



Understanding Segregation and Recycling Practices of Tin Cans and Plastic Bottles in the Household, Municipality, and Agency in Zanzibar

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AIA and CJO designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors JKH, SAA, MMK, OMS, TIS, HAM, and ASA managed the study's analyses and the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This study seeks to understand waste handling and disposal practices, including hindering segregation and recycling plastic bottles and tin cans in Zanzibar. Focusing specifically on the household, schools, collectors, pickers, key informants, and recycling agencies in Zanzibar, the study uncovered the factors that influence the separation and selling of empty plastic bottles and tin cans from households to recycling agencies in Zanzibar. Therefore, this study was done to understand the current practices on waste recycling, agencies involved, and barriers to market penetration from households to recycling agencies. Data were collected from 60 household surveys, focus group discussions with secondary school students and NGOs, in-depth interviews with key informants, and systematic observations in the households, recycling agencies, and

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collectors. The findings show that waste is generally not separated in households, among collectors and Zanzibar Municipality Council. The study identifies a lack of proper education, poor knowledge of law and policy enforcement, insufficient capital, limited storage warehouses, and an unstable recycling market among the major challenges to sustainable plastic bottle handling and tin can waste. To encourage tin can and plastic bottle users to separate their waste and hand in their plastic bottles and tin cans for recycling, the study recommends some suggestions to improve the situation such as the provision of proper education and loan, law enforcement, promotion of environmental clubs, as well as the creation of a more stable market for the recycling agents.

Keywords: Plastic bottles; recycling agencies; tin cans; households.

1. INTRODUCTION

Sustainable solid waste management is a serious problem not only for developing countries but also for the developed countries [1]. Enormous amounts of waste are generated throughout the world, and the most crucial question posed is how to manage these wastes effectively and efficiently to protect the environment and human health [2]. The organic component of Municipal Solid Waste may not be too much of a problem since that is biodegradable. However, plastics and metallic parts like tin cans in solid waste can be quite problematic because they are non-biodegradable. Therefore, they can stay in the environment for a considerable length of time, causing all sorts of problems [1]. In other cities around the world, however, local authorities have intervened to introduce solid waste management practices and promote solid waste recycling. In Can Tho City, Vietnam, for example, household solid waste is collected from each household and classified into ten physical categories; plastic waste is further segregated into 22 subcategories [3]. In Madrid, communication campaigns that involve residents were found as the best way to reduce solid waste and promote recycling [4]. An assessment of such practice in various countries in Africa as carried by some workers showed numerous benefits of recycling plastic waste, and it's more environmentally friendly than the other methods of waste disposal [1]. Other workers contended that recycling of plastic waste lead to material and energy recovery, and therefore value will be derived from the waste instead of regarding it as garbage [5].

Like other cities of the developing countries, Zanzibar city has been experiencing a number of hindrances in dealing with solid waste effectively. There is no formal solid waste management system in Zanzibar, so people collect waste in containers such as plastic bags, buckets, and palm baskets, disposed of throughout the suburb

[6, 7]. Rotting waste attracts scavengers such as rats, which leads to the waste being scattered widely, often ending up in rivers and streams. As a result of inadequate waste management and stormwater management, the residents of Zanzibar town live in unhealthy conditions, which have a negative impact on their health and quality of life [6]. The spread of municipal solid waste (MSW) in Zanzibar municipality creates environmental pollution, unpleasant urban conditions, contamination of water sources and coastal areas. It also harbours malaria vectors [8]. About half of domestic waste produce annually failed to reach the main disposal sites due to insufficient staff, solid waste technology, and infrastructure [9].

The Stone Town Act No. 3 of 1994 allows for private agents to work on solid waste management. On 19th March 2008, the non-governmental organization Zanzibar Scrapes and Environment Association (ZASEA) was officially registered. Its aim was to conduct sustainable solid waste management in Zanzibar on a long-term basis, focusing specifically on collecting and exporting plastic scraps, waste management education, and environmental conservation. The association was formed as a result of a rapid increase in plastic waste in Zanzibar and a lack of management and proper disposal systems. Despite the presence of this organization and others like it, plastic bottles and tin can waste remains high in and around Stone Town [10].

