Design an Effective Solid Waste Management Model for Sri Lankan Context

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Abstract

The purpose of this research paper was to design an effective Solid Waste Management model (SWM) for Sri Lankan context based on current Sri Lankan Solid Waste process. In line with that, researchers have observed generation, collecting, controlling and get recycled outcome on solid waste. The increasing solid waste generation has become an important issue in recent years due to the uncontrolled growth of the urban population and industrialization. In Sri Lanka, urban solid wastes heap up on the roads due to improper disposal system and this higher level of waste generation in Sri Lanka is happening due to increased consumption patterns. Applying the case observational method, researchers designed a model which is capable for managing solid waste in Sri Lanka. The model that identified in the study is an effective solid waste management process to manage improper solid waste disposal. Through a substantial literature review on different types of waste management models, researchers observed current solid waste recycling models and identified significant phases in the available SWM practices in Sri Lanka. Significant phases on SWM like; waste collection, transportation and disposal methods have been depicted in the developed model in the study. The model provides important approach for policy development in the country. Also the model lead the companies to have a supportive strategic decisions and develop RRR businesses and lead the households to earn income by selling reproduced solid waste which highlight a sustainable waste management in Sri Lanka.

Key words: Solid Waste, Solid Waste Management, Recycling, RRR businesses

Paper Type: Model Development.

Introduction

In a rapidly urbanizing global society today, solid waste generation become a key challenge faced by the entire world. Relating to the solid waste extent in the world, there is 1.3 billion tons per year solid waste generating in today which will

be leading to 2.2 billion tons per year by 2025 (Tata, et al., 2012). According to Tata, et al., (2012), it is projected the annual global cost will rise from $ 205 billion to $ 375 billion. Further, developing country are , already coping with rising populations, financial resource scarcity, and limited resource availability to manage environmental issues, that they will require to deal with by 2025. Moreover, different phases like systematic control of generation, collection, storage, transportation, source separation, processing, treatment, recovery and disposal of solid waste reflect the real mean of Solid Waste Management (SWM) practices (Anon., 2015).

In today world most waste is generating by human activities, which pose risk to the environment and to public health. Nathanson,(2015) have revealed that improper disposal of municipal solid waste (MSW) can create uncetainity conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne diseases which are spread by rodent and insects. On the other hand one to two thirds of the world solid waste generations is not collected by any responsible parties (World Resources Institute, 1997).

Figure 1: *Solid Waste can be harmful to human and animal health*

As a result , the uncollected waste, which is often also mixed with human and animal excreta, is dumped indiscriminately to flooding , breeding of insect and rodent vectors which spread of the diseases (UNEP-IETC, 1996). Since solid waste is creating damage for human and animal life managing solid waste is a typical problem needed to address. Considering above facts there is a problem behind those issues. Considering the Sri Lankan context, the issue of Municipal Solid Waste is most acute in the Colombo municipal area and in the suburbs of Colombo (Bandara, 2011). In line with that, objective of this paper is to investigate how SWM practices apply in Sri Lankan context.

Most of the municipal solid waste generated in low income level Asian countries collected and dumped on land in a more or less uncontrolled manner. Because of that throughout the cities it is the urban poor that suffer most from the life – threatening conditions deriving from deficient SWM (Kungskulniti, 1990; Lohani, 1984), since municipal authorities tend to allocate their limited financial

resources to the richer areas of higher tax yields where citizens with more political power reside (C.Zurbrugg, 2003).

Disposal of solid waste is a significant environmental issue in Sri Lanka which becomes a national level concerning fact (Wijerathna, et al., 2012). Bandara, (2011) reveals provisions of the Local Government Act, the Local Authorities (LAs) in Sri Lanka are responsible for collecting and disposal of waste generated by the people within territories, furthermore, as per the National Environmental Act of 1980 which was subsequently amended in 1988 provides the necessary legislative framework for environmental protection in the country. Although haphazard solid waste disposal has been identified to be one of the major causes for environmental degradation in the National Action Plan of Sri Lanka, still the most common method of municipal solid waste disposal is open dumping (Perera, 2012). According to Bandara, (2011) daily collection of Municipal Solid Waste in the Sri Lanka is about 2683 tons of waste and the generated amount far outweighs this with almost negligible collection in rural areas of the country. The average MSW generation per day was 0.85kg in Colombo Municipal Council (CMC), 0.75kg in other Municipal Councils (MC), 0.60 in Urban Council (UC) and 0.4kg in Pradeshiya Shabhas (PS) further MSW of Sri Lanka typically consists of a very high percentage of perishable organic material which is about 65%-66% by weight with moderate amounts of plastics and paper and low contents of metal and glass (Bandara, 2011).

SWM is the largest budget item for developing countries, they have inefficient SWM programs, but in developed countries they manage their solid waste in proper way and invest high amount in such programs (The World Bank, 2013). With that fact, it seems that as a developing country Sri Lanka has an opportunity to develop SWM systems.

