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**TRANSITION IN WASTE MANAGEMENT: RESEARCH ON RESOURCE RECYCLING  
OF MUNICIPAL SOLID WASTE IN DHAKA CITY, BANGLADESH**

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## **ABSTRACT**

Lappeenranta- Lahti University of Technology LUT  
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**Transition in waste management: research on resource recycling of municipal solid waste in Dhaka city, Bangladesh**

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Social innovation can lead to a sustainable transition. Sustainable transition in waste management needed in Dhaka City as it can adapt to enhance the sustainable environment of city. The research aims to present evidence-based issues in resource recycling, to analysis social innovation and its relation with a sustainable transition, to present the municipality's behavior in solid waste recycling to help in validating how the municipality's actions contribute to environmental degradation and the urgent need for sustainable transition and within Bangladesh to validate the need for a sustainable transition. Data used in answering the research aims and objectives were obtained the use of questionnaires. Besides, the thesis contained information on transition in waste management from existing literature. Primary data collected in questionnaires were analyzed and visually presented in figures using Microsoft office word 2016. Therefore, both literature review, which contained secondary data and questionnaires that had primary data were put into consideration when making recommendations and conclusions. Ultimately, it is concluded that the strategies adopted in the research validate social innovation as a strategy for a sustainable transition. Therefore, recommendations have been from the findings. One of the key recommendations was to adopt an integrated solid waste management model. The ISWM model is the ideal tool for transition in waste management because it gives direction with regards to solid waste management and encompasses the aspects that necessitate the involvement of the society in waste management. Besides, the model vouches for recycling, education and works in hierarchy thereby ensuring minimum wastage.

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In Lappeenranta 22 May 2020

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**ABSTRACT****ACKNOWLEDGEMENTS****CONTENTS**

## Contents

<b>1. INTRODUCTION.....</b>	<b>9</b>
<b>1.1 Background.....</b>	<b>9</b>
<b>1.2 Description of Research Gap .....</b>	<b>10</b>
<b>1.3 Research Aims and Objectives.....</b>	<b>11</b>
<b>1.4 Summary of Chapter .....</b>	<b>12</b>
<b>2 WASTE MANAGEMENT USING TRANSFORMATIVE SOCIAL INNOVATION THEORY .</b>	<b>12</b>
<b>2.1 Introduction to Chapter .....</b>	<b>12</b>
<b>2.2 Conceptual Framework.....</b>	<b>13</b>
<b>2.2.1 Waste in terms of ISWM.....</b>	<b>15</b>
<b>2.2.2 Principles of ISWM.....</b>	<b>15</b>
<b>2.3 ISWM versus Conventional Waste Management .....</b>	<b>16</b>
<b>2.4 Background of the Notion of ISWM .....</b>	<b>20</b>
<b>2.4.1 Technical Aspects of ISWM .....</b>	<b>21</b>
<b>2.4.2 The Latest Approaches in ISWM.....</b>	<b>23</b>
<b>2.4.3 Application of ISWM Tool .....</b>	<b>26</b>
<b>2.5 Social Innovations within Transforamtive Social Innovation Theory .....</b>	<b>29</b>
<b>2.6 Summary of Chapter .....</b>	<b>32</b>
<b>3 RESEARCH METHODOLOGY .....</b>	<b>32</b>
<b>3.1 Introduction to Chapter .....</b>	<b>32</b>
<b>3.2 Research Design .....</b>	<b>32</b>
<b>3.3 Research Strategies.....</b>	<b>33</b>
<b>3.4 Study Context.....</b>	<b>34</b>
<b>3.5 Data Collection.....</b>	<b>35</b>

3.5.1 Data Collection using Secondary Data Collection Methods .....	36
3.5.2 Data Collection using Primary Data Collection Method.....	36
3.6 Sample and Sampling Procedure.....	37
3.7 Administration of Questionnaires .....	38
3.8 Rate of Response .....	39
3.9. Aspects of PESTEL.....	40
3.9.1 Technical Aspects.....	41
3.9.2 Environmental Aspects .....	41
3.9.3 Socio-Cultural Aspects .....	41
3.9.4 Financial Aspects .....	42
3.9.5 Policy and Legal Aspects .....	42
3.10 Summary of Chapter .....	42
<b>4 EXPERIMENT, DATA ANALYSIS, AND DATA VISUALISATION.....</b>	<b>43</b>
4.1 Introduction to Chapter .....	43
4.2 Experiment Description.....	43
4.3 Experiment Execution Details.....	43
4.4 Data Analysis.....	44
4.4.1 Demographic Data Analysis .....	44
4.4.2 Satisfaction rate on the current state of solid waste management among respondents ....	45
4.5 Advance Data Visualization .....	58
4.6 Results .....	59
4.7 Summary of Chapter .....	61
<b>5 RECOMMENDATIONS FOR THE FUTURE STUDIES.....</b>	<b>62</b>
5.1 Introduction to Chapter .....	62
5.2 Recommendations .....	62
<b>6 CONCLUSIONS.....</b>	<b>64</b>

