

2.4.1. Literature Review

To study the problem a large numbers books, journals, periodicals, abstract, articles, published and unpublished research works, seminar proceedings, government reports on the subject were discussed.

2.4.2. Waste Quantum Study

T**o** determine the waste quantum generated in the town weighting exercise method was adopted. To perform the exercise the number of trips performed by all categories of vehicles were recorded for seven consecutive days. The record helps to determine the average number of trips performed by each category of vehicle/day and to estimate the total volume of waste generated daily in the study area. In India, most of the municipality authorities adopted this method to estimate the volume of daily generated waste (Kumar, 2009).

2.4.3. Waste Characteristics Analysis

About 100 kg of waste samples were collected from 10 community bins located in different localities across the town and mixed thoroughly. The mixtures were finally reduced to 12.5 kilogram by Quartering Techniques. From this 12.5-kilogram sample, wastes were categorized into 9 pre designed categories – organic, silt, demolition debris, plastics, paper, metal, glass and miscellaneous wastes. Segregated components were weighed to determine their weights as a percentage of the total weight of sample. Weighting exercise method is considered to be the best method to know the waste characteristics as far as the Indian conditions are concerned (Kumar, 2009).

Sl. no	Waste Types	Percentage of Waste Types
1	Organic	72.00
2	Fine Earth	9.00
3	Demolition Debris	3.00
4	Plastic Materials, Polythene Bags etc.	8.00
5	Metals	0.30
6	Glass	1.00
7	Soiled Papers, Card Boards	2.50
8	Textiles	0.20
9	Miscellaneous	4.00
TOTAL		**100.00**

Table 1: Percentage of different components in the waste stream in Tezpur during wet season

2.4.4. Sources of Wastes

In Tezpur municipal area wastes were mainly originated from the sources like private residences, commercial centres, institutions, recreational centres, community halls, constructional sites, nursing homes and hospitals etc. The quanta of wastes generated from different sources were tabulated in table 2.

Sl .no	Waste Sources	Weight in ton/day
1	Residential Areas	16.95
2	Commercial centres	6.72
3	Recreation centres (Park, picnic spots)	o.35
4	Community halls	0.22
5	Constructional sites	0.32
6	Industry	0.75
7	Nursing Homes and hospitals	0.10
8	Institutions	2.05
9	Misc	0.24
TOTAL		**27.70**

Table 2: Source and the quantum of wastes generated in Tezpur Municipal Area

2.4.5. Sampling Size Determination

In order to determine a suitable sample size, a sample size calculator provided w.w.w.salttrek was used to collect data from households and 380 numbers of households were considered. Besides 120 numbers of commercial centres of all categories, 25 numbers of institutions and offices, all the recreational centres, community halls, hospitals and nursing homes were also considered for data collection.

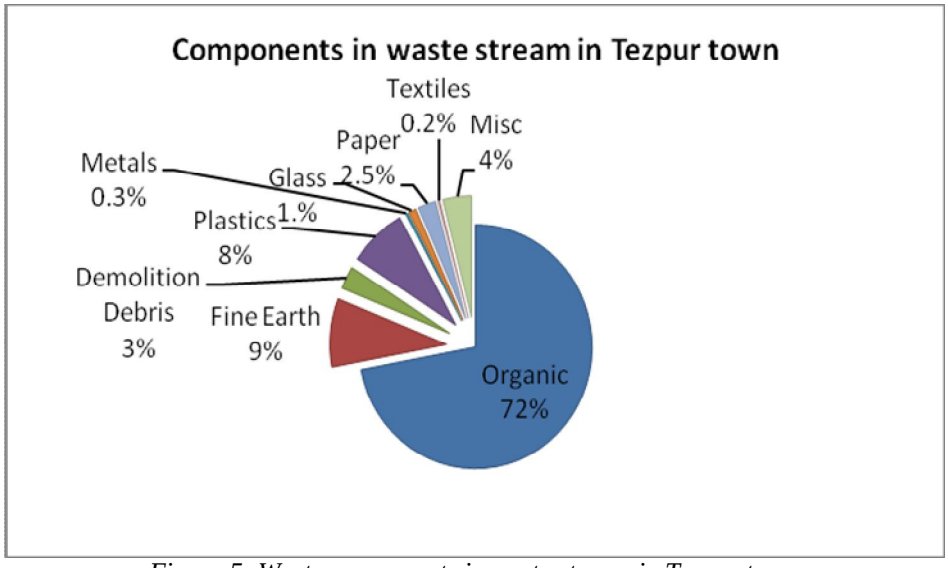

Figure 5: Waste components in waste stream in Tezpur town

2.4.6. Interview Schedules
Eight different sets of interview schedules were designed to collect information directly from the respondents. Both structured and unstructured questions were framed to collect data on quantum of waste generation, types of wastes and waste management system.

