

Solid Waste Management Along Lake Victoria Beaches

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Abstract The production of solid waste materials due to, Uncontrolled growth of beaches in terms of population and structures, have led to environmental and health problems in the area. Although several studies have been undertaken on waste management in general, little has been done on solid waste management in the beaches around Lake Victoria. The objective of this study was to Examine the existing methods used in managing the different types of solid wastes. The study was anchored on the cost-benefit analysis theory. Descriptive cross sectional survey design has been used to collect both qualitative and quantitative data. The target population of the study area was 420 people and a sample size of 189 household representatives was selected for the study. Proportional sampling was used to determine sample size while simple random sampling was used to select individual respondents. Questionnaires, interviews, focus group discussions and observations were used to collect data. The study revealed that dumping of solid waste was the most used method of waste disposal regardless of the type of waste produced. Waste management strategy that promote use of food and other organic wastes, but also leverages on initiatives in reuse and recycling can improve waste management in the beaches.

Keywords Integrated Solid Waste Management, Environmental Hazard, Sampling Techniques

1. Introduction

Cities in the world are facing high levels of pollution. The governments and experts, agree that the dual influence of resource supply and protection of ecological environments is posing a significant challenge to sustainable development of cities in developed and developing countries [1] There has been a tremendous increase in waste generated in the world cities due to a more affluent lifestyle. There has therefore, been a growing concern for increasing level of solid waste generated and poor solid waste management in cities especially in developing countries and those with mixed economies. For instance [4] reported that the Chinese economy achieved faster growth in the cities, but ecological damage and environmental pollution also increased at a high rate. However, it is only recently that the problems of solid waste management in developing countries have been taken seriously. Generally, in most cities in developing countries, solid waste generated remains uncollected on streets [5]. Most of the cities are unable to provide waste collection services to all parts of the city [6]. Just like in inland cities and towns, increased population and human activities in cities and towns located in coastal or beach areas has also resulted into solid waste becoming a major public health and environmental concern for the beach inhabitants. This has

been especially challenging for the beach populations been left to deal with waste disposal on their own [7].

Solid waste generation vary according to geographical space, season of the year, collection frequency, characteristics of the population and extent of generation. Solid waste issue was a problem even before air and water pollution became a matter of public interest. During pre-industrial periods, solid waste consisting of bones, ash from fires, wood, and decomposed vegetables were disposed in pits. However, this later changed during middle ages when population in World cities began to bulge and people did not understand that accumulation of wastes was a problem. Waste materials that could be re-used were recycled while others such as scrap metals were disposed. However, the quality of waste has changed with the advent of technology and invention of new products and services.

The composition and quantity of waste is depended on the culture, geography, income, and other economic aspects in society. In addition, natural situations such as, disasters also contribute greatly to the problem of waste accumulation. During the industrial revolution, tremendous industrial activities led to transitions in economies, which were accompanied by explosion in waste quantities. With time, the capacity to handle wastes became a challenge for most economies due to rapid increases in urban areas, population and industrial activities.

The inability of Municipal corporations to handle wastes has resulted into a trend of involving the private sector and Non- Governmental Organizations (NGOs) in Municipal Solid Waste (MSW) management [10]. There are a number of successful case studies of community and private sector

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participation in solid waste management in developing countries [10]. A study done for waste management in urban Tanzania advocated for a community based waste management approach [11]. In Kenya, county governments are charged with the responsibility of collection and disposal of municipal wastes within their areas of jurisdiction. Centralized solid waste management systems are used by most county authorities like Nairobi, Mombasa and Kisumu. According to estimates from the [14], majority of waste management authorities in developing countries spend over 30% of their budgets on refuse collection and disposal but can only collect at most 50–70% of municipal solid waste and most do not meet environmentally safe msw disposal standards.

Statement of the Problem

Poor solid waste collection, storage and disposal is a threat to public health and reduce the quality of life for residents of urban centres, especially in-unplanned settlements. Beach settlement such as Usege, Uhanya and Mahanga around Lake Victoria are no exceptions and are also some of the typical examples of such unplanned settlements. Those charged with the waste management like county governments and other stake holders have done little to solve the problem of solid waste management in general. Several studies have been done on various aspects of waste management in cities of developing countries and in different types of settlement. However, the beach settlements have not been considered. Their challenges in waste management has therefore remained undocumented in existing literature. This study sought to fill the gaps in knowledge and strategies for solid waste management and propose strategies to address waste management challenges in the beaches.