In his study from 2010, Vuai while working on Characterization of MSW and Related Waste-Derived-Compost in Zanzibar municipality, reported that most of the waste is of a domestic and vegetable market in origin, and could thus be used for compost production, by which 60% of the waste could be reduced through aerobic composting [8]. In this case, the introduction of a well-institutionalized system in dealing with waste could be of advantage in the agricultural sector where this compost could be utilized in

agricultural activities to boost production. Different types of waste management options are currently used in Zanzibar, such as landfilling, open burning, incineration. Some workers, however showed that management of plastic waste through combustion (incineration) and land filling are not environmentally friendly and are unsustainable since incineration releases carbon dioxide, a major contributor to global warming as well as dioxins and furans, which are persistent organic pollutants linked to cancer and respiratory diseases [11]. Landfilling is also not desirable since plastics are non-degradable. In doing so, no economic value would have been derived from the waste; thus, recycling is the best option.

2. MATERIALS AND METHODS

2.1 Study Site

This study was conducted in Zanzibar, a semi-autonomous group of islands in the Indian Ocean as part of The United Republic of Tanzania. Zanzibar covers 2643 Km² and a total population of 1.3 million (OCGS, 2012). The study was based on the selection of specific three districts Urban district, the West district, and North district.

2.2 Methods used for Data Collection

2.2.1 Survey questionnaires

Household interviews were conducted using a structured questionnaire. The questions were designed to collect information on current practices of solid waste management, in particular plastic bottles and tin cans from domestic waste. The questions were in the Kiswahili language for better understanding. A total of sixty survey questionnaires were administered to randomly selected households in two wards (Mkunazini and Vikokotoni) within the municipality

2.2.2 In-depth interviews

A total of twenty-six (26) in-depth interviews were conducted with five key informants, five managers at recycling agencies, nine municipal council staff, and seven collection points' owners and waste pickers. The key informants were selected from different sectors that are familiar with environmental issues. The interviews

focused on the current practices along the chain, i.e., segregation, collection, transportation, and recycling to the marketing of recycled products. Information on knowledge and awareness levels of actors as well as motivators and challenges was also collected.

All the interviews were conducted and recorded by the interviewer in the Kiswahili language and translated in English by the researchers. Household survey questionnaires were analyzed using SPSS. Interview data were coded and categorized using matrix form to find the themes. The observations were guided by the checklist, making the data collection easier to simplify for the analysis.

2.2.3 Focus Group Discussion (FGD)

A total of seven FGDs were conducted. Two of these were done with municipality staff responsible for waste management, three with youths in three different secondary schools (one in each school), and one with participants from NGOs involved in environmental conservation, and the last FGD was with a group of participants from collection and recycling agencies. The discussion themes included current practices of segregation and recycling, perceptions on waste segregation and recycling, and factors motivating and hindering the practice.

2.2.4 Observations

An observation checklist was prepared, and observations were made at households, collection, and recycling sites while conducting interviews. Observations focused on the general condition of the agencies, collectors, and households concerning segregation and recycling as well as general waste scattered outside the house and the street.

2.2.5 Data analysis

All FGDs and interviews were conducted in *Swahili*, and notes were taken during the interviews and discussions. Focus group discussions were translated into English from Swahili by researchers. The questionnaires, observations, and interviews were structured into subthemes that guided the analysis. Quantitative data from questionnaires were entered into the SPSS software program (version 17), and descriptive answers were computed in verbatim text.

3. RESULTS

3.1 Waste Handling and Disposal Practices

The FGD results revealed that the household solid waste is usually collected in plastic buckets, plastic sacks, and dustbins. Information obtained from the household survey in Mkunazini and Vikokotoni wards on the type of containers used to collect waste in household's shows that 23% and 16.7% (Mkunazini and Vikokotoni wards) of households were using large plastic containers, 54% and 33 % were using small buckets, while 23% and 50 % were using other improvised materials. The observation made in households

on collection and disposal habits were rated, and are presented in Table 1. The FGD shows no specific household member in charge of waste collection, although older siblings usually perform this duty). The waste was placed outside each household for the Zanzibar Municipal Council (ZMC) staff to collect. It is collected in trolleys and disposed of at the Darajani temporary dumping site. There was no ZMC Lorry litterbin located nearby, so the ZMC staff has to carry household waste away to the dumpsite. A similar response was obtained from key informants. In the case of agencies, the observation results show that most employees do not use protective gears during the sorting, shredding, and cleaning process.