2.4.7. Application of GIS
Super map 7C GIS soft ware was used to prepare the map of the study area. The tables and cartograms were prepared by using MS excel.

2.4.8. Focus Group Discussion
Discussion were made with the chairman, vice-chairman, elected members of the ULB, engineers, executives of the Regional Pollution Control Board, citizen forum and district administration, NGO's in different sitting to find the solution to the problem.

3. Discussion

3.1. Waste Management Scenario
Municipal solid waste management encompasses planning, engineering, organizing, administrating, financial and legal aspects of activities associated with generation, storage, collection, transfer and transport, processing and disposal of municipal solid waste in an environmentally compatible manner adopting principles of economy, aesthetic, energy and conservation (Joseph, 2002).
Like many other Indian cities and towns in Tezpur also MSWM system is assigned to the municipal board. Here an attempt has been made to discuss the waste management scenario of the study area.

3.2. Waste Storage
Storage is one of the most fundamental activities of the MSW management system. Storage facilities should be designed in such a manner that, waste stored is not exposed to the open air and it should be aesthetically acceptable and user friendly. Storage facilities should have an easy to operate design for handling, transfer and transport of wastes.
Road side community bins were used by ULB to store the wastes in Tezpur municipal area. The bins were distributed all throughout the municipal area and of different types and sizes. Both RCC and metallic bins with a storage capacity of 2 to 3 tons of wet wastes were placed on the road sides. Lack of public awareness and few numbers of community bins were responsible for open dumping of wastes along the road sides and open drains.

3.3. Collection of Wastes
The second most important task of MSWM is collection of wastes from the storage sites in an efficient manner. Solid waste collection refers to gathering of waste from community bins and from open dumping sites. Ineffective collection system often leads to waste accumulation, creating nuisance and odour problems, environmental pollution and threatening to the public health.
The collection drive starts at 7 AM in morning and continues till 2PM in the afternoon. About 132 numbers of municipal workers were involved in the collection, transfer and disposal of wastes in the study area. Crew members were divided into some small groups to collect the wastes from different localities. Tri -cycle were used to collect wastes from the areas along the narrow roads and from the open dumping site and dumped in the nearby community bins from where, the wastes were collected and transferred to the final disposal site. The processes of Waste collection were highly irregular in nature. Regular collection drives were made only along the core areas.

3.4. Transfer of Wastes
Waste transfer to the disposal site is basically done by lifting the wastes directly from the storage and collection bins. In the study area, the concerned authority has used two tractor trailers, one mini truck and one dumper placer to transfer the whole quantum of wastes. Every day, the tractor trailers performed 6 trips in total, the mini truck and the dumper placer only 2 trips each. The collected wastes were carried in open trailers and trucks for about 4 Kilometres to the final disposal site located at Marabharali. The collection and transfer of wastes starts from four different points under the supervision of four officials of the engineering divisions of the urban local authority. In each tractor and in the mini truck seven numbers of workers excluding driver were engaged on the other hand only two workers were engaged in the dumper placer.
Most of the collection points were messy with garbage strewn away by cows, dogs, pigs and scavengers thus, workers were faced a lot of problems to collect the wastes from those storage sites. On the other hand the public were faced problems like traffic congestion, foul smell; loitering of wastes etc. as the collection and transfer drives were made during the busy hours of the day. As the collection and transfer drives were very irregular hence, during rainy season the accumulated wastes when partially decomposed not only responsible for pollution but also responsible for spread of vector born diseases and environmental pollution.