Objective

To Examine the existing methods used in managing the different types of solid wastes.

2. Literature Review

This section presents literature review on solid waste management from waste types, Sources and disposal.

2.1. Types and Sources of Solid Waste

The quantity of solid waste generated increase with growth of the economy and urban population. In Chongqing China, Urban Solid Waste (USW), is mainly composed of domestic refuse, road cleaning refuse, institutional refuse (official, business, schools, and service industries), as well as a small amount of construction refuse [12].

Solid waste sources are broadly classified into three main categories; domestic refuse (solid waste generated by households, markets, food centers and commercial premises such as hotels, restaurants, shops, etc.); Industrial refuse (not including toxic and hazardous waste that requires special

handling, treatment and disposal) and Institutional refuse (solid waste from various Government and Statutory Board installations, hospitals, schools, recreational facilities and public development projects).

Although the comparison of waste statistics is complex due to the difference in composition, classifications and the manner in which the data may be presented, solid waste composition, for example, in Singapore was found to be quite similar to that in Sapporo, Japan, but very different from those in Yokohama and Osaka, Japan [13] and those in the US [15]. Studies suggest that urban solid waste is composed of plastics, paper, fiber, wood, glass, food waste, metal, and rubber. The proportion of any one type however varies from one study result to another. In a study by [4], food waste was found to constitute the highest proportion at 59.2% followed by plastics, paper, fiber, wood, glass, metal, and rubber. In Singapore, food waste was found to account for about 39% of the total waste stream while paper makes up to 20% of waste. In Sapporo, Japan, food and paper accounted for 46.6%, 25.2% of total solid waste respectively. The composition was reported to be about 40.0%, 35.7% and 37.6% of paper waste in Yokohama, Osaka and the US, respectively; this almost doubles the percentage in Singapore. On the other hand, food waste in Yokohama (9.8%), Osaka (6.5%) and the US (6.7%) is just about one fourth to one sixth of the percentage in Singapore [16].

Source-separation of household-generated MSW is one of the key steps of Integrated Solid Waste Management (ISWM). Source-separated collection means that the MSW is first classified as several different parts such as composting material (food waste), combustible materials (fiber and paper) and recyclable materials (metals and glass). Once classified, these different waste types are then collected and forwarded to the appropriate users. However, [4] observe that source-separated collection at the household level is not yet implemented successfully in many cities around the world, like Osaka in Japan, Bonn in Germany, Cairo in Egypt.

Residential refuse is whereby individual households place their daily refuse into a container near their residences. In China, such refuse is then collected and delivered to the waste collection station by the residents committee or the realty management department. In some instances an agency (for example, the Environmental Sanitary Protection Division of the Administration Commission (ESPDAC) in Chongqing Municipality in China) then transfers this refuse to treatment sites. [16]. reports that in some large residential villages in Chongqing city, the refuse is collected and sent directly to the treatment sites by the real estate company.

2.2. Solid Waste Disposal

Solid waste disposal is the collection and transportation of solid waste to the official disposal site [17]. There are several types of solid waste disposal methods as briefly discussed below.

2.2.1. Recycling

Recycling means the waste generated by a source is sold or given away for reuse or recycling. It makes use of materials that otherwise would become waste by turning them into valuable resources [4]. Recycling helps reduce greenhouse gas emissions, in part, by diverting waste from landfills. In some countries a great deal of recycling occurs before the waste reaches the landfill. Scrap dealers buy directly from households and businesses, waste pickers or scavengers collect materials from waste bins, and waste collectors separate materials that can be sold as they load their trucks [4].

Recovery of resources from solid waste is achieved mainly through recycling, which is mostly practiced by individuals. In a case study of Dar es Salaam in Tanzania [18] notes that recycling provides an opportunity to recover some benefits from municipal refuse, particularly in the form of long term energy and resource savings. At the same time waste recycling prevents environmental degradation and pollution, while useful materials are obtained from what would otherwise be unwanted and offensive materials.

Solid waste recycling takes place in different extents at the source and disposal places, and applies mostly to household and commercial waste. Common items for recycling include paper, plastic, metal and glass. Recycling is also a vehicle for job creation [19].