Table 1. Mean Ratings for Household and Street observations on the collection of PBTC

Observation	Rating 1	Rating 2	Rating 3	Rating 4	Rating 5	Average
Collection of Waste						
Use of proper dustbin with lid	1.0	1.3	1.2	1.0	0.8	1.06
Use dustbin without lid	2.2	2.5	2.3	2.5	2.1	2.32
Use plastic bag	1.5	1.5	1.8	1.5	1.6	1.58
Improvise materials	0.2	0.3	0.2	0.2	0.3	0.24
Thrown outside of their houses	2.0	2.5	2.2	2.0	2.0	2.14
Disposal site						
Absence of waste around houses	3.0	3.2	3.0	3.5	3.0	3.14
Absence of waste in the streets	2.6	3.0	2.8	2.5	2.5	2.68
Presence of ZMCP waste container	1.0	1.0	1.0	1.0	1.0	1.0
Condition of ZMCP waste container	0.9	0.8	1.0	1.0	0.8	0.9
Separation of waste	0.1	0.1	0.2	0.1	0.2	0.14

Rating scale: 1=very poor, 2= poor, 3= fair, 4=good and 5=very good

Table 2. Household response on domestic waste segregation training, presence of agents, and PBTC as a source of income (n=60)

	Yes, to domestic waste segregation training	No to domestic waste segregation training	Total
Mkunazini Ward	4 (5) [0.2]	56 (55) [0.02]	60
Vitokoni Ward	6 (5) [0.2]	54 (55) [0.02]	60
Total	10	110	120
X² = 0.436, DF=1, p- value = 0.5088			
	Yes, to Presence of purchasing agents	No to Presence of purchasing agents	Total
Mkunazini Ward	1 (2) [0.5]	59 (58) [0.02]	60
Vitokoni Ward	3 (2) [0.5]	57 (58) [0.02]	60
Total	4	116	120
X² = 1.0345, DF=1, p- value = 0.3091			
	Yes to PBTC as a source of income	No to PBTC as a source of income	Total
Mkunazini Ward	54 (52) [0.08]	6 (8) [0.5]	60
Vitokoni Ward	50 (52) [0.08]	10 (8) [0.5]	60
Total	104	16	120
X² = 1.1538, DF=1, p- value = 0.2827			

There were no statistically significant differences in the responses shown at both Mkunazini and Vitokotoni wards

Table 3. Limitations and solutions to separation and selling of PBTC waste

Sources	Limitations	Solution
FGD	<ul style="list-style-type: none"> • Lack of education • No provision of right education • Lack of unreliable market • Lack of equipment • No purchasing agents 	<ul style="list-style-type: none"> • Provision of proper education • Promotion of environmental clubs • Good prices
Key informants	<ul style="list-style-type: none"> • Absence of provision of right education • Lack of proper equipment • No agents in the ward • Lack of unreliable market • Inadequate number of ZMCP staff • Low salary for ZMCP staff and delays in payment of overtime 	<ul style="list-style-type: none"> • Provision of proper education • Salary increase • Reliable market • Prompt payment for overtime • ZMCP should do separation of waste • ZMCP should increase the number of collecting wastes-bin to community
Household survey	<ul style="list-style-type: none"> • Lack of equipment (6)* • Lack of education (17) • Absence of laws (50) • Lack of community awareness (27) 	<ul style="list-style-type: none"> • Supply of equipment (13) • Proper education (13) • Law enforcement (33) • Community awareness campaign (41)
Agencies	<ul style="list-style-type: none"> • Insufficient capital • Insufficient skilled staff • Bad community attitude in the business • Lack of storage warehouse • Lack of support from the Government • High transport cost • Poor education from community and staff 	<ul style="list-style-type: none"> • Proper provision of education on waste management • Provision of a loan without interest • Allocation of warehouses • Government and political support • Improve infrastructure eg roads, electricity supply