Relating to the research objectives section two discuss the layout of the study relating to the pertaining theoretical foundations, then section three discuss the methodological aspects employed in the study. Finally, the paper proceeds to discuss the findings, implications and presents some suggestions that required to be addressed in the future.

Literature Review

Solid waste

Solid waste can be defined as the any discarded or abandoned materials arising from domestic, commercial, industrial, and institutional activities in urban areas (Hagerty, et al., 1973). As per the same author, solid waste may be categorized

according to its origin (domestic, industrial, commercial, construction or institutional); contents (organic material, glass, metal, plastic, paper etc.) or hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc.).

Solid waste generation has become an important issue in recent years due to the uncontrolled growth of the urban population and industrialization (Khan and Samadder, 2014). It has direct relationship with human behavior and arose because of human are illegally disposed solid waste in the ground, or burnt at source or dumped in open spaces, streams, or road sides (Mwanza and Phiri, 2013). The remaining fraction is being illegally dumped on road sides, forest areas, river banks and low lying marshes, thereby significantly reducing the aesthetic value of the environment (Menikpura , et al., 2012).

The environmental impacts of solid waste

Municipal solid waste generation rates is increasing rapidly in Asian countries due to the accelerated urban population growth, unplanned urbanization, and increasing economic activities and resource consumption (Menikpura , et al., 2012). According to Manikpura, et al., (2012), waste characteristics vary by country and even by city in some countries; urban refuse in developing countries includes largely foods, vegetables and putrescent matter as well as varying amount of paper, metals, plastics and inert matter such as coal ash or sand.

People clean their houses and litter their immediate surroundings which affect the community including themselves and this type of dumping allows biodegradable materials to decompose under uncontrolled and unhygienic conditions and this also produces foul smell and breeds various types of insects and infectious organisms and lack of sufficient awareness at the grassroots level of the waste generators adds to the problem of littering. As a result there is a serious threat to public health due to environmental pollution (Khan and Samadder, 2014).

However, as a developing country, in Sri Lanka, urban solid wastes heap up on the roads due to improper disposal system and this higher level of waste generation in Sri Lanka is happening due to increased consumption patterns as well as the movement of the people from the rural areas to urban centers (Khan and Samadder, 2014).

In Sri Lanka, industrial solid wastes are sources of toxic metals and hazardous wastes, which may spread on land and can cause changes in physicochemical and biological characteristics thereby affecting productivity of soils (Menikpura , et al., 2012). In refuse mixing, the hazardous wastes are mixed with garbage and

other combustible wastes, also various types of wastes like cans, pesticides, cleaning solvents, batteries (zinc, lead or mercury), radioactive materials, plastics and e-waste are mixed up with paper, scraps and other non-toxic materials and burning of some of these materials produces dioxins, furans and polychlorinated biphenyls, which have the potential to cause various types of ailments including cancer (Menikpura , et al., 2012).

However, local communities, as well as decision and policy makers, are not well aware of the magnitude and severity of the direct and indirect impacts of open dumping with regards to environmental degradation, economic losses and social burdens, or the benefits of improving existing poor municipal SWM with appropriate technologies (Menikpura , et al., 2012). If waste is unmanaged, it becomes a source of contamination and disease and proper waste management is needed to reduce health problems, water pollution risks and other environmental hazards, besides the negative aesthetic impacts (Mwanza and Phiri, 2013). Same author has reviewed Integrated SWM (ISWM) is a comprehensive waste prevention, recycling, composting, and disposal program involves evaluating local needs and conditions, and then selecting and combining the most appropriate waste management activities for those conditions.

Solid Waste Management

The prior studies done based on the developing countries context, recognized specific solution to the solid waste called as SWM (Henry, et al., 2006). According to Henry, et al., (2006) SWM reduces or eliminates adverse impacts on the environment and human health and supports economic development, improved quality of life and key to providing a livable environment for the future and SWM encompasses the functions of collection, transfer, resource recovery, recycling and treatment.

Solid Waste Management Models

Prior studies have addressed the waste management model development which mainly focuses on city councils and other organizations involved in the management of waste. This study is based on identifying a SWM process model based on SWM practices in Sri Lanka. Researchers selected effective SWM models and identified significant variable in those models. Based on those significant variables and current Sri Lankan waste management process researchers intended to design effective SWM model in practical scenario.

There are different SWM models, considered in the study, the first conceptual model studied within the study is, BCC ISWM (Conceptual Model of Bulawayo

city council integrated SWM system) by Mwanza and Phiri, (2013). This model focus on waste type which is a determinant of the waste receptacles, collection, transportation and disposal methods which are depicted in the model. As per the author, the model is based on integrated SWM system. This model provide easy access to data for the formation and implimentation of effective SWM polices, strategies and programs to achieve sustainable waste management.