2.2.2. Composting

Composting is defined as the controlled aerobic biological decomposition of organic matter, such as food scraps and plant matter, into humus, a soil-like material [20]. Compost acts as a natural fertilizer by providing nutrients to the soil, increasing beneficial soil organisms, and suppressing certain plant diseases, thereby reducing the need for chemical fertilizers and pesticides in agricultural and landscaping activities. Organic material often comprises a large portion of the solid waste stream, particularly in communities that rely heavily on tourism. Composting is particularly helpful to communities managing their waste and thus reducing greenhouse gas emissions.

Composting is widely used in Western countries, but rarely used in many developing countries because of several market reasons. Firstly, sorting urban solid wastes is not widely practiced by residents since sorting equipment's are to be purchased first before composting could take place. But equipment cost makes the price of compost higher than fertilizer. Secondly, public acceptance of composting is low, because most farmers have psychological resistance to the products derived from wastes. Thirdly, the usefulness of compost is also limited. The compost has less fertility than the chemical fertilizer. Compost can only be used to grow non-food products such as public green spaces. Such lack of demand causes serious problems for survival of compost companies. Lastly, strict regulations, monitoring and quality standards which prevent pollution due to compost are not adequate; therefore, composting is not a recommended

method [12].

2.2.3. Combustion

Combustion means the controlled burning of waste in a designated facility to reduce its volume and, in some cases, to generate electricity. Combustion is an ISWM option for wastes that cannot be recycled or composted, and is some times selected by communities where landfill space is limited. While the combustion process can generate toxic air emissions, these can be controlled by installing control equipment such as acid gas scrubbers and fabric filters in combustors. Combustion of solid waste helps reduce amount of waste going to landfills [8].

2.2.4. Land Filling

A landfill site, also known variously as a tip, dump, rubbish dump, garbage dump or dumping ground, historically is a site for the disposal of waste materials by burial. It is the oldest form of waste treatment although the burial part is modern; historically, refuse was just left in piles or thrown into pits. There are several types of landfills.

2.2.4.1. Simple Land Fill

A simple landfill is a disposal method in which solid waste is disposed of in a manner that is not environmentally sound. It can contaminate groundwater and soil, attract disease carrying rats and insects, and even cause fires. However, properly designed, constructed, and managed sanitary landfills provide a safe alternative to uncontrolled dumping [6].

Several studies report that in many cities, like, Nairobi, Tripoli, Kinsasa, in developing countries, open uncontrolled and poorly managed dumping is commonly practiced, giving rise to serious environmental degradation. Such dumping activities were observed as practiced in coastal towns, and led to heavy metals rapidly leaching into the coastal waters. In many urban centers, like Mombasa, Kigali, Lagos, in developing countries, MSW are disposed of by depositing it in areas outside the city without following principles that would make it a sanitary land fill hence many such areas are turned into simple landfill [7].

Compaction and leveling of waste and final covering by earth are rarely observed practices at most disposal sites. When such areas are low-lying, studies have found that they are often devoid of a leachate collection system or landfill gas monitoring and collection equipment [21].

Wastes in such sites are often exposed to the natural elements, vectors and scavengers, and susceptible to open burning with only minimal dust removal facilities. Pollution-control facilities are always simple and low in effectiveness. A simple landfill therefore, has serious environmental problems caused by untreated leachate and lack of covering clay. A simple MSW land fill may have a separation, compost and incineration or landfill facilities, but because of cost and market reasons, the compost and incineration facilities are not often in use. Furthermore,

such simple landfill sites tend to be scattered hence do not meet the standards of environmental sanitation. Where the city authorities are able, they are converted to centralized disposal sites through construction of standardized, modern sanitary landfills in order to improve urban solid waste management [4] Illegal dumping implies, that the waste generated by a source is dumped in the vicinity of the source or in a place where such a practice is prohibited, such as at the roadside, in open spaces, in drains, and in valleys.

2.2.4.2. Sanitary Landfill

Because of the harm caused by simple landfills, many countries, like Japan, Sweden, Germany, Israel, have increasingly used new and standardized MSW treatment methods to protect the environment and people's health often called sanitary landfill. Sanitary landfill employs an engineered method of disposing solid wastes on land in a manner that minimizes environmental hazards by spreading the solid waste in thin layers, compacting the solid wastes to the smallest practical volume and applying a cover at the end of the operating day. A properly designed landfill has an earthen or synthetic liner. As waste decomposes, it emits methane, a greenhouse gas that can also cause fire. To prevent fires, a properly designed landfill should have a way to vent, burn, or collect methane. Sanitary landfill operators also recover this methane thereby reducing emissions and generate electricity from the captured gas [19].