3.5. Disposal of MSW
Waste disposal methods are varied greatly from one region to another depending upon a number of factors like wastes characteristics, technology used, waste policy, public awareness and participation etc. The choice of a particular method is also governed by factors like cost, availability of disposal site and labour. Ocean dumping, land filling, incineration, composting and energy recovery are some

important methods of waste disposal used by the concerned authorities to dispose the wastes. The dumping site is about 0.033 square kilometres of area and is located about 4 kilometre away from the town on the bank of the Marabharali river.
In the dumping ground for years together the bulk of wastes were dumped very unscientifically and unsystematically and is responsible for air and water pollution in the nearby areas. Very often, in the dumping site, the bulk of the wastes were burnt in the open air without considering their characteristics and such practices were responsible for release of highly toxic gases like Carbon-di – oxide, carbon monoxide, dioxin etc.

3.6. Community Participation

Waste management system is such a mechanism in which involvement of all the public and private sectors are considered to be very essential. Active public participation makes the process smooth, effective and efficient. The role of community is very much important in decision and implementation process. Community participation becomes very much effective through educational awareness and training programmes. But an ineffective and imperfect education programme may confuse the public and reduce the public confidence and invite hostility towards the programme. A consistent and ongoing educational programme is necessary for the success of the waste management programme. (Sashikumar and Gopikrishna, 2009).
In Tezpur publics were not aware about their role and responsibilities towards municipal solid waste management mechanism and all responsibilities were assigned to the urban local body. The attitude and perception of the people stand as the main hurdle for sustainable management of the wastes in the municipal area. Therefore, arrangement of educational programme to aware the public about their role and responsibilities in the waste management mechanism is utmost important. Introduction of such programme not only increase the public involvement but also help to manage the waste in sustainable manner.

4. Conclusion

The present waste management scenario indicates that the mechanism was traditional and needs up-gradation in all the phases of the management starting from storage to disposal of wastes in a sustainable manner. Financial hurdles and lack of co-ordination and co-operation between the concerned authority and the public has created bottlenecks in improving its efficiency. The potentiality of the community participation in the waste management system, has to be given more and more emphasis for smooth management of the system along with the adoption of latest spatial analytical technologies such as GPS-GIS system. Waste recycling can be promoted through consumer campaigns that will encourage citizen to co-operate in waste separation and to purchase recycled products. In the same time ULB should encourage composting of wastes which will not only reduce the volume of waste to dispose but also maintain a healthy environment and low risks to public health. Finally, proper monitoring of the system in every steps is utmost important for smooth functioning of the system.

5. References

1. Abhay, R.K.(2010). Problems of Solid Waste Management in Urban Areas.In J.Singh & AL. Ramanathan (Ed.), Solid Waste Management: Present and Future Challenges (186-194) New Delhi: I.K. International Publishing House Pvt. Ltd.
2. Acharya, S.K. & Parashar,A.(2008). Managing Waste in a Peri- Urban Locality: Vejalpur, Ahmedabad. In D. Mahadevia & J. Wolfe(Ed.), Solid Waste Management in Indian Cities (24- 84) New Delhi: Concept Publishing Company.
3. Agarwal, B.(2001). Participatory Exclusion, Community Forestry and Gender: and Analysis for South Asia and a Conceptual Framework. World Development, 29 (10).
4. Ahmed, S.M.(2006). Using GIS in Solid Waste management Planning- A Case Study for
5. Aurangabad, India.Retrieved March 2, 2011, from http:/www.gogle.co.in/AFOjC NHt Iv- tRDEpOSA_ squd FKWd 9 ci Z WW.
6. Ansari, J.H. (2001). 'Public- Private Partnership Arrangements in Solid waste Management'.
7. .Quarterly Review of regulatory Development, TERI Newsletter (9), 4-7. Asnani,
8. P.U. (2005). Status of SWM in India. Paper presented at the National
9. Workshop on Urban Governance and Environmental Management : Action Oriented
10. Policy Studies on Waste Management in Jabalpur and Raipur, Bhopal.
11. Bagchi,A.(1990).Construction and Monitoring ofsanitaryLandfill.NewYork:John Willy&
12. Sons.
13. Bandela, N.N., & Tare, D.G. (2009). Municipal Solid Waste Management. B.R. Publishing
14. Corporation, New Delhi.
15. Bhagawati, A.K., Bora, A.K, & Kar, B.K.(Eds.).(2001). Geography of Assam. New Delhi:
16. Rajesh publications.
17. Bhide, A.D., & Sundersan, B.B. (1983). Solid Waste Management in Developing Countries.
18. Indian National Scientific Documentation Centre. New Delhi.
19. Bhuyan, D., (2001). Urbanization. In A.K.Bhagawati,A.Bora& B.K.Kar (Eds.),Geography of Assam (pp156-168) New Delhi; Rasesh Publications.
20. Bora.A.K.(2001).PhysicalBackgroundofAssam.In A.K.Bhagawati, A.K.Bora,B.K.Kar (Eds.), Geography of Assam (pp2-35) New Delhi; Rasesh Publications.
21. CPCB.(1996).Pollution Control acts , Rules and Notifications Issues There Under.Pollution