BCC ISWM model is designed on the basis of different waste types generated from different sources of community. The different sources of waste are the residential areas, industries, commercial areas, institution, farme and construction companies etc. Generatated waste of these sources can be catogorized into domestic waste, industrial waste, toxic waste, biodegradable waste etc. The waste is separated at the source and stored in specific waste receptacles, it will be easy to transport waste to the designated disposal ares and waste can be treated by various ways to recover material. This includes energy recovery from industrial waste, compost from bio-gradable waste and recycling by both households and industries. This model provides a clear undestanding of waste management process (Mwanza and Phiri, 2013). Based on this model researchers identified variables are waste generated sources, waste types, stored, transport, disposal and recycling.

Researcher studied another model was Krakow and Stockholm MSW management models in Poland (Stypka, 2007). The Krakow has a recycling program with 150 recycling banks located around the town. They are prepared to collect metal, paper, PET bottles and glass. Additionally, there are the "bring and earn" recycling centers where one can bring recyclables and collect money. These centers are mainly used by scavengers and by industry located within the city limits. The composting facitily processes the green waste seperatly collected in the city. This is from the open markets and the food and tobacco industry located in the city. Textiles waste is separately collected by the charity organizations. Stockholm city waste disposal system is far more technically advanced and developed than in Krakow. The recyclables can be collected at Kerbside plus in 300 collection banks or in the three recycling centers. There are also 22 household hazardous waste collecton stations, and small composting and anaerobic digestion plants. Land filling is seen as the last resourse and used only for 6% of the waste stream (Stypka, 2007). Based on these models researchers identifyed variables are recycling banks, waste collect, recycling, composting and land filling.

The final model studied was the easy waste model, this model divided into three main parts for user input; 'waste generation', 'waste collection' and 'waste treatment, recovery and disposal'. Under the waste generation part the amounts and composition of waste are defined. The waste is defined by material fraction and the chemical and physical properties may be modified. The collection system is defined initially by defining source separation fractions and efficiencies, secondly by defining the fuel consumption for waste collection. The third part 'waste treatment, recovery and disposal' is the largest user part to be conducted. In this part all routings of collected waste collection fractions to desired treatment methods are chosen. Final treatments that do not leave any residues are remanufacturing of materials (ex: paper and glass), reuse of biomass on arable land and land filling (Kirkeby, 2005). Based on this model researchers identified variables are waste generation, waste collection, waste treatment, recovery and disposal.

Benefits of effective SWM model

By using this type of effective SWM models help to ensure financial sustainability of developing countries. Zotos, et al., (2009) said consulting and training activities on sustainable waste management targeting local communities and specific target groups should become a priority in order to support related initiatives and financing such actions through competitive external projects is an option that should be further exploited by LAs to a much larger extent, something that requires significant investments in human capital and resources.

Hai and Ali, (2005) said experts have suggested that a community based SWM system involving recycling and composting in conjunction with sanitary land filling with possible provision for transfer station to account for long distance of landfill sites may be the possible way out of the current inefficient system.

When focus our attention to SWM practices we can't avoid benefit of society due to this scenario and we have to carry out some rules and policies to motivate people for reduce the undesirable adverse impacts of overflowing of waste bins and accumulated wastes on road sides, strict rules must be applied on the management related activities and the level of public awareness should be increased (Hai and Ali, 2005).

Methodology

Methodology section devoted to discuss about the designing an effective SWM model for Sri Lankan context. In order to achieve the objective of the study,

which is to investigate how SWM practices apply in Sri Lankan context, researches firstly observed current solid waste recycling models and identified significant phases in the available SWM practices in Sri Lanka. Then researcher observed Sri Lankan industry and identified the companies which are practicing SWM systems. Researchers used case study comparison method for compare those cases. Using these method researchers compares two cases and identified common SWM steps and differences including in those cases.

Population, Sample & Data Collection

For the purpose of collecting data for the study researchers considered all SWM practicing businesses in the industry. Applying the snowball sampling technique, ten companies were identified for the data collection purposes from CMC and their main collecting centers, dumping places as the sample of the study.

For the data collection purpose researchers applied various methods within the study. With that, researchers visited the selected companies to collect the primary data through field visits, observations of processes and semi structured interviews conducted with various stakeholders in selected companies. The secondary data which have used for the study were collected through the published documents by various stake holders of SWM (Solid Waste and RRR businesses) industry. Through the literature review researchers identified different available SWM process internationally.

Observational Analysis

Public Sector

In Sri Lankan context, Sri Lanka has 18 municipal councils, 37 urban councils and 256 Pradeshiya Sabhas. These LAs are sole responsible for SWM within their areas. There are more than 8000 employees employed in SWM in LAs, where they are operating 172 special dumping trucks, 618 four wheeled tractors, 205 two wheeled tractors, 1152 hand carts and 83 other equipment for waste collection (Colombo Municipal Council, 2012). Colombo district in the western province selected for the study because of the Western province is responsible for more than one and half of waste production in the country and Colombo is the largest waste generated district in Sri Lanka (Colombo Municipal Council, 2012).