2.2.5. Incineration

Incineration and other high temperature waste treatment systems are sometimes described as thermal treatment. Incineration converts waste materials into heat, gas, steam, and ash. Incineration leads to energy recovery and destruction of toxic wastes, for example, hospital wastes. One of the most attractive features of the incineration process is that it is used to reduce the original volume of combustible solid waste by about 20 to 30 percent of the original volume. In some newer incinerators designed to operate at temperatures high enough to produce a molten material, it is possible to reduce the volume by 80–90% or even up to about 5% or even less.

Although incineration may continue to play a major role in the reduction of solid waste volumes in the foreseeable future, a major challenge is the utilization of ashes from incineration plants. However, in countries such as the Netherlands, more than 90% of the annual bottom ash from waste incineration is utilized in embankment and road base applications, while fly ash is also utilized as admixture in the preparation of asphalt filler. In Germany 60% of the bottom ash from the municipal solid waste incineration is utilized in road construction. Incineration bottom ash is also used in the US as an aggregate substitute in road construction and in asphalt pavement [15]. In Singapore, research has shown that incineration ashes may be used as a partial substitute for cement in the manufacture of concrete products, such as paving blocks [13].

The release of toxic substances in the air, soil and groundwater during incineration is of public concern. Salts and acids present in the ashes intensify the solubilization of heavy metals in places of high rainfall, humidity and temperature. But incineration is not very much practiced in many cities like, Moputo, Cairo, Addis-Ababa, in developing countries. Several studies suggest that, this could be due to the high organic material (40–60%), high inert content (30–50%) and low calorific value content (800–1100 kcal/kg), [21].

2.2.6. Other Methods

Other less developed methods includes self-disposal or discharge. This means that the waste generated by a source is disposed of by the source itself within its premises. Typical examples of self-disposal methods are burying of waste in pits and burning. Discharge means that the waste generated by a source is given away to a waste collector or discharged at a certain place from where it could be collected by another party. This includes placing the waste at an approved collection point or in a waste collection truck.

3. Methodology

Study Area

The area of study is located along the shores of Lake Victoria in Kenya, Siaya County; Bondos sub county, west Yimbo Ward. The purposively selected beaches were Usenge, Uhanya, and Mahanga. These beaches were selected because they are in different sub locations that constitute the ward; they are busy in terms of fishing activities and have the highest population in the area thereby producing more waste than other small beaches. There are a total of sixteen beaches in the Ward namely Osieko, Nambo, Siungu, Goe, Wakawaka, Sika, Mtundu, beaches among others.

The study areas has a total population of 420 people and distributed as follows; Mahanga 140, Usenge 110 and Uhanya 420. Uhanya beach has the highest population amongst all the three identified beaches. According to Bondo sub county strategic plan 2005-2010, the population is steadily growing and becoming urbanized. Money circulation and availability is high in West Yimbo Ward in comparison to other Wards in Siaya County as it is well connected to other mainland towns like Bondo and Siaya where economic activities are evident (Bondo Sub County Strategic Plan 2005-2010).

4. Results and Discussions

4.1. Introduction

This section presents the findings, of the study. The information on the general characteristics of the respondents such as gender, education levels and occupational status has been presented. After which the

results and discussions are presented on the basis of the study objective.

4.2. Beach Residents' General Characteristics

The demographic information exploring beach residents' gender has been summarized under this section.

4.2.1. Respondents' Gender

The results on respondents gender shows, that 61.1% of the respondents were female. More female respondents participated in the research compared to men. This could suggest that majority of the residents in the beaches are women. Male participants accounted for 38.9% of the respondents. This relatively low number of males could be because being the ones often directly engaged in fishing, it is possible that some could have moved to the neighboring beaches like Lolwe, Hamaa and Wayasi in search of fish during the time of the study as is common with fishermen. The results however, generally reflect demographic characteristics of the national population of Kenya, where females are more 52.8% than males 47.2%, this is according to 2010 National Housing and Population Census but the result reveal that the population of the females in the beaches is much higher than the national figures. The study also sought to establish the level of education of the respondents.

4.2.2. Level of Education

The results show that the majority- 59.5% of participants had attained primary education. This suggests that respondents value basic education. Only a few (7.6%) have attained higher education. This suggest high dropout after primary school which could be a common problem in beach areas where easy access to money through unrestricted

entry into fishing lead people to drop out of school. The fishing culture seems to entice young people to prefer fishing in order to make quick money than schooling. This is further suggested by only 7.6% and 1.1% who have attained advanced secondary and vocational schooling respectively.