**A number in brackets indicate percentage of respondents*

Key informants and participants in the FGD said that PBTC was not separated from other types of solid waste in households or at dumping sites. In the household survey in Mkunazini and Vikokotoni wards, 76% and 67% of households did not separate PBTC; 11% and 0% re-use PBTC, and only 13% 33% separated PBTC before disposal. However, a participant in the FGD said that their household used to separate PBTC from other solid waste, placing it into a separate plastic bag. But when collecting this waste, the ZMC staff mixes the separated and other solid waste, so the household stopped separating their PBTC from other types of solid waste. Another participant in the FGD shared a different experience:

“We don’t separate plastic bottles and tin cans from other waste here during working hours, but sometimes hawkers come by to pick up plastic bottles and tin cans. They confirmed selling them to

agents although the market is not sustainable.”

The municipality has no formal disposal site after they were stopped using the Tunguu site in the Urban West district (following community protests over the poor state of the disposal site). According to the officials, all solid waste should be disposed of at the Darajani Temporary Disposal Site. However, key informants in this study reported that solid waste was occasionally sold to individual citizens who used them as compost or simply dumped on open trenches in the outskirts of the municipality. Key informants estimated that the community generates about one million plastic bottles and tin cans per week in Stone town alone.

3.2 Training on Separation of Solid Waste

ZMC staff, Mkunazini, and Vikokotoni residents had not received prior training on the separation of household waste. But FGD with youth

participants in high schools said that they had been trained on waste segregation in their environmental clubs. However, they only practiced separation of waste at school but not at home. As one participant explains

“We are getting training in our school as our school has environmental and UN clubs which offer knowledge on separating organic matters and inorganic matters from other types of waste. But we rarely practice what we have learned from school, and the separating practice is only limited to our school environment.”

Solid waste agencies and collectors also said that they had not received any form of training. They said that training on waste handling and provision of protective gears are among the key challenges they faced in their daily duties.

3.3 Solid Waste as a Source of Income

Results obtained from the household survey on solid waste training, purchasing, and PBTC's income potential PBTC is shown in Table 2. It shows that greater number of the respondents had not received any type of training on the separation of domestic solid waste. From the survey, an appreciable number of participants acknowledged that PBTC could be a source of income. FGD and key informant interviews showed that households in the Mkunazini and Vikokotoni wards were aware that PBTC waste could be sold and become a source of household income. However, they did not have further information on the purchasing agents and where to find them. All they knew was that there were no formal or informal agents purchasing and recycling plastic bottles and tin cans within the Mkunazini and Vitokoni ward.

3.4 Factors Limiting the Separation and Selling of PBTC Waste – and Possible Solutions

The key informants and participants in the FGD identified a number of factors that limit the selling and separation of PBTC waste; they also came up with possible solutions to this problem. Their input is presented in Table 3, in order of priority. As the table suggests, the key informants and participants in the FGD identified the lack of education on proper PBTC waste handling and disposal practices– in households as well as among ZMC staff –to be the main reason why

domestic PBTC waste is not separated and sold to recycling agents. Education comprises a lack of knowledge on the importance and benefits of engaging in effective waste handling and disposal practices and how to perform these practices.

3.5 Characteristics of Recycling Agencies

Results obtained from the interviews and observations showed that most of the recycling agencies in Zanzibar are small-scale and informal, owned by local people engaged in the initial stage of the recycling process. These agencies have many activities taking place at the site, though they do not have enough permanent staff and enough capital for the sustainable management of the recycling business. The two recycling agencies visited employed about 16 people at the site. The majority of the staff were untrained workers who work daily at a pay of about 4000 Tsh. Productivity from workers is low due to poor facilities and equipment that they use. On average, each of the two agencies processed about 1.5 tons of shredded plastics, which they sell to recycling factories outside the country for processing.