Accordingly first case of the study, Greenpath is one of the community based waste management center which managed by CMC. The center collects the non-

biodegradable solid waste (paper, plastic, polythene, glass). There are twenty employees currently working here. Majority of them work as waste collectors and three of them responsible for waste separation and selling for recycling. The center mainly doing waste collection and waste sorting and sell those to third parties those who are engaging with recycling processes and act as intermediary waste collectors. Collection center has built three counters for different types of waste, if any one needs to dump their waste directly to the center they can use the separated collecting counters in the center. Then they separate the collected solid waste into paper, glass, polythene, metal, plastic etc., and they directly sell portion of it to the recyclable collectors. Greenpath center can identify as the collector of large volume of non-biodegradable waste and selling them to intermediary waste collectors.

As second case of the study, Torinton collection center which manage by CMC, provide recyclable waste collections and separation facility for recyclers and large scale waste suppliers. This center is larger than Green path center. This center collects recyclable waste from Kirulapana, Thummulla, Borella and BMICH etc. Collected waste of the center already separated by the residents. Hence, Torinton center is a simple solid waste collector. Torinton center collect waste which already separated at the source.

Comparing Torinton collection center with the Green path center, both centers are collecting solid waste and selling recyclable waste. But Torinton center does not sort solid waste while Green path separated waste after collecting.

According to third case of the study, Karadiyana waste management project direct by the CMC. It situated at Thumbovila area of Kesbewa divisional secretariat and it comprises 25 acres. This project is creating as common waste disposal center which disposes waste from government institutions. 50MT of waste dumping to the Karadiana land per day and 230 waste loaded vehicles are arrived. The center charge SLRs.500 per MT from the LAs for its dumping service, and ad-hock service charge based on the volume from any private person or organization that dumps their waste into site. Daily collection of waste is pushed into 6 lots while removing the non-biodegradable and recyclable waste from it. These lots are keeping for more than three months to be converted into compost. After three months compost are rising and the power form of compost are packed as organic fertilizer for selling. Remaining big particles should be crushed and make in to powder form compost. The recyclables collected by the waste are stored and sell to third party waste collectors. The main function of

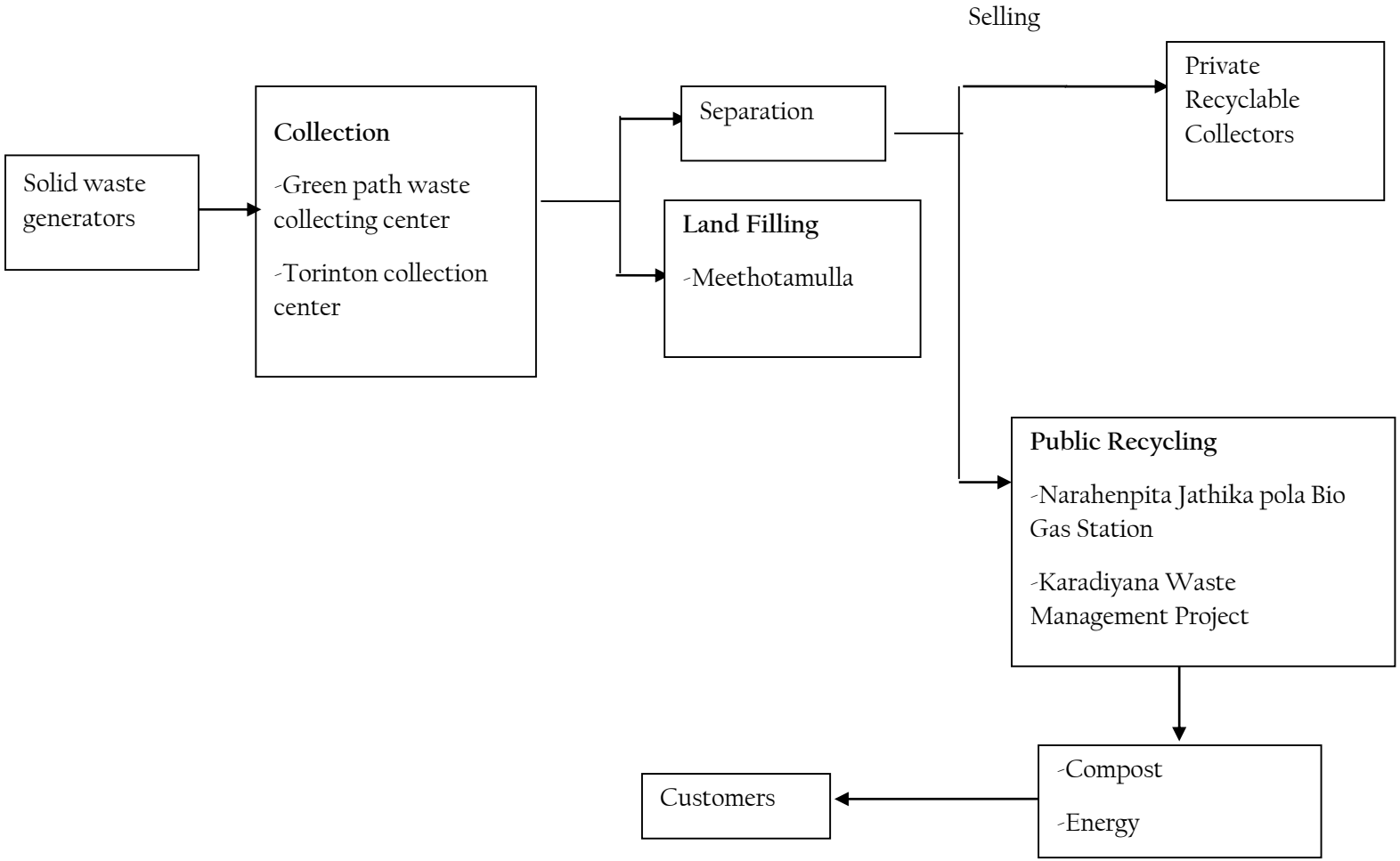
the Karadiana center is composting. As well as they selling collected recyclables to third party.