4.2.3. Respondents Occupation

The results shows that majority of the respondents (36.2%) are fishermen. As would be expected, fishing seems to be the main economic activity in these beaches. Fishing as an economic activity does not require any special skills, provided one is energetic and of sound mind. In addition there could be many people engaged in other fishing related economic activities. Fishing is followed closely by those who are employed at 34.4%. These could be respondents engaged in other employment activities including those who do not own or cannot afford to make their own boats and buy fishing gears hence could be employed to work in other people's fishing boats. The result also shows that unemployment level is at 18.4%, which is a reflection of the general high unemployment level in Kenya, although the study reveals that employment rate in the beaches is much higher than the national average estimated at 9.3 percent and projected to reach 10% by 2020 according to a World Bank, (2019).

4.3. Methods of Disposing Solid Waste

Methods of solid waste disposal used in the beaches were investigated by the study. The study wanted to establish if there were any methods of solid waste disposal used and how they relate to the types of solid waste produced in the selected beaches.

Table 1. Solid waste disposal methods (%)

Type of Solid waste	Burn	Bury	Dump	Recycle	Reuse	Compost	Total
Food waste	5	0	89	0	0	6	100
Reeds, hyacinth	14.5	2.7	68.5	0	30.1	0	100
Faecal waste	24.3	2.2	38.3	0	0	35.1	100
Plastic	36.2	2.7	53.5	0	7.6	0	100
Metal	0	0	39.5	15.1	45.4	0	100
glass	1.1	0	52	4.9	0	0	100

The results shows that there are several disposal methods currently being used in these beaches. However, except for metals, dumping appears to be the main method of disposal for all other waste types- 89% for Food waste, 68.5% for Reeds, Hyacinth and Papyrus wastes, 38.3% for Faecal waste, 53.5% for plastics and 52% for glass wastes.

The use of dumping as the main method of waste disposal is perhaps because it is viewed as cheap as it involves no or minimal cost to the user, even though long-term effects are not often taken into consideration. However, observations during the study showed that its use has led the beaches and

the surrounding areas to be very untidy. This was observed to be more so due to the windy nature of the beaches which leads to the wastes being scattered all over. Dumping is a common practice even in other areas and similar findings have been observed in other studies. [16] in a study conducted in 22 cities in four different continents report that open dumps were the most common disposal method. Ceip, (2000), found out that about 95% of solid waste generated was disposed through dumping.

Observations during the study also showed that dumping was the main method of disposal used, as there were heaps of

waste left on the roadside and other open places, this suggest lack of effort by the County authorities or those who provided collection and disposal services. It also suggests lack of effort from the members of the public which could be due to lack of involvement of those who are supposed to educate the beach community on solid waste management.

Burning of solid waste was also reported by 36.2% of the respondents. For most of those who practice burning, interviews and group discussions findings, revealed that some of them dig shallow holes where they collect the wastes and subsequently burn, but others just use open spaces.

Another method that appeared to be common, was reuse of wastes. This was mainly done for metal wastes (45.4%) and for Reeds, Hyacinth and Papyrus wastes (35.1%). Metal waste is reused to make other valuable items like hoes and boxes. The reuse of metals presents an opportunity that could be explored further to help manage metal wastes while generating income for the beach population. What would be considered waste from reeds and papyrus are also re-used as sources of fuel/energy for other economic activities. The linking of waste management with income generation as a strategy in waste management has been seen as a good strategy in other studies [21]. It also suggests that households look at potential benefits when deciding on which wastes to reuse.

Although composting was reported for food waste and fecal waste, further probing during interviews and group discussions did not clearly show how this is practically done. Other studies have documented intensive composting including setting up of composting plants. This is, however, common where there is large production of organic wastes which can be composted and is common in large cities like Mumbai in India. This study did not assess the quantity of food and other organic wastes. Small scale composting is also done in some areas and has been documented in a study by [20].

