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# Solid Waste Management

## Abstract

Solid Waste Management is a pressing issue that needs abrupt consideration globally. The purpose of this study is to assess the characteristics of municipal solid waste from households waste to reduce disposal at landfill site. The study seeks to answer the research question, 'What are the characteristics of solid waste in the municipality of Nadi in 2019 that can be recycled to reduce the amount of waste disposed at landfill site'. The goal is to characterize the types of solid waste from households and analyse the various types of recyclables waste discharged by volume and weight from households in Nadi. A descriptive and experimental study would be used to compare the baseline data available with the Nadi Town Council on the generation amount, generation rate and the participation rate of households.

## Introduction

Solid Waste Management in countries that are developing becomes a challenge for the municipalities largely because of the growing amount of waste generated, high cost burden on the municipalities budget due because of its management, absence in understanding the wide range of factors affecting the dissimilar phases of managing waste and its associations that enables complete functioning of the management system.

In developing countries, one of the problems faced in the management of waste is the absence of a culture of sorting waste by type at source or the generation point. This leads to the mixing of all types of waste generated. There may be other special solutions for recycling of solid waste, but separation at source is the starting point (Banga Margaret 2013).

The Fiji National Solid Waste Management Strategy 2011 – 2014 identifies waste management as a pressing issue that needs instantaneous action. Waste management which is recognized as a key concern has various potential impacts on development activities of any country such as the health of people, the environment, food security, tourism and trade. The strategy highlights the negative impacts that waste management has on tourism, its connotation with vector-borne and infectious diseases, and the likely chances of food contamination that affects the revenue generated from exports.

Waste management in Fiji is covered under several pieces of legislation as follows:-

- Public Health Act (Cap 111),
- Environment Management Act 2005,
- Environment Management (EIA Process) Regulations 2007,
- Environment Management (Waste Disposal and Recycling) Regulation 2007,
- Litter (Amendment) Decree 2010,
- Fijian Affairs Act (Cap 120),
- Biosecurity Promulgation 2008.

However, none of the legislation has anything on the promotion of the separation of recyclables

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waste in managing of MSW except for the SWM-MP of Nadi Town Council and Lautoka City Council. Currently, Fiji is drafting a 5R Policy for all councils to promote the concept of 3R.

In the setting of Nadi, the municipality of Nadi has a population of approximately 12,000 people and has land coverage of 666 hectares. The generation amount of MSW is 22.3 tons/day; the generation rate is 1,894g/person/day. The generation amount of HH waste is 4.4 ton/day; the generation rate of HH waste is 374g/person/day. Kitchen waste is 36.4% of total MSW discharged. The municipality of Nadi does not have a waste disposal facility, hence all MSW collected is transported and disposed at the Vunato Disposal Site in Lautoka (Master Plan on the Solid Waste management for Nadi Town Council , 2010).

## **Review of literature**

### **Composition and categories of municipal solid waste**

Municipal Solid Waste (MSW) management is one among the foremost issues within the current urban municipalities preponderantly in developing countries. Municipal solid waste includes all types of waste generated from the commercial and residential areas and it contains different categories and composition of waste. The separation of recyclables is integrated into the solid waste management strategy. It can be applied to mixed municipal solid waste (MSW) or to separately collected paper, plastic, glass, tins, cans, metals etc. Separate collection is where waste is collected separately from the waste stream by its nature and type so it can be treated specifically. Waste composition of most countries globally is often subjugated by organic matter followed by paper and plastics except for Japan who generates more recyclables waste (Agamuthu.P 2007).

A Qualitative and quantitative review by Mohee Romeela et.al (2015) discovered that the waste composition in small island developing states comprises mainly of organics (44%) shadowed by recyclables specifically paper, plastics, glass and metals which accounts to 43 percent. In the same review, as compared to the Organisation for Economic Co-Operation and Development countries, the recyclables waste accounts the highest (43 percent) followed by 37 percent of organics waste. The study reflects a high waste generation rate on the average in these islands which amounts to 1.29 kg/capita/day. Mohee Romeela et.al (2015) revealed the prevalent waste management practices in the small developing states of mainly landfilling, backyard burning and illegal dumping. With the emerging of sustainable waste management practices in these states, there is a need for the introduction of waste minimization and recycling promotion activities.

In another review by Rajendra K. Kaushal et al (2012) carried out in India revealed an increasing trend in the composition of solid waste generated from municipalities. The components of paper, plastic and glass have a growing pattern from 4.1%, 0.7% and 0.4% individually in 1971 to 8.18%, 9.22% and 1.01 correspondingly in 2005. Metals during the same period also revealed an accumulating pattern. This study concluded with revealing unorganized and unplanned segregation at source except for medical and industrial waste in India. Scavengers play an important role in sorting waste that reduces the competence of segregation since these people only segregate items that have high market return value. Therefore, this increasing trend of recyclables waste recommends the promotion of the separation of recyclables waste for formal recovery. Reduction of waste at source is a primary factor for improving the system and cost of managing waste (Latifah Abd Manaf et.al, 2009).