<b>REFERENCES.....</b>	<b>67</b>
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## **APPENDICES**

### **APPENDIX 1: Questionnaire**

### **APPENDIX 2: Questionnaire Dispatch Plan**

### **APPENDIX 3: Facilitator Biodata**

## **Tables**

<b>Table 1.</b> Conventional Waste Management versus ISWM.....	16
<b>Table 2.</b> System Elements of ISWM and Technologies.....	22
<b>Table 3.</b> ISWM features and the selection of waste management technology.....	28
<b>Table 4:</b> Gender of the respondents.....	44
<b>Table 5.</b> Rate of satisfaction.....	45
<b>Table 6.</b> Evidence of seen poorly disposed solid waste in Dhaka.....	46
<b>Table 7.</b> Availability of Plastic bags.....	47
<b>Table 8.</b> How solid waste is disposed.....	48
<b>Table 9.</b> The potential of the municipality to reduce poor solid waste disposal.....	49
<b>Table 10.</b> Effort of the municipality in combating poor solid waste disposal.....	51
<b>Table 11.</b> What the municipality should do on Dhaka streets.....	52
<b>Table 12.</b> Familiarity with transition in waste management.....	54
<b>Table 13.</b> Actions of the private sector with regards to in transition waste disposal.....	55

**Table 14.** Restriction of the private sector from owning landfills.....56

**Table 15.** Government and transition in solid waste management.....57

## **Figures**

**Figure 1.** Waste management hierarchy.....13

**Figure 2.** Integrated sustainable waste management framework.....24

**Figure 3.** Gender of the respondents.....45

**Figure 4.** Rate of satisfaction.....46

**Figure 5.** Evidence of seen poorly disposed solid waste in Dhaka.....47

**Figure 6.** Availability of plastic bags.....48

**Figure 7.** How solid waste is disposed.....49

**Figure 8.** The potential of the municipality to reduce poor solid waste disposal.....50

**Figure 9.** Effort of the municipality in combating poor solid waste disposal.....52

**Figure 10.** What the municipality should do on Dhaka streets.....53

**Figure 11.** Familiarity with transition in waste management.....55

**Figure 12.** Actions of the private sector with regards to in transition waste disposal.....56

**Figure 13.** Restriction of the private sector from owning landfills.....57

**Figure 14.** Government and transition in solid waste management.....58

## **List of Symbols and Abbreviations**

**BEPA** - Bureau of European Policy Advisors

**CC** - City Corporation

**DNCC** - Dhaka North City Corporation

**DoE** - Department of Environment

**DSCC** - Dhaka South City Corporation

**FAO** - Food and Agricultural Organization

**ISWM** – Integrated Solid Waste Management

**JICA** - Japan International Cooperation Agency

**MSW**- Municipal Solid Waste

**SDS** - Secondary Disposal Sites

**SWM** – Solid Waste Management

**STS** - Secondary Transfer Stations

**TSI**- Transformative Social Innovation

**UDS** - Ultimate Disposal Sites

**WM** - Waste Management

## 1. INTRODUCTION

### 1.1 Background

Waste management and sustainability are closely linked. Innovations in society causes changes in the global environment. Therefore, it is vital to put into consideration the role of innovations in sustainable development. To comprehend the linkage, defining the two terms is vital. According to Gutberlet (2008) sustainable development is an emerging paradigm that brings to light new methods of carrying out activities that put into consideration the limitations of the environment and still lead to societal development and the economy. Therefore, Gutberlet (2008) thinks that sustainable development is a form of social innovation. Social innovation, on the other hand, can enhance sustainability by formulating new methods of carrying out activities at the societal level that would affect the people's lifestyle and the economy (Moore, 2008). This would ultimately counter the current trend of environmental degradation and lead to environmental regeneration.

Bangladesh, a third world country that is richly endowed with resources greatly suffers from solid waste management. The potential of the country is dependent on the resources, which when recycled and disposed of in the right manner would lead to a sustainable transition from the present degraded solid waste management status (Moore, 2010). To obtain such a change, the society needs to be engaged and informed on ways of conducting activities. However, resource recycling, which is often spoken of by both Bangladesh government and the private sector, is not efficiently conducted, especially of the many solid waste disposal points spread across the country. To find out social innovations to aid in better ways to recycle for sustainable transition, the need for conducting this research emerged.

Some of the factors for the prevailing poor solid waste recycling in Bangladesh include lack of well-formulated policies that address the recycling of solid waste and the reluctance of the Bangladesh government to look into the matter for sustainable solutions. Bangladesh lacks a properly formulated policy document that discusses social innovation for sustainable recycling of solid waste. The goal of the research is that a study on secondary data on how other nations handle the solid waste with regards to social innovations and the research findings from primary data are adopted by the government and the general Bangladesh population with the view of helping the nation develop sustainable resource recycling through social innovations.