Recycling as a method of waste management was found to be practiced though at a negligible level for metal and glass wastes as reported by 15.1% and 4.9% of respondents respectively. This however, suggest that waste materials from metal and glass are seen as of economic value. Individuals who participated in reuse reported that they scavenge for these waste materials and sell to scrap dealers who eventually send the same to recycling factories away from the beaches. It suggests the existence of organized scrap waste value chain. Recycling has been documented in other studies and is viewed as a vehicle for job creation [19]. The materials recycled includes, plastic, paper, metal, glass, organic, battery, electric and electronic wastes. It was further, observed that when citizens receive information about the benefits of recycling, how to sort the waste and they participate in designing of the programs, they are more likely to participate in recycling. This little effort could be scaled up, to act as a possible source of income for the beach households. The quantity and availability of such metals or glass wastes will nevertheless determine whether such a venture would be profitable. This study did not look at

quantities of various types of wastes generated.

Waste recycling and composting form a major component of a sustainable waste management system in addition to waste reduction [17]. Waste recycling appeared to be practiced at only a small scale level suggesting that the beaches are still far from sustainable waste management.

The data shown in table 1 were analyzed further to examine if there was a relationship between type of wastes and the methods of waste disposal. The null hypothesis was that no heterogeneity would exist between type of waste and method of disposal.

Table 2. The relationship between type of waste and method of waste disposal and results of χ^2 analysis on heterogeneity/association between waste types and their disposal

Disposal Methods	Respondents reporting types of waste.		χ^2, p
	N=189	(%)	
Burning	28	14.8	$\chi^2 = 110.96$ $p < 0.0005$ DF = 6
Burring	21	11.1	
Dumping	76	40.2	
Tractor	10	5.3	
Recycling	17	8.9	
Reuse	22	11.6	
Compost	15	7.9	

From the analysis in table 2, There is no evidence that the methods of disposal show heterogeneity ($\chi^2 = 110.963$, $p < 0.0005$), these means that the observed frequencies are not similar to the expected frequencies. Hence it can be concluded that no relationship exists between the categorical variables and that all waste are disposed using the same methods.

5. Conclusions and Recommendations

5.1. Conclusions

Several studies have been done on various aspects of waste management in cities of developing countries and in different types of settlement. However, the beach settlements have not been considered.

The study looked at the various types of wastes found in the selected beaches. It was established that the main type of waste in these beaches are domestic refuse (solid waste generated by households, markets, and food centers and commercial premises such as hotels, restaurants, shops, etc.). Food waste was found to form a significant proportion of the wastes generated in the beaches, although other wastes such as plastic solid waste, fecal/stool waste, glass waste and metal waste were also reported.

The study also investigated the existing methods of disposing the different types of wastes. The study revealed that dumping was the most used method of waste disposal regardless of the type of waste produced. Other methods used were burning and reuse of wastes. Reuse was mainly for metal wastes. The methods currently used in solid waste

disposal in the beaches are not environmentally sound and could easily result in endangering the lives of the residents. Respondents currently burn their waste in open dumping sites or use random open dumping, lacking proper health and safety requirements. None of the forms of waste disposal reported in this study is conducted according to the required standards of the concerned authorities like National Environmental Management Authority (NEMA), consequently the study concluded that there could be a considerable exposure to potential related impacts that result from poor waste management in the beaches, particularly among the people living in close proximity to the dumping sites.

In summary waste management in the beaches is poorly developed, when looking through the waste management stream from generation at household level, which should involve waste separation, storage, collection, transportation and disposal. The study found out that there was no source separation of waste, and where there were storage bins, they were commonly used for both decomposable and non-decomposable waste (no segregation of waste is performed). Where the wastes were taken to, what otherwise, would have been communal collection points where the bins were located, the wastes were just dumped turning what would have been points of collections to dumping sites. The bins hence were not properly managed and no collection and transportation was actively going on. Efforts to organize house-to-house collection has not started in these beaches as concluded by this study. There were also absence of alternative or small scale waste management providers, other than the county government that seem to be doing very little.

5.2. Recommendations

This study proposes a waste management strategy that promote use of food and other organic wastes, but also leverages on already existing, although on very small scale, initiatives in reuse and recycling to improve waste management in the beaches. For this to happen in the beaches, the various types of solid waste produced should be separated at source to allow any economically viable utilization to take place. Once food waste, plastic waste, metal waste and glass waste are segregated it may be easier for the waste to be utilized. For separation to take place, there is need for sensitization and awareness creation among the beach residents on the benefits of separation and the economic uses that waste can be put to. Public awareness can also alleviate some of the problems especially the littering phenomenon if the beach population are made aware of the potential health impacts of unmanaged wastes.

Alongside awareness, there is a need to develop a system for enforcement of final disposal of solid waste in the beaches in order to reduce and possibly end the random open waste dumping practices. Littering should be prohibited in the beaches.

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