Forth case of the study is Narahenpita Jathika pola Bio gas station project generate biogas electricity which can provide organic fertilizer as the by product. CMC, Sri Lanka sustainable energy authority and National Engineering Research and Development Center have the ownership and responsibility of the project. The generated biogas has been used to generate electricity and by product compost was expected to sell to farmers coming in to the market. Though this expected to generate high biogas volume, this project is not success in currently.

Both Karadiana center and Narahenpita jathika pola biogas project are recycling centers. Karadiana center is collects, sort, recycle and selling recyclable waste. Narahenpita project dumping, composting and sell them to farmers.

Fifth case of the public sector is Meethotamulla Dumping facility which is the largest active dump manages by CMC. In this center, currently no any process going on. It is functioning only as a waste collecting and dumping process. There is no revenue generating model. When comparing Meethotamulla Dumping place with Green path, Torinton, Karadiana and Narahenpita biogas centers Meethotamulla has only dumping facility.

Based on above cases researchers highlighting steps are solid waste generators, solid waste collection, land filling, separation, selling waste to private recyclable collectors, public recycling, sell public recycling output to the customers.


Selling
Solid waste generators
Collection
-Green path waste collecting center
-Torinton collection center
Separation
Land Filling
-Meethotamulla
Private Recyclable Collectors
Public Recycling
-Narahenpita Jathika pola Bio Gas Station
-Karadiyana Waste Management Project
-Compost
-Energy
Customers

Private sector

According to researcher's observation there are private solid waste collectors as well. As the sixth case of the study, Piramal Ceylon Glass Company is the only existing large scale glass manufacturer in Sri Lanka. They are the one and only buyer of glass related waste for entire Sri Lanka which has the capacity to recycle almost all glass waste collected in Sri Lanka. There are three types of materials inserted for glass manufacturing, silica, dolomite and waste glass. Waste glass is the other material use in the manufacturing process the volume of waste glass used helps to reduce the material cost as well as the energy cost. Piramal glass needs to collect large volume of waste glass for their continuous production process. They have no their own suppliers, anyone who can bring the waste glass to their Horana plant. They collect waste glass from CMC and other LAs. However they are the only waste glass buyer in Sri Lanka. Their current production process adds 35% waste glass; it can be increased up to 70%.

Neptune Recyclers is the seventh case of the study business which researchers selected. It is situated in Sedawatthe, Wellampitiya over twenty years ago. Neptune papers is the pioneering company in paper recycling and waste management sector and current market leader in exporting waste paper. They have involved in the collection, shredding, recycling as well as exporting of other recyclable waste, thereby provides a total recycling solution to their clients. Neptune papers collects waste papers and other recyclables using their own vehicles from all parts of the country. They promote waste collection as a service for the places where collected paper waste has become a problem. After collecting waste papers, they are weighted and stored. Then it sorts within the store for 11 different categories. The remaining which do not come under papers such as linen, polythene and plastics are been sent to the other recycle plants situating in the area. The sorted papers are again stored in the store rooms until they process further. After the sorting process papers are shredded in to small pieces, bleed and stored until ship. Remaining papers also bleed and stored. The environmental impact of waste paper recycling is also high as it reduces the dumping and reduces the carbon dioxide emission. To sustain in the market Neptune recyclers should expand their recycling modes such as plastic, polythene and e- waste.

