Middle-East Journal of Scientific Research 24 (4): 1128-1134, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.04.23231

Characterization and Management of Solid Waste Generated in Nasarawa LGA in Nasarawa State, Nigeria

Abdulkarim Nasir, Umar Kasimu, Bori Ige and Abubakar Mohammed

Department of Mechanical Engineering, Federal University of Technology, Minna, Nigeria

Abstract: Solid wastes constitute a significant amount to environmental hazard in the society. The need to characterize solid wastes as an initial step to proffer solution to the problem of solid waste management cannot be over emphasized. In Nasarawa local government area (LGA) in Nasarawa state, the solid waste materials are characterized into six (6) different materials type which includes paper/cardboard, plastic food pack/plastic bottles, metal cans, food waste, polythene bags/polystyrene food pack and other combustible miscellaneous waste material. The waste characterization shows that Polythene bags/polystyrene food packs constitute the highest waste of 141.09 kg/day collected during the study period. This is followed by food waste with 130.37 kg/day. Plastic food pack/plastic bottles, metal cans, paper/cardboard and others has 64.64 kg/day, 59.39 kg/day, 53.51 kg/day and 29.15 kg/day respectively. The non-biodegradable wastes such as polythene bags/polystyrene food pack, plastic food pack/plastic bottles and metal cans constitute about 56 % (257 Kg/day) of the total waste collected during the study period. It is recommended that Nasarawa state waste management scheme should include the adoption of 3R's methods scheme for reducing the biodegradable waste components and also employed for reducing the non-biodegradable waste components.

Key words: Solid waste · Nasarawa · Characterization · Management

INTRODUCTION

Waste management is the collection, transportation, processing, monitoring and reuse of waste. It is also seen as way of recovering resources from wastes. It can involve managing of solid, liquid or gases. The United States Environmental Protection Agency (EPA) defines solid waste as any useless, unwanted or discarded material with insufficient liquid content to be free flowing. Waste recycling involves a process of characterization, sorting, grading, reduction and reuse of wastes [1]. This chain of activities requires the services of experienced staff to identify and categories wastes according to its end uses. For example, glass wastes are grated according to colours, while plastic wastes are graded according to their composite texture. Recycling of paper wastes depends on the stranded's strength [2]. These different and specific details inform the proper understanding of waste recycling.

It was also observed that different wastes are recycled according to their relative cost as compared to the production of new ones. Plastic recycling suffers poor patronage because it is cheaper to produce a new plastic product than to recycle used ones. While glass, aluminum and paper recycling have a comparative advantage over the production of the fresh one. In fact aluminum and glass can be recycled indefinitely, saving economic and environmental resources. The environment of man lies at the mercy of both natural disaster and negligence on the part of man in the course of controlling the gifts of nature. The latter, takes the form of dumping solid/industrial waste in such a manner that this leads to negative impact on the environment such as desert encroachment, erosion, depletion of ozone layer, depletion of natural resources, pollution of land, rivers and generally the environment. In early times (pre-colonial days up till 1970), the disposal of refuse and other wastes did not pose any significant problem. The population was small and enough land was available for assimilation of wastes. Solid waste problem started with urban growth resulted partly from national increase in population and more importantly from immigration [3]. No towns in Nigeria especially the urban and semi-urban centers of high population density can boast of having found a lasting

Corresponding Author: Abdulkarim Nasir, Department of Mechanical Engineering, Federal University of Technology, Minna, Nigeria.

solution to the problem of filth and huge piles of solid waste, rather the problem continues to assume monstrous dimensions [4]. To urban and city dwellers, public hygiene starts and ends in their immediate surrounding and indeed the city would take care of itself. The situation has so deteriorated that today the problem of solid waste has become one of the nation's most serious environmental problem.