This thesis aims at identifying solid waste recycling state in Bangladesh and the opportunities for sustainable recycling. Thereafter, the solid waste recycling status will be analyzed. From secondary data, findings are used to draw a strong recommendation of what Bangladesh needs to do to ensure sustainable recycling of solid waste.

## **1.2 Description of Research Gap**

Most research on waste management have centered their approaches on the application of the process by local government authorities. The proposals and recommendations that have then been made from previous research were tailor-made for a system where the government had the sole responsibility of waste management. Some of the recommendations revolved around establishing a place where waste collected from urban areas would be stationed and then exposed. Only a few research has focused on the applications of social innovations and technological use to improve the process of waste management. This gap in research makes it challenging for countries that desire to apply the use of technology through social innovations to apply a more robust means of waste management. This thesis provides insight into waste management through the use of social innovation theory in Bangladesh.

To ensure efficiency and a limited time to conduct the research, the research resolved to exclusively focus on resource recycling of municipal solid waste in Dhaka. The technique is aimed at establishing sustainable waste management status in Bangladesh by the use of social innovations in Dhaka. The research is suitable because an analysis of the use of social innovations for sustainable waste management in Dhaka lacks. Therefore, the findings from this research will serve to enrich existing literature on sustainable resource recycling and also bring new knowledge that can be applied to improve sustainable solid waste management in Dhaka.

The research focus is a system transition towards more efficient resource recycling in Dhaka city, Bangladesh. The current Dhaka city population is about 16.78 million in 2019 (Corner and Dewan 2013, 9). Dhaka is a megacity situated in the center of Bangladesh besides the Buriganga River. It is the capital city of Bangladesh and the most populated city in Bangladesh. The density of the population of Dhaka city is about 23,234 per square kilometer within a total area of 300 square kilometers (Corner and Dewan 2013, 9). Dhaka is divided into two-part. One part is under Dhaka

North City Corporation and another part is under Dhaka South City Corporation. Compared with Dhaka South, Dhaka north is well developed and well planned. Dhaka south is poorly managed less maintained as waste dumps leading to blocked sewage drains that increase the births breeding of mosquitos as well as other harmful insects. (Ershad 2014). Due to overpopulation in Dhaka city, the amount of generated waste is also high. They create mainly organic waste from the residential buildings.

### **1.3 Research Aims and Objectives**

An effective research develops specific research aims and research objectives. Gill and Johnson (2010) postulate that the aims and objectives of the research have to be developed efficiently, and in the right framework. This is important because the aims and objectives, in the end, lead to the ultimate goal of the research. Therefore, careful consideration of the aims and objectives makes the research effective, acceptable and streamlined with the opposite opening doors for chaos.

The aims of the research have been carefully developed to ensure the attainment of the research purpose which is validating the role of social innovations in sustainable transition. One aim of the research is to present evidence-based issues in resource recycling within Bangladesh to validate the need for transition that is sustainable. Another aim of the research is to be able to appropriately analyze social innovation and how it relates to sustainable transition. Lastly, the aims to present the municipality's behavior in solid waste recycling to help in validating how the municipality's actions contribute to environmental degradation and the urgent need for a sustainable transition.

According to Stake, (2010) objectives of the research have an impact to the research design and the overall flow of the research. It is vital to mention that the research seeks to show the role of social innovations in sustainable development that majors around resource recycling of solid waste in Dhaka city municipality in Bangladesh. The analysis, therefore, ensures that specific factors are analyzed and they have been presented in the objectives. One of the objectives is to establish that social innovations lead to a sustainable transition. Another objective is to identify some of the innovations that Dhaka can adopt to enhance sustainable transition. The last objective of the research is to make recommendations based on the prevailing trends with the view of showing the need for social innovation to enable sustainable transition.

According to Stake (2010), a research study needs to include queries. Queries enhance the efficiency and effectiveness of research and form the basic research requirements of all researches (Stake, 2010). The overall intended findings of this research is to establish how well the strategies adopted in the research can show the contributions of social innovations to sustainable development in solid waste recycling. Therefore, it is of primary importance that the research has research questions. The first research question is why is social innovation needed for transition resource recycling that is sustainable in Dhaka city? The second research question is what kind of external and internal factors are associated with sustainable waste management in Dhaka? The third and last research question is what kind of necessary measures based on social innovation have already been taken and those that should be taken in the future to achieve efficient waste management?

#### **1.4 Summary of Chapter**

The chapter one is introduced the topic of research and the research gap. Here then research aims, and objectives have been proceeded and outlined. The aims of the research and objectives of the research were important to get the answer to the research questions, which were also presented in the introductory paragraph. Thereafter, a research hypothesis was developed which included two contradicting statements. It has been sought to determine the right statement at the end of the research. Lastly, the chapter included a summary of how the research will be conducted from one chapter to the next.