Both Piramal Glass and Neptune Recyclers use solid waste as their material and produce recycled product and sell them. Piramal glass use glass waste and Neptune use waste papers.

The eighth case is Poly-cycle (Pvt) Ltd is stared in year 2000. It is the largest plastic film re-cycler who located their main factory in Angoda. They manufacture and printers of plastic films in sheets, rolls and bag in Sri Lanka. Poly-cycle Limited collects non degradable waste polythene film and does storing, segregation, grading, washing, drying, crashing and agglomerating. They collect waste/scrap polythene from over 300 direct individual collectors, local governments and from large organizations. Collected polythene sent to stores and unnecessary parts from the polythene are removed and dumped to the government owned dumping centers. Polythene are shredded in to small pieces and same time the moisture is also been removed from the polythene. Poly-cycle is a leader of recycling polythene films in Sri Lanka. This business makes a significant impact for the environmental aspects as it recycles the waste polythene of households' government authorities and large scale industries.

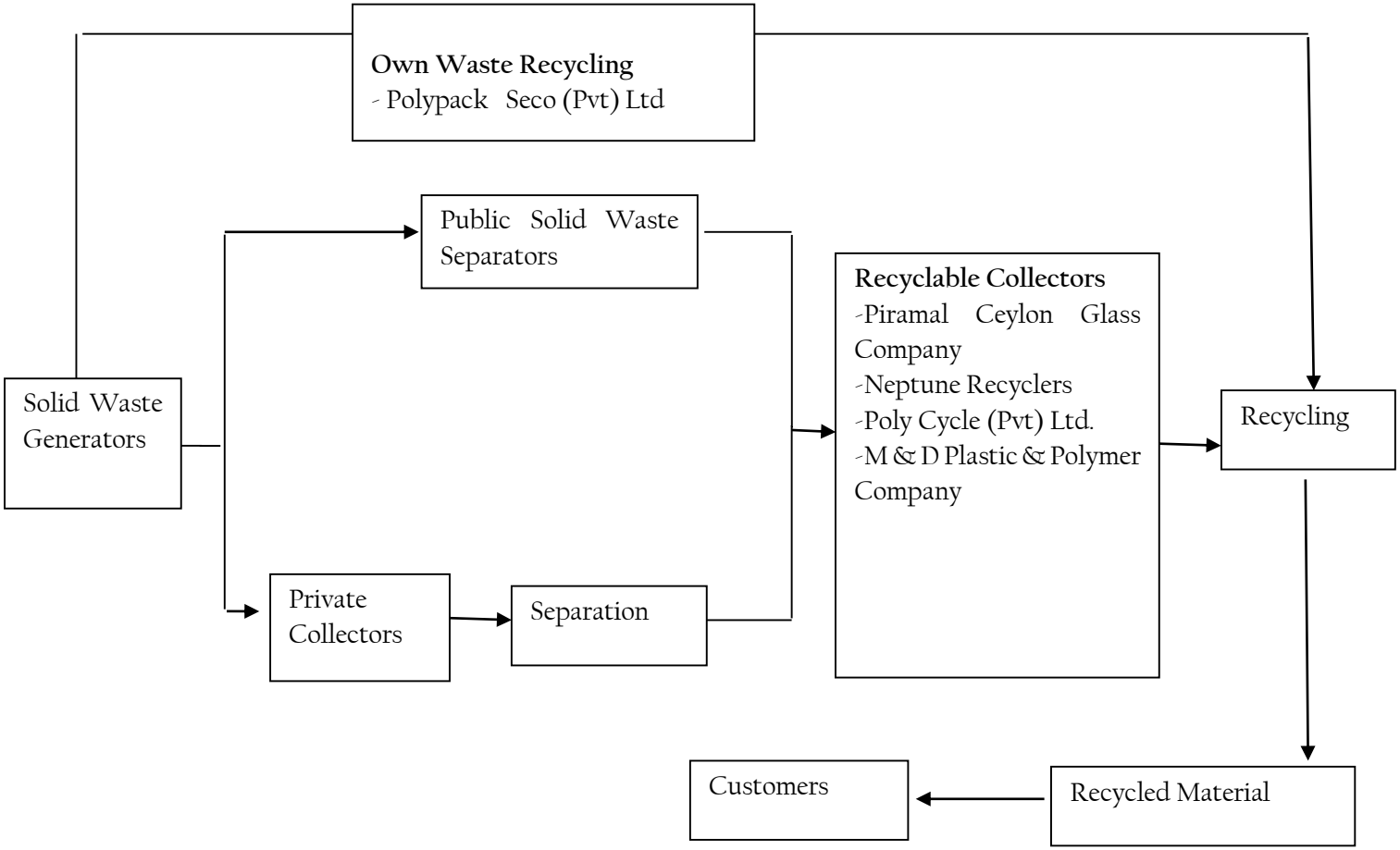
Polypack Seco (Pvt) Ltd is the ninth case of the study which is situated in Kaduwela and they produce plastic and polythene products and recycle the waste that is generated from their production. Waste is generated when there are breakdown machines while processing and during the plastic production waste is generated when cutting in to small pieces. They can increase its capacity by buying waste from the collectors recycled them and sell to the market. This gives positive environmental impact. They recycle waste to make material for their plastic and polythene production, it reduce their total cost.