In a survey conducted in fifteen towns in Nigeria in March 2002, a total of six hundred people were asked to define precisely what they understand as waste, definitions received include unwanted materials (8%), useless object (20%), garbage (22%), rubbish (7%), dirt (15%), refuse (28%) [5]. According to Udechukwu (2009)[6], wastes are useless, unwanted and discarded material. Douglas (2004) [7] corroborates Udechukwu's stance and argues that 'waste is a material which arises from animal and human life and activities and is discarded as useless and unwanted'.

Since all human activities produce wastes [8], waste generation is inevitable in Nasarawa state. A part from the waste generated by population of both the public schools, Hospitals and tertiary institutions, the waste also consists of that generated in the markets where daily activities take place which lead to a large tendency of having very huge amount of biodegradable and non-biodegradable waste. From these, the natural tendencies of discarding unwanted or used materials abound into propensity of large scale domestic waste generation [9]. Nasarawa state manages its waste generation through its Self-owned waste disposal systems that use delivery trucks to deliver the wastes to the landfill sites. However, that these wastes are never characterized portend improper waste management and planning which could present danger to health and the environment. For instance, human solid wastes could be made up of non-conservative or biodegradable constituents and conservative or non-biodegradable components [10]. Stabilization of biodegradable components could produce greenhouse gases such as methane and carbon dioxide. Leachate containing soluble components and degradation products contaminate surface water and ground water resources [11]. These affect human health and environmental well-being [12]. However, a proper waste management is the requisite step towards curtailing negative environmental impact of wastes [13]. Beside this, benefits that could be derived from wastes, including material and energy recovery, are by-products of developments of sustainable waste management system [14]. A good waste management is usually initiated from data acquisition of waste constituents obtained from waste characterization [15].

In this paper the waste generated in the Nasarawa LGA of Nasarawa state will be identified and characterized. The effective and most suitable method of waste management will also be recommended.

MATERIALS AND METHODS

Study Area: The study was carried out in Nasarawa Local Government Area (LGA) of Nasarawa state, Nigeria. Nasarawa is the largest by land area (5,704 square kilometer) and with a population of over 217520 (estimated 2011 population), Nasarawa LGA is the third most populated LGA in Nasarawa state after Lafia and Karu. The state created on October 1st, 1996 from the (today neighboring) Plateau State. Nasarawa State is bounded in the north by Kaduna State, in the west by Abuja (Federal Capital Territory), in the south by Kogi and Benue States and in the east by Taraba and Plateau States. Figure 1 shows the study area highlighted.

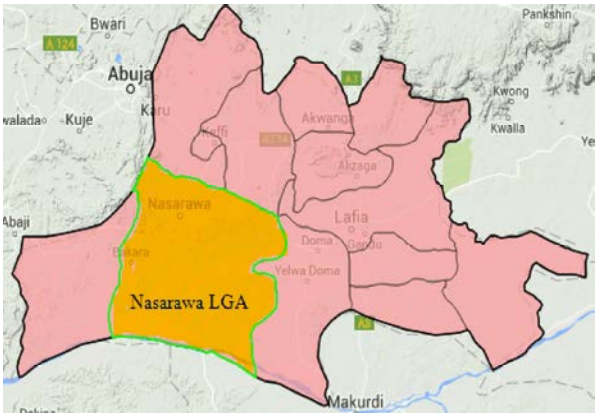

Fig. 1: Map showing Nasarawa state with the study area highlighted

Materials and Solid Waste Collection: The materials used for the collection of solid waste include Waste bin, Storage bin, Waste container, Shovel, Rake, Broom, Incinerator, Hand gloves, Nose mask, Overall, Delivery truck and Weighting balance.