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## Baseline Data

To promote separation of recyclables it is necessary to have baseline data on the characteristics of MSW. Hassan N Mohd et.al (2002) in a study conducted in Malaysia revealed that one of the most important requirements for a successful recycling programme is to have reliable data on waste generation rates and composition.

A baseline study by ESCAP (2011) in Vietnam revealed how the city of Kon Tum used the baseline data in planning and implementation process of recycling. According to the writer, this city lacked practices of segregation of waste and all waste generated were disposed at landfill site. Based on the findings and information of the baseline data, the city of Kon Tum prepared the National Strategy for Integrated Solid Waste Management which included the concept of 3R and waste recovery in Vietnam.

Another baseline survey carried out in Australia by the Queensland University of Technology for Community Recycling Network Australia (2012), provides an in depth of how solid waste and recycling planning data to be used. The results were used and integrated into the Waste Management Strategy for strengthening waste separation and 3R practices in Australia. Such data is useful for solid waste and recycling managers to develop comprehensive plans and policies and persuade key stakeholders, municipalities and governments on the benefits of waste separation and recycling. Thus conducting a baseline survey assists in determining the local circumstances and situations to come up with critical information and data and such data and information helps support appropriate decision making (ESCAP 2010).

## Awareness on separate collection of recyclables

Education and awareness on separate collection of recyclables is essential for change in behaviour of people. According to M Florica and Bucur Bondan (2017), environmental education is a tool for implementing changes and creating awareness to residents on environmental issues. For proper waste management in urban and rural areas it is important to cogitate on public education. The effectiveness of preventing and minimizing waste involving prevention and minimization at source is connected to community participation and behaviour of the people. Basis factor in recycling waste recovery is the attitude and behaviour of the people towards recycling (Wichitra Singhirunnusorn et al, 2012). Different forms of awareness raising should be promoted to disseminate information to the community level and achieve high participation rate in recycling.

In a descriptive and questionnaire survey study by L.A. Guerrero et al, (2013) on three continents comprising thirty urban areas in twenty two developing countries found that fourteen of the inspected cities do not have recycling practices. Management of MSW is improved once stakeholders are willing to take charge and share responsibility with municipalities on the decision making for SWM which are associated with three necessary components:-

- Awareness - The effectiveness on the separation of waste depends on the awareness of its people and leaders on the effects of waste management systems within the town/city.
- Knowledge - Municipal Decision makers are only likely to set up waste separation programs once they are familiar and acquainted with the new and suitable technologies and the proper practices for the management of waste.

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- Equipment. The availability and provision of necessary equipment and machinery to manage and recycle waste is a key factor that promotes separation of waste at the household level.

Education and Awareness Techniques - Research has also been done on the different methods used for creating awareness. Adam D (1999) in a study conducted in the UK revealed the common methods of communication used by the UK local government in creating awareness on recycling were media campaigns, household leaflets, radio advertisement, seasonal promotions, public meeting, celebrity launching, reminder cards, conference presentations, mobile advertisement, recycling tours, telephone hotline, school presentation, surveys, and promotional videos. To increase low public awareness and participation the local government found that door-to-door or house-to-house communications strategy is the most effective promotion to increase recycling rate and public participation in the recycling service. This study further concluded roadshow being helpful communication tool. These different forms of awareness campaign have increased average weekly recycling tonnage from 107 to 132 tonnes in the UK local government. Hence these varieties of methods for communication can form a central and effective approach to raising residents' participation.

In support, a Pilot recycling program in Quito by Hernández Orlando (1999) revealed a mixture of cluster group discussions, in-depth interviews and a household survey being used to gauge the way to increase and sustain resident's participation on separation of waste.

Furthermore, in another study by Omran, A. et al. (2009) carried out in Malaysia concluded various activities implemented to increase awareness on the importance of household participation in recycling which includes mass media awareness (TV and Radio) advertisement, awareness programs organized in communities, schools and shopping complexes. However, in the same study various launching programs of recycling failed. It revealed that the households did not comprehend and respect the waste collection schedule and there was a lack of co-operation and understanding from the households in discharging waste separately. Omran, A. et al. (2009) in this study strongly emphasizes that social influences, altruistic and regulatory factors are a number of reasons which can inspire communities to develop strong recycling habits. Educating people on how, what, and where to recycle is paramount. Not everybody will participate. Thus it is necessary that people are aware of the reasons for recycling and the positive impact that waste separation and recycling has on the environment.