3.6 How Plastic Bottles and Tin Cans are Obtained from Households

The results from the interview with Agents indicated that the formal agents receive plastic bottles and tin cans from pickers and collectors (informal agents), which are picked from households, streets, dumps, and hotels and send to the collectors or directly to the agencies as shown in the Fig. 1. This result was consistent with interviews with the collectors who said that they collect empty plastic bottles and tin cans from the same sources and send them to the agencies. Similar views were obtained from the interview with MRA who argued that they also get plastic bottles from individual pickers and collectors.

The interviews with the agencies showed that they received enough amounts of plastic bottles to satisfy their demands. However, there were cases whereby the agencies and collectors occasionally had to turn away sellers until they sold their stock to the agency Level 2 outside Zanzibar. MRA did not report any cases where prospective selling agents are turned down as he said they continuously buy empty bottles from pickers and collectors.

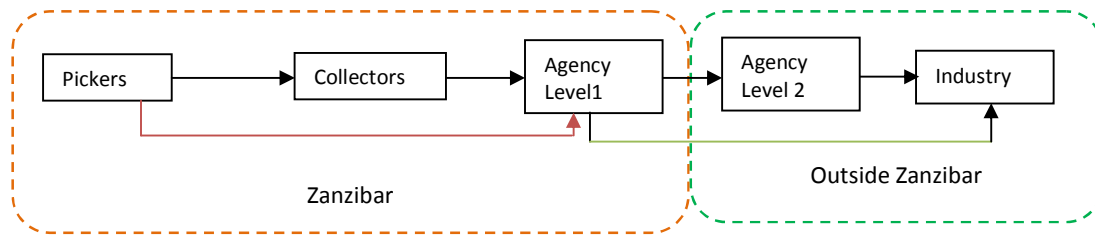


Fig. 1. Plastic bottle and tin cans chain from pickers to the industry

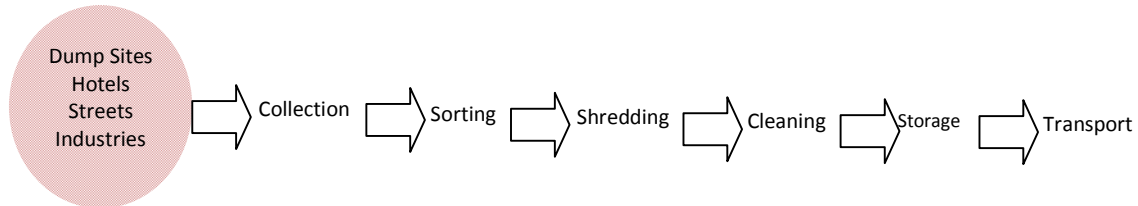


Fig. 2. Recycling process

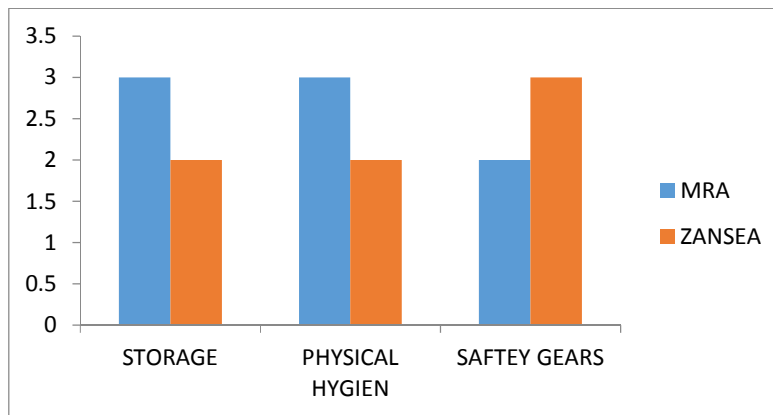


Fig. 3. Observation Results

Key: 1 very poor, 2 poor, 3 satisfactory, 4 good, 5 very good

3.7 Recycling Process

Five stages were identified in the recycling process that is done within Zanzibar (see Fig. 2).