For the purpose of this study, fifteen (15) areas were earmarked from Nasarawa local government area. These are include Nasarawa LGA Secretariat, Nasarawa Central Mosque, Cafeteria 1, Cafeteria 2, Hostel Mosque, Henad Hospital, KasuwaLaraba, Nasarawa Main Market, Tammah, Main Town, Nasarawa General Hospital, Government girls secondary school (G.S.S.S.), Government College (G.C.) Quarters, Federal Polytechnic

Fig. 2: Solid waste collection sites: (a)-waste bin for GC quarters, (b)-waste bin for Henad Hospital, (c)-refuse dumped at hostel Mosque, (d)-waste bin for cafeteria 1, (e)-broken glasses at Cafeteria 2, (f)-discarded electronic waste at KasuwaLaraba, (g)-refuse dumped along market side, (h)-refuse dumped along police station, Mararaba/Loko road, (i)-refuse dumped along General Hospital road, (j)- refuse dumped along GSSS road, (k)-waste dumped along Tammah, (l)-refuse dumped along Nasarawa secretariat road.

Nasarawa (FPN) Sport centre and KarejiTsowo. Some of the solid waste collection sites are shown in Figure 2 below. The waste are collected before they are delivered to landfills by the state operated trucks disposal systems, from residential, commercial (coke village) and hostels. In the residential buildings, some samples were taken from individual households to develop waste composition data for the specific types of building to achieve a system of source generator-based study.

Procedure: The solid waste materials collected from the sites were sorted into six (6) different materials type which include paper/cardboard, plastic food pack/plastic bottles, metal cans, food waste, polythene bags/polystyrene food pack and other combustible miscellaneous waste material. Each of these was then weighed to obtain the mass-based characterization for the waste components. The process was repeated for seven (7) days and the values tabulated. Microsoft package was used to analyses the data.

RESULTS AND DISCUSSIONS

Dailywaste Collection: The waste generated on a daily basis were collected, characterized and weighed. The result shows that the weight of waste generated ranges from 449.50Kg to 579.88 Kg. The maximum and minimum

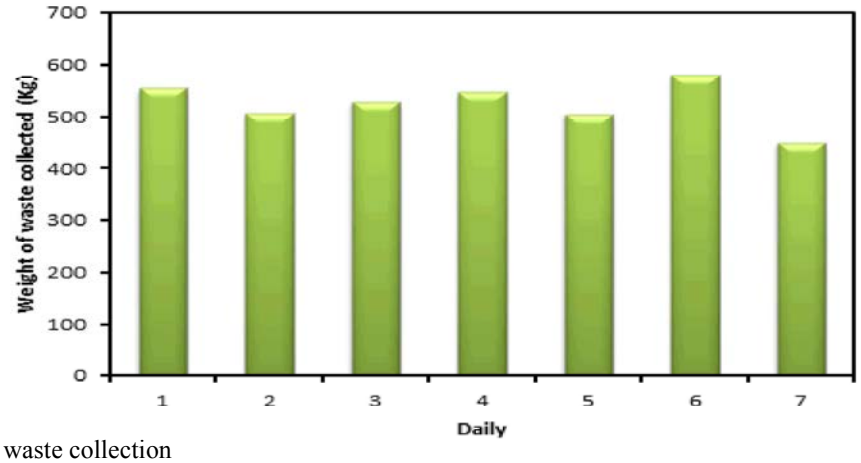

Fig. 3: Total daily waste collection

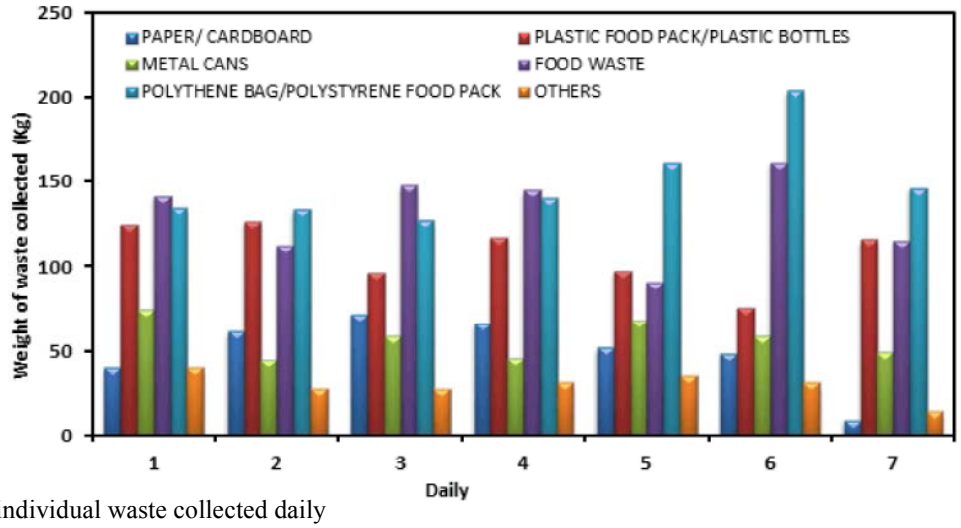

Fig. 4: Total individual waste collected daily

wastes were generated on day 6 and 7 respectively (Figure 3). The maximum waste collected for days 1, 3 and 4 is food waste. This may be due to the condensed nature of waste resulting in the increase in weight. However, polythene bags/polystyrene food pack constituted the maximum waste collected for days 2, 5, 6 and 7 (Figure 4). The minimum waste collected for days 1 and 7 was paper/cardboard, while other waste constituted the minimum waste collected in days 2, 3, 4, 5 and 6. Figure 4 shows the individual daily waste type collection. The maximum paper/cardboard waste collected was on day 3 (Figure 4) and in Main town waste collection area as shown in Figure 5. There was no paper/cardboard collection in Cafeteria1 and Cafeteria 2 during the study period.Plastic Food Pack/Plastic Bottleshad a maximum waste collection on day 2 (Figure 4) and was from Henad Hospital waste collection area as shown in Figure 5. There was no Plastic Food Pack/Plastic Bottlescollection in FPN Sport Centre during the study period.The maximum Metal Cans waste collected was on day 1 (Figure 4) and was from Cafeteria 2 waste collection area as shown in Figure 5. There was no Metal Cans collectedfrom KarejiTsowo during the study period. Figure 5 shows that Food Waste maximum collection of 162.44 kg was on day 6 and was from Cafeteria 1 as shown in Figure 5. Nasarawa LG Sec, KasuwaLaraba, FPN Sport Centre and KerejiTsowo recorded no Food Waste collection.204.06 Kg of total Polythene Bag/Polystyrene Food Pack collected on day 6 is the highest waste collected on the basis of daily collection.

Study Area Waste: Figure 5 shows that Henad hospital and Main Town constituted the highest waste of 601.02 Kg and 556.86 Kg respectively collected in the study areas. Main Market, Cafeteria 1 and Cafeteria 2 are the next categories of higher waste collection in the study areas. This high waste volume was due to the high population density of these areas, compared to the other