On the other hand, Banga Margaret (2013) in a case study conducted in Kampala, Uganda surveyed 500 randomly selected households and the results indicated that, although people were aware of separation and recycling practices, they had not participated in such initiatives. The result also indicated that participation in solid waste separation activities not only depends on the level of awareness of recycling activities but on resident's attitude, household income, educational level and gender. Banga Margaret (2013) further found that one of the effective methods to increase the rate of participation in separation activities needs to be initiated by government policymakers and local authorities.

Increased participation and discharge rate of recyclables can be achieved through community participation. This is supported in a study by Hassan N Mohd et.al (2002) which concluded that community participation is critical to the success of any recycling programme and therefore the economical recovery of large volumes of great quality recyclable depends on people's involvement. Wichitra Singhirunnusorn et.al (2012) supported by concluding that an important

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source of recycling knowledge come from public education and campaigns which shows a positive connotation with recycling rate.

## **Benefits - Separate collection of Recyclables**

Hernández Orlando (1999) in another review revealed that local governments in Africa, Asia and Latin America spend 20 to 50 per cent of total municipal revenue on solid waste services. Thus, recycling can reduce costs to the municipality for the collection and disposal of solid waste by reducing the amount of waste transported to its landfill.

Alexis M. Troschinetz and James R. Mihelcic (2008) further, concluded that material or resource recovery is an advantage of recycling and substantial quantities of recyclables are reused as resources. This study shows the recycling rates of developed countries falling within the ranges of developing countries from 0 to 41%. It revealed comparison of the developed countries utilizing curbside recycling programs to amass and sort wastes for recycling processing while developing countries utilize the social sector known as scavengers to handle such activities. Such practices benefit thus; creating job opportunities for people thus reduces poverty that enhances stronger economy, lower cost for raw material for industries, resources and raw materials are preserved, pollution is reduced, and the environment is protected.

Similarly, the study by M. Sharholly et al (2009) revealed the key role of scavengers in solid waste management in Delhi India stating that the proportion of recyclables like paper, glass, plastic and metals is precisely low due to the presence of the more than 100 000 scavengers who separate and collect the recyclables at generation sources, assortment points and disposal sites. Approximately 40–80% of plastic waste is recycled in India in comparison to 10–15% in the developed nations. About 17% of waste handling in Delhi is done by scavengers where one collects 10–15 kg/ despite the health and safety risk associated with it. This allows saving for the governments of US\$13,700 daily. M. Sharholly et al (2009) also revealed the informal sector involvement in Bangalore which again allows the municipalities in Pune to save around US\$200,000/ year on description of scavengers. This does not only allow the government to save cost on collection, transportation and disposal but tolerate the scavengers to generate income at the same time reducing the need for landfill space.

To support the above, a guide by ASPERM (2016), also reflects about the advantages of waste recovery into resource materials. Waste if managed properly becomes a resource and can be recycled into new products thus stabilizing the reduction of raw materials. Such examples are recycle of cans into glasses, plastic containers into chair, glass bottles into a new glass bottle, PET fibres into clothes, glass into tiles (Tim Hornyak, 2017). Banga Margaret (2013) also supported by concluding that the enhancement of waste recycling activities saves resources and costs by reducing on the purchase of raw materials, lowers the costs of the final disposal of the residues, produces cheaper goods that support low-income households, and creates new jobs.

## **Conclusion**

Proper solid waste management policies and practices can be adopted to manage MSW at a considerable level. Separation of recyclables waste is an imperative and key component of 3R practices. The benefits of recyclables waste separation are several folds and have various

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economical and environmental impacts. The implementation of recycling and separation is encouraged at the household level that also indicates the high interest and response of the citizens to get involved in the management of their waste. To achieve education and awareness on waste separation, behavioural and attitudinal changes in the residents is essential. Strengthening and enhancing environmental education brings about behavioral changes in the awareness level of the residents which contributes to heightened participation level as well.

Recovery of resource materials can be made possible by strengthening policies, and providing support on the advantages of recycling as it generates benefits at every level: environmental, financial and social. Since the composition of MSW comprises 40 – 60% recyclables waste, reducing by resource recovery does not only increases landfill life but addresses health hazards as well. There was a reduction of nuisance that occurred during the collection and transfer of MSW; it lowered the burden on landfill increasing their lifecycle. The various reviews also advocate that a holistic management of MSW at all levels not only reduces the burden on landfill sites but contributes to the reduced carbon emission. There are a large number of different stakeholders involved in waste management. They all play a role in shaping the system of a municipality, but often it is seen as a responsibility of the local authorities. An effective system is not only based on technological solutions but also environmental, socio-cultural, legal, institutional and economic linkages that should be present to enable the overall system to function. Therefore, proper management of MSW at all stages is very important to address not only health and hygiene issues of a population but also the effect it has on the environment which comes back to human health and environmental degradation. The planning, changing or implementing a waste management system in a city requires decision makers to be well informed in order to make positive changes in developing an integrated waste management strategy.