22. Control Series: PCL/2/1992(Volume –I). New Delhi:.Central Pollution Control Board.
23. CPCB. (1999). Status of Solid Waste Generation, Collection, Treatment and Disposal in
24. Metro Cities. New Delhi:.Central Pollution Control Board.
25. CPCB. (2000). Management of Municipal Solid Waste. New Delhi: Central Pollution
26. Control Board.
27. C.R.Kothari (2004).Research Methodology: Methods and Techniques.New Delhi: New Age
28. International Publishers.
29. Das, D., Srinivasu, M., & Bandyopadhyay,M. (1998). Solid State Acidification of Vegetable Waste, Indian Journal of Environmental Health, 40 (4), 333-342.
30. Das, M.M.(1985). Physiographic Frame of Assam. North Eastern Geographer, Vol.17, No.1and 2.
31. Department of Economic Affairs Ministry of Finance (2009). Position Paper on the Solid WasteManagement Sector in India, Government of India, New Delhi.
32. Deka,S.(2008). North East India: Geo-environmental Issues. Guwahati: EBH Publishers (India).
33. Ezeah,C.(2010).Analysis of Barriers and Success Factors Affecting the AdoptionofSustainable Management of MSW in Abuja , Nigeria. Retrieved August 21, 2010,from http://www.ncbi.nlm.nih.gov/pubmed/22459066.
34. Taher,M. & Ahmed, P.(1998).Geography of North- East India. Guwahati: El – Dorado Publications.
35. Joseph, K. (2007). Perspective of Solid Waste Management in India. Retrieved January 10, 2010, from http://www.swlf.ait.ac.th/data/pdfs /PSWMI.pdf.
36. Kansal, A. (2002).Solid Waste Management Strategies for India'. Indian Journal of Environmental Health, 40 (4), pp. 333-342.
37. Keith, F. P.(2005) Introduction to Social Research: Qualitative and Quantitative Approaches.
38. 2nd ed. London: Sage.
39. Khan,I.IH, & Ahsan, N.(2009). Text book of Solid Waste Management . New Delhi:
40. CBS Publishers & Distributors Pvt. Ltd.
41. Kumar,S.,(2009)."Municipal Solid Waste Management in India: Present Practices and
42. Future Challenges", Retrieved February 11, 2010, from https://cdm. Unfccc.in/filestorage
43. /J/C/H/V27BDLU1QE3OF9G6POANRYMTW2X/Encloser 3pdf.
44. Kumar, S. (2010). Sustainability of Urban Solid Waste..In J.Singh & AL. Ramanathan (Ed.), Solid Waste Management: Present and Future Challenges (pp.91-104) New Delhi: I.K. International Publishing House Pvt. Ltd.
45. Kushik,A.,& Kaushik,C.P.(2004). Perspective in Environmental Studies. New Delhi:
46. New Age International.
47. Mahadevia, D., & Wolfe, J.M. (Eds.). (2008). Solid Waste Management in Indian Cities.New Delhi: Concept Publishing Company.
48. Mahadevia, D.,Wolfe, J & Parasher, A. (2008).Solid Waste Management in Indian Cities:
49. An Overview. In D. Mahadevia & J. Wolfe(Ed.), Solid Waste Management in Indian
50. Cities (pp 24- 84) New Delhi: Concept Publishing Company.
51. Sashikumar,K.,& Gopikrishna, S. (2009). Waste Management. New Delhi: PHI learning Pvt. Ltd.