- 1. Collection:** Collection is done by pickers who obtain the plastic bottle and tin cans from different areas such as from the shops, markets, hotels, restaurants, on the streets, and mainly at the dumpsites. After collection, other processes are undergone as described in Fig. 2
- 2. Storage:** Storage is done before and after shredding. Interviews with agencies revealed that there were enough space for storage of plastic bottles and tin cans. However, the results from the observation confirmed that there was no enough space for storage, as

shown in Fig. 3.. Empty bottles and cans were seen scattered everywhere at the sites, and this made the workers have a difficult time finding their way to the machine rooms.

- 3. Sorting:** Plastic bottles and tin cans are available in different sizes, colours, and materials. Sorting process is carried out to categorized bottles and tin cans according to their commonalities and to remove unwanted materials. The respondent from ZANSEA stated, "Some customers mix stones and iron in their bags to increase the weight so that they can be paid more." Researchers observed some employees from both ZANSEA and MRA segregating bottles with respect to the colour, and processed bottle lids separately to improve the quality of the product.

4. **Shredding and flattening:** The sorted plastic bottles are shredded into small chips while the tin cans are flattened to minimize the volume. The interview with ZASEA and MRA indicated that in average, they can shred up to 1.5 tons a day. The results from the interview further showed that sometimes machine shreds hard material like stones which were not seen during separation. When this happened, knives became damaged and consequently caused the machines to stop operating until repaired.
5. **Cleaning and packaging:** Observation from ZASEA showed that after shredding of the plastic bottles, the product containing plastic chips, dust, and sand was sieved to get clean plastic chips. These chips were then **packed** into the bags, ready for transport. However, observation from MRA, revealed that output products were washed, sieved, and dried. Subsequently, the clean chips were **packed** for transportation.

3.8 Factors Impeding Agencies from Penetrating Households Waste

3.8.1 Limited capital and steady market

Based on the interview with a key informant from Zanrec, data revealed that most agencies here in Zanzibar have limited capital to run their business sustainably. This result was also supported by one collector who stated, *"I have ceased collecting and buying bottles as sometimes the agents stop buying the bottles and consequently stick my capital"*. The interview with the ZASEA agency also revealed that the lack of persistent market led them to cease buying bottles and tin cans from both pickers and collectors.

3.8.2 Working equipment

Data from both interviews and observation showed that the agencies use simple machines (shredders), and they were very few, that is, each agency had only one working machine. In interview with ZASEA the respondent stated, *"We provide tools such as masks, gloves, ear mumps and safety boot to our staffs"*. However, the observation showed that the staff was working bare feet, without gloves and other safety materials with little hygienic concern, as elaborated in the Fig. 3.

3.8.3 Neighborhood resistance due to noise pollution

The researchers observed that one of the agencies received a letter of complaint from the Local Government that claimed that neighbours keep complaining about the noise pollution from the machine. This complaint impedes the agency to work during night time.

3.8.4 Lack of clear policy

Interview with the key informants indicated that there is no clear policy that governs the recycling of plastics and tin materials. Consequently households mix empty bottles and tin cans with organic waste. This resulted in pickers and collectors getting dirty bottles and tin cans with a nasty smell.

3.8.5 People's negative attitude

The interview with one collector showed that there is a number of people who believed that reasonable people do not have to collect empty plastic bottles and tin cans. This respondent stated: *"People believe that I'm a madman as I pass on the street to collect empty bottles and tin cans"*. The interviewee further added that *"If I don't ignore their words I couldn't have continued with this job"*.

3.8.6 Lack of reliable power

The interview with one of the key informants showed that lack of reliable electric power impedes running recycling factories. This respondent insisted that failure to have a reliable power is a big challenge to run this kind of business.