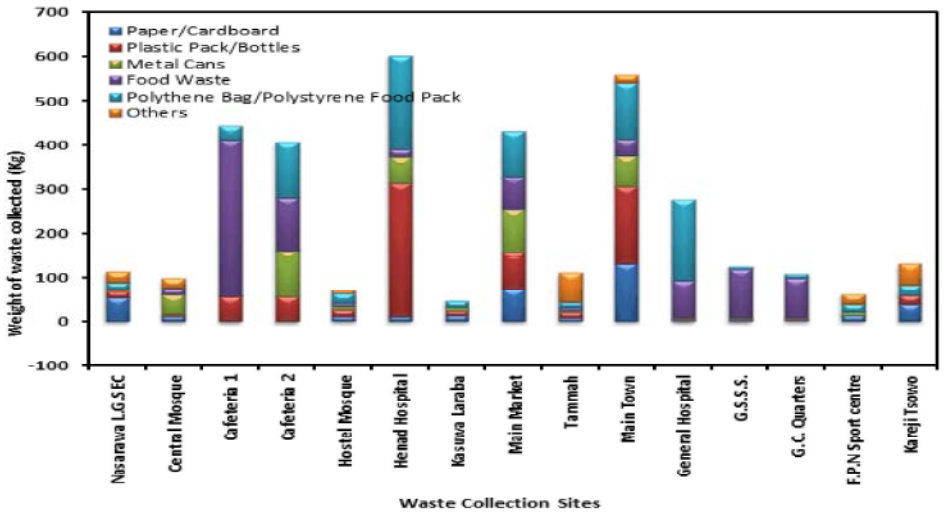

Fig. 5: Study area waste collection

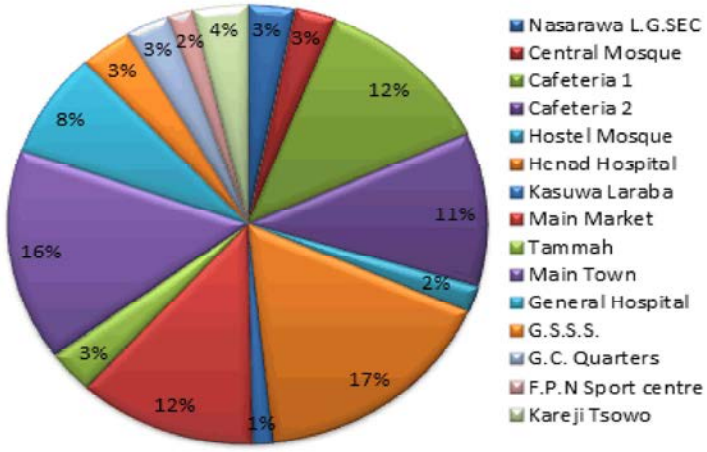

Fig. 6: Percentage of waste collected in study area waste collection

parts of the town. The lowest waste of 46.99 kg was collected in KasuwaLaraba. It was closely followed by FPN Sport Centre and Hostel Mosque with 61.6 kg and 70.34 kg respectively. In terms of percentage, Henad Hospital constitutes 17% of the total waste collected in all the study areas as shown in Figure 6. Main Town has 16% while Cafeteria 1 and Main Market both have 12%. Cafeteria 2 is 11% and General Hospital is 8%. KarejiTsowo has 4%, while the rest study areas have 1 to 3%.

Type of Solid Waste: Figure 7 shows that polythene bags/polystyrene food packs constitute the highest waste (141.09 kg/day) collected during the study period. This is closely followed by food waste with 130.37 kg/day. Plastic food pack/plastic bottles, metal cans, paper/cardboard and others has 64.64 kg/day, 59.39 kg/day, 53.51 kg/day and 29.15 kg/day respectively. In relation to overall solid waste collected from the study areas, polythene bags/polystyrene food packs and food waste constitute 30 and 27 % respectively. Other waste such as Plastic food pack/plastic bottles, metal cans, paper/cardboard and others constitute 14 %, 12 %, 11 % and 6 % respectively (Figure 8). The non-biodegradable wastes such as polythene bags/polystyrene food pack, plastic food pack/plastic bottles and metal cans constitute about 56 % (257 Kg/day) of the total waste collected during the study period. The fact that non-biodegradable componentsconstitute over 50% of the waste collected shows that the disposal of waste through landfill system alone is not a viable waste management method in Nasarawa LGA. To effectively manage the waste in these

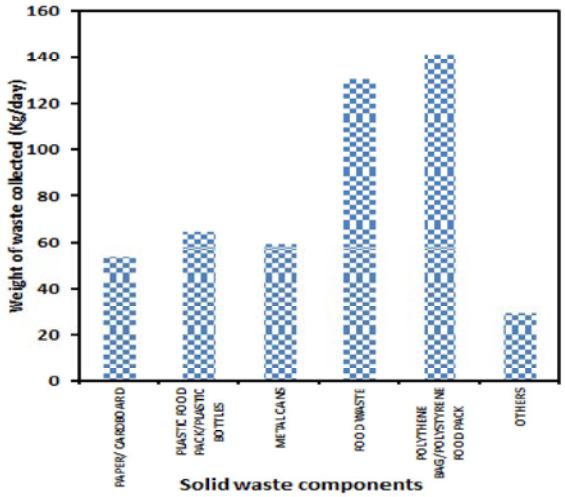

Fig. 7: Distribution of solid waste collected

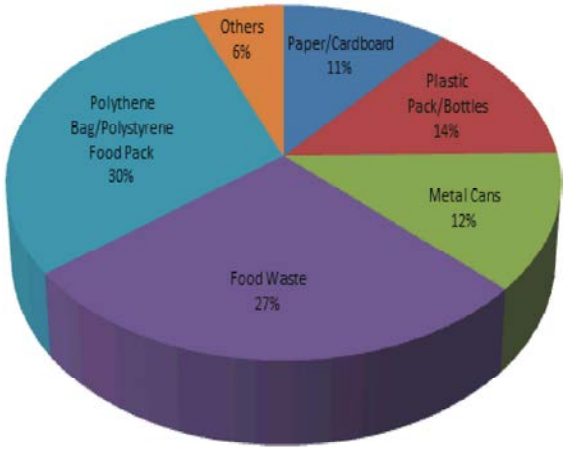

Fig. 8: Distribution of solid waste collected in percentage

areas, a method consisting of recycling of plastic materials, the use of co-incineration, gasification and pyrolysis should be abducted [16-19]. Food wastes constitute about 27 % of the waste collected during the study period in Nasarawa LGA. Again, these high mass of food wastes also suggests that the landfill waste management system as currently employed in these areas is not an environment-friendly. Food waste has the potential of being hazard and can contaminate water bodies. The use of bio-gasification scheme in waste management will make the system environmentally friendly with an extra benefit of generating biogas and using the residues as composts for agricultural land conditioning [10].

Adoption of 3R's for Waste Management: For effective waste management of Nasaraawa LGA in Nasarawa state, the 3Rs (reduce, reuse and recycled) should be adopted. Reduce is the best way to reduce waste is not to produce it in the first place. Everyone should try to reduce his or her consumption of goods as much as possible. For example, choose products, which have the minimum of packaging around them and instead of accepting plastic bags when shopping, use cloth bags. Staffs should buy only what they need because a better way to reduce waste is by not creating it. This has to the behavioral nature of people living in a particular area. Therefore, in a place like schools strong policies should be set as to how waste should be manage fully by notifying students and people on how to reduce waste. This method will significantly reduce the amount of non-biodegradable waste.

Items should not just be thrown away after use if they can be used again (reuse). This can result in reduction in waste and better conservation of resources. Items which can be reused include metal cans, plastic bottle, paper etc. If people have to acquire goods, they should try getting used ones or obtaining substitutes. Many people are just after their desired satisfactions when using items without thinking of its alternatives usage, but by purchasing reusable goods there will be drastic reduction in waste and also contribute to the free hazardous environment [11-19].

Recycling is creating new things from used items. Most of the wastes obtained as non-biodegradable waste from this research are recyclable in this format such as paper, can be re-pulped and reprocessed into recycled paper, cardboard and other paper products. Metal cans can be re-melted and made into containers. Some forms of plastic can be re-melted and fabricated into carpet fibre.Food wastes and yards wastes can be composed to produce a fertilizer. Waste should be recycling instead of letting it in the landfill. The State should set aside waste recycling units where all wastes can be process efficiently and effectively. The total amount of mass waste obtained from this research is so much that if when recycled will contributes immensely towards reduction of non-biodegradable and biodegradable wastes and thereby promoting the standard of living of the people.

CONCLUSION

Characterization of solid wastes generated in Nasarawa State has been carried out in this work, which easily provide more suitable waste management method or system which the state can adopt for effective waste disposal. The waste characterization shows that Polythene bags/polystyrene food packs constitute the

highest waste of 141.09 kg/day collected during the study period. This was closely followed by food waste with 130.37 kg/day. Plastic food pack/plastic bottles, metal cans, paper/cardboard and others has 64.64 kg/day, 59.39 kg/day, 53.51 kg/day and 29.15 kg/day respectively. The non-biodegradable wastes such as polythene bags/polystyrene food pack, plastic food pack/plastic bottles and metal cans constitute about 56 % (257 Kg/day) of the total waste collected during the study period. It is opined that these results are suggestive of the requirement of a radical change in the current practice of waste disposal system. It has been discovered that generated wastes should not be managed using landfill system alone if a sustainable waste management system is to be achieved. From the results of this study, Nasarawa state waste management scheme should include the adoption of 3R's methods scheme for reducing the biodegradable waste components and also employed for reducing the non-biodegradable waste components. Waste should be treated according to its suitable method such as burning of papers with an incinerator, plastic food pack/plastic bottles, metal cans should be reuse, gathered and sold to industries where they can be recycle for either same use or other purpose and food waste should be taking to the land fill for final disposal.

REFERENCES

1. Bonnie, D., 2006. Rewarding recyclers and finding gold in garbage, New York Times *Books*.
2. US Environmental protection Agency, 1990. Characterization of Municipal Solid Waste in the United State updated EPA 1530-SW-90-04
3. Egunjobi, T.O., 1996. Problems of Solid Waste Management in Nigeria Urban Centre, paper presented at the National Conference on Environment and Development, NISER, Ibadan.
4. Okpala, I.C., 1986. Practical guide to environmental auditing, excellence environmental system. Lagos: Vinez Books.
5. Nwokocha, G., 2012. Managing household solid waste, Journal of Policy and Development Studies, 5(1): 29-35.
6. Chukwuemeka, E., J. Ugwu and D. Igwegbe, 2012. Management and Development Implications of Solid Waste Management in Nigeria, Asian Journal of Business Management, 4(4): 352-358.
7. Douglas, S.E., 2004. The politics of Nigeria underdevelopment, J. Polic. Dev. Stud., 1(2): 34-39.
8. Ogboi, E. and J.l. Kperegbeyi, 2009. Bioscience Research Communications, 21: 229-236.
9. Oyelola, O.T. and A.I. Babatunde, 2008. African Journal of Environmental Science and Technolog, 3: 430-437.
10. Mendes, M.R., T. Ararnakib and K. Hanakic, 2003. Waste Management, 23: 403-409.
11. Alkassasbeh, J.Y.M., L.Y. Heng and S. Surif, 2009. American Journal of Environmental Sciences, pp: 209-217.
12. Mor, S., K. Ravindra, A De Visscher, R.P. Dahiya and A. Chandra, 2006. Science of the Total Environment, 371: 1-10.
13. Lamport, C., Waste management in Austria / GHG mitigation effects of the landfill regulation, Workshop on Best Practices in Policies and Measures, 11-13 April 2000, Copenhagen, Denmark.
14. Fobil, J.N., D. Carboo and N.A. Armah, 2005. International Journal Environmental Technology and Management, pp: 576-586.
15. Ojolo, S.J. and A.I. Bamgboye, 2005. Agricultural Engineering International: the CIGRE Journal, pp: 7.
16. Agunwamba, J.C., 1998. Analysis of scavengers, activities and recycling in some cities of Nigeria, Environmental Management, 32(1): 116-127.
17. Bernache-Perez, G., S. Sanchez-Colon, A.M. Garmendia, A. Dávila-Villarreal and M.E.A. Sanchez-Salazar, 2001. Waste Management and Research, pp: 413-424.
18. Seemann, A., 2007. Proceedings of the International Conference on Sustainable Solid Waste Management, Chennai, India, pp: 348-355.
19. Post, V. and I. Haenen, 2007. Solid Waste Management in Sri Lanka: Plastic Recycling. CORDAID Tsunami Reconstruction 6 Project Report, WASTE, Accessed March 3, 2016 from WASTE Website: http://www.waste.nl.