Comparing Poly-cycle with Polypack Seco, Poly-cycle sell large portion to its mother company and Polypack use waste generated from its own production and after recycling that waste they use to manufacture company products and sell some of them to other producers in Sri Lanka and finally can produce consumer products.

Final and tenth case of the study is M & D Plastic & Polymer Company have started ten years ago. They give solution for uncontrolled polythene used by the public. This business is focused on re-construction of polythene by the dump polythene in public roads. M & D collect waste and use polythene from various manufacturing companies, directly buy from intermediary waste collectors and collects throw away waste polythene on public roads. They clean polythene by removing moisture and dust from the waste polythene. After cut and crush the waste in to small pieces and make the pallets. Finally pallets converted to polythene. This private owned business generates income by pallet polythene and constructed polythene.

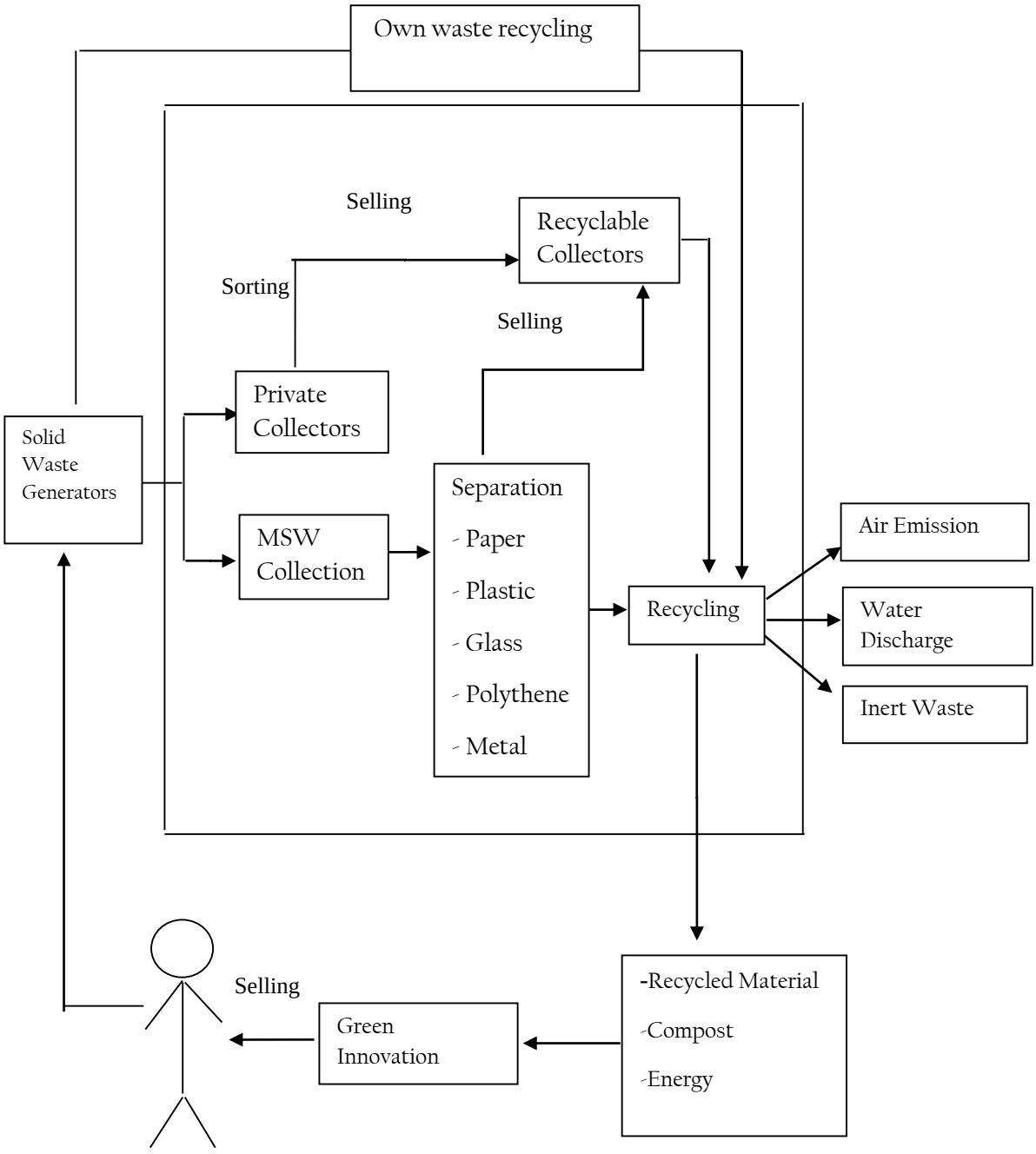
Comparing M & D with other selected private waste collecting businesses they produce polythene by using waste polythene. From collection to producing recycled product M & D have step by step process.

Based on above cases researchers highlighting steps are solid waste generators, solid waste collection, separation, selling to the private recyclable collectors, private recycling, own waste recycling, sell recycling product to the customers.


Own Waste Recycling
- Polypack Seco (Pvt) Ltd
Public Solid Waste Separators
Solid Waste Generators
Recyclable Collectors
-Piramal Ceylon Glass Company
-Neptune Recyclers
-Poly Cycle (Pvt) Ltd.
-M & D Plastic & Polymer Company
Recycling
Private Collectors
Separation
Customers
Recycled Material

According to the study researchers have identified, government and private companies recycling these waste for generate innovative products, compost and energy and they sell these to the domestic users or retailers. When domestic users consume those recycled goods, it generates solid waste over again and this process going as a cycle. By analyzing these details researchers have identified what is common solid waste process in Sri Lanka. Finally researchers have developed this SWM process as an effective solution for the SWM.

Based on above cases researchers mainly identified two sectors in SWM process. There are public sector and private sector. These sectors have some interrelated tasks. Researchers identified processes are solid waste generation, solid waste collection, separation, selling to the private recyclable collectors, private and public sector recycling and sell recycling product to the customers.


Own waste recycling
Selling
Recyclable Collectors
Sorting
Selling
Private Collectors
Solid Waste Generators
MSW Collection
Separation
- Paper
- Plastic
- Glass
- Polythene
- Metal
Recycling
Air Emission
Water Discharge
Inert Waste
-Recycled Material
-Compost
-Energy
Green Innovation
Selling

Conclusion

Unmanaged solid waste is a tropical environmental problem in Sri Lanka. National policy makers also focused about this problem. Through this research the researches have discussed about this common topic. Researchers have observed generation of solid waste, collecting waste and how to manage and get recycled outcome. To achieve the objective of the study, researchers observed the industry and identified the companies which are practicing SWM systems. Ten companies were identified by researchers and collect details from CMC. Municipal solid waste issue in Sri Lanka has reached highest hazardous level of solid waste due to lack of public participation. The entire burden of solid waste handling has been left to LAs most of which are incapable of handling the total amount of waste generated in its area due to financial and resource constraints.

Researchers have noted that number of programs has been taken by the authorities and several governmental and non-governmental organizations to implement integrated waste management practices some of which have been successful such as the recycling centers at bio gas plants operating in the country as Narahenpita Jathika Pola. According to researchers' observations, Sri Lanka municipal councils have resources which are underutilize.

Through the collected data researchers designed a model which has capacity for managing waste. The outcome of this model shows that it can be useful at a number of different levels of society. Further it can be used to government to make policy, companies to support strategic decisions and develop RRR businesses and households to earn income by selling solid waste. However, unless community commitment is obtained at least by providing incentives it is doubtful whether efficient SWM can be achieved in the country in the near future.

Recommendations

- Urban local government authorities are responsible for effective SWM services. So, the appropriate policy and strategic framework needs to be developed, together with technical guidelines on key issues such as organic composting and landfill operations, to properly guide local bodies in effective SWM
- Enhancement of public participation and consultation would be effective in advancing SWM (SWM) practices.

- The researchers identified great potential for resource recovery in Sri Lanka. Therefore reduce, reuse, and recycle of solid waste should be promoted.
- Municipal council can strictly advised people to collect the solid waste separately and they can provide bins for their areas.
- Businesses (recyclable collectors) should build strong relationship with Government and private sector collectors to obtain row materials (collected solid waste – glass, paper, polythene etc.) simply for their business processes.
- Public-private partnership offers opportunities for operational efficiency and cost effectiveness. The role of the private sector will be more important for complex tasks such as the operation of waste collection, sorting, recycling etc.
- Government can extent Green innovation concept in the business world and give rewards for the businesses that follow with this concept.
- Government should create new local and international market place for this recycling waste and provide some quality levels for that production.
- Some companies do not go for the recycling process, because of lack adequate infrastructure, operate in an inefficient institutional set-up, and have limited financial and technical resources. Then government can give financial facilities and knowledge for those businesses.
- Strengthening the capacity of private collectors is essential, as they are mandated to provide SWM services to the people.
- Current poor management practices such as open dumping and open burning should be stopped immediately to allow for more integrated SWM.

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