4. DISCUSSION

4.1 Waste Handling, Separation, and Disposal Practices

The study provide a clear impression of solid waste management – particularly plastic bottles and tin cans – in the Mkunazini ward. It also showed the presence of scattered plastic bottles, tin cans, and other domestic waste along the streets of the ward. Most residents keep their waste outside their house, and ZMC staff collect it on a daily basis. Observations showed that ZMC does not provide proper containers for storage of domestic waste, so some households

use improvised materials that are not safe and cannot be reused. Poor handling and mixing of different types of solid waste have a negative impact on the environment in the ward, resulting in messy streets and a bad smell everywhere (shop keeper). It may even result in an outbreak of diseases. "A study conducted in Accra, Ghana [12] reveals that home collection of waste is limited to high and certain middle-income areas, while the poor are left to contend with the problem on their own. This leads to indiscriminate disposal of waste in surface drains, canals and streams, creating unsanitary and unsightly environments in many parts of the city". In a study conducted in Thailand [13], Chiemchaisri *et al* reported that increasing municipal solid waste (MSW) generation with a high fraction of organic waste and a common disposal of open dumping have been common practices for many years in Thailand, and more than 60% of the domestic solid waste is disposed in open system. Other workers [14], draw attention to differences in waste generation depending on demographics and other local factors, but most households dispose of essentially similar types of waste. Variation occurs in waste composition depending on income levels and category of sources. Variation also occurs based upon the extent of source reduction and recycling opportunities in Dhaka. Similar results were reported by Nguyen *et al*, [15], showing that the household habits and behaviours of plastic waste discharge without placing in the proper dustbin is resulted to scattered of domestic waste and destruction of environmental.

4.2 Knowledge of Agents and Income Generation

The findings of this study reveal that most of the household informants had not attended any type of training on solid waste separation, which explains why they continue to mix the various types of solid waste. Lack of training was found to be one of the key barriers to better solid waste management in households. However, the absence of formal and informal purchasing agents in Mkunazini and Vikokotoni wards also accelerates the accumulation of domestic waste in this ward. In a study,[4] it was reported that in Madrid, communication campaigns had influenced citizen awareness of what constitutes hazardous waste and how to separate this type of waste properly. Other workers revealed that domestic waste's current separation and recycling provide substantial environmental

benefits compared to a non-recycling alternative [16].

4.3 Limiting Factors for the Separation and Selling of PBCT

Four major limitations for the separation of PBTC were obtained from this study: lack of education, lack of equipment, absence of laws, and community awareness. For example, distance to disposal sites is an issue that can be tackled immediately. During observation, some people were seen to leave plastic bottles or other types of solid waste in the street simply because there were no dustbins nearby and the disposal site was far away. However, the Act of Stone Town Conservation states that throwing waste along streets and pavements in Stone Town is prohibited. Some workers [17] reported that the major barriers to municipal solid waste management (MSWM) in developing countries were the lack of a number of resources: government policies, finances, waste characterization, waste collection and segregation, household education, household economics, MSWM administration, MSWM personnel education, MSWM plan, local recycled-material market, technological and human resources, and land availability. As recommended by workers in Ghana on waste management, the policies to guide the successful implementation of waste management in the community should be supported by public education and the right infrastructure [18]. Similar results were mentioned in this study that the absence of policy, law enforcement, and infrastructure are among major waste management challenges in Zanzibar.

4.4 Different Solutions Concerning Waste Handling, Disposal Practices, Selling and Separation Practices

The key informants in this study put forward a number of suggestions on how to improve the management of PBTC waste. Among the most important were the supply of proper equipment (e.g. wastes containers, wheelbarrows, sterilized collection bags etc), education in separation and disposal of solid waste, law enforcement, and community awareness campaigns. However, such initiatives will only have sufficient impact if they are combined. For example, household awareness campaigns have no effect if households cannot dispose of their waste in proper containers. By-laws on solid waste

management will also need to be enforced to make people realize that they need to change their practices [4]. The need for legislation is supported by a study carried out by Imam et al. [19], which states that a policy and planning framework for waste management as well as consistent enforcement of waste by-laws are required if communities are to adopt better solid waste management practices. Moreover, training of ZMC staff on the separation of solid waste should be prioritized as well (the ZMC staff interviewed drew attention to the fact that unskilled labour is handling domestic waste). Delay in payment of salaries to waste disposal workers also prevent domestic waste from being collected from the streets and households. Finally, if the formal agents and recycling companies that purchase PBTC and other types of solid waste were more visible in the Mkunazini and Vikokotoni wards (e.g. with offices), people's awareness of waste separation and disposal might increase.

4.5 Challenges and Suggestions of Recycling Agencies

This study shows details on the processes involved in obtaining and processing plastic bottles and tin cans for recycling among recycling agencies in Zanzibar and the barriers leading to poor market penetration. According to the present study, separation is always given a priority before shredding to minimize the risk of unwanted objects getting into the shredding machines, which might lead to blocking and damaging the machines and maintaining the quality of the products. This finding corresponds with the results of other studies [20] that found that segregation is important before crushing. However, the reason given from agents that they separate because customers mix other solid wastes such as stones in plastic bottles for adding more weight hence they earn more money is in contrast with the findings of other workers [21] who stated that the problem of separation exist because people are not familiar with all types of plastic material.

The main sources of plastic bottles and tin cans in Zanzibar were given in this study as shops, restaurants, hotels, streets, industries, and mainly from the dumps. However, there is a global tendency to pick plastic bottles and tin cans from municipal waste disposal and dumping sites due to the lack of separation of domestic waste from households. Therefore it is now high time for Zanzibar to adopt formal ways of waste

disposal for recycling to succeed. Interviews and observations with ZASEA and MRA revealed that they washed the plastic materials after being shredded. ZASEA sieved the output to get the chips only, whereas MRA washed, sieved, and dried to enhance quality. Different findings were obtained from other workers [22] who argued that containers and bottles should be rinsed before removing any residue and avoiding odour and contamination issues while they proceeded. However, this deems difficult for the Zanzibar context because of the lack of cleaning facilities in the agencies.

Information obtained from pickers showed that there was a negative attitude towards those picking and collecting plastic bottles and tin cans. There is a negative cultural stigma in communities since most insane people are often seen dirty, collecting and carrying solid waste, including plastics, as they walk around. The collectors were also seen as people bringing foul smells to communities. However, findings had revealed that the collection and selling of plastic bottles and tin cans were seen as purely an economic activity that generates funds for households [23]. So perceptions on collectors in Zanzibar may need to change for separation and recycling of waste to succeed.

Information obtained from the study showed that workers were provided with safety gear such as gloves, safety boots, masks, and ear mumps for safety reasons. However, most workers were not always using those equipment. Similar findings were obtained from some workers who showed that workers were supplied with protective clothing, but they were reluctant to use them [24]. The reasons given by workers as to why they were not using them are many, but negligence and weather discomfort were the most prominent.

There is no clear policy regarding plastic bottle recycling in Zanzibar municipality. This study also showed that there is a minimum involvement of Zanzibar municipality in enhancing recycling. Likewise, a study showed a low percent of district municipality involvement in waste management [25]. However, other workers posited the importance of authorities to support regional network so as to promote waste recycling [7]. Based on the results, researcher are in opinion that maximum involvement and support from the Municipal Council in the recycling process may boost recycling practices in Zanzibar.

5. CONCLUSION

This study suggests that informal resource recovery (recycling) needs to be supported to improve existing practices and integrate them within municipal solid waste management systems. Recycling should also be incorporated at both the implementation and policy levels of municipal waste management. In addition to that, for recycling to achieve its intended purpose, government authorities must play an important role in the promotion and viability of plastics and tin cans reprocessing activities by their approaches to local waste management and economic policies adopted. People must be educated on the need for the separation of waste. Environmental by-laws on improper littering and illegal dumping must be strictly enforced. Furthermore, recovery points can be established to present and collect the used plastic wastes and tin cans for a token. In this case, the plastic and tin wastes become money, and people will be willing to deposit these for some cash. Communities also need to change their perceptions towards waste recycling and start seeing it as a source of income.

CONSENT

It is not applicable.

ETHICAL APPROVAL

Permission was sought and granted from the Second Vice President's office, the responsible institution for all research conducted in Zanzibar with No: OMPR/M.95/C.6/2/VOL.XIII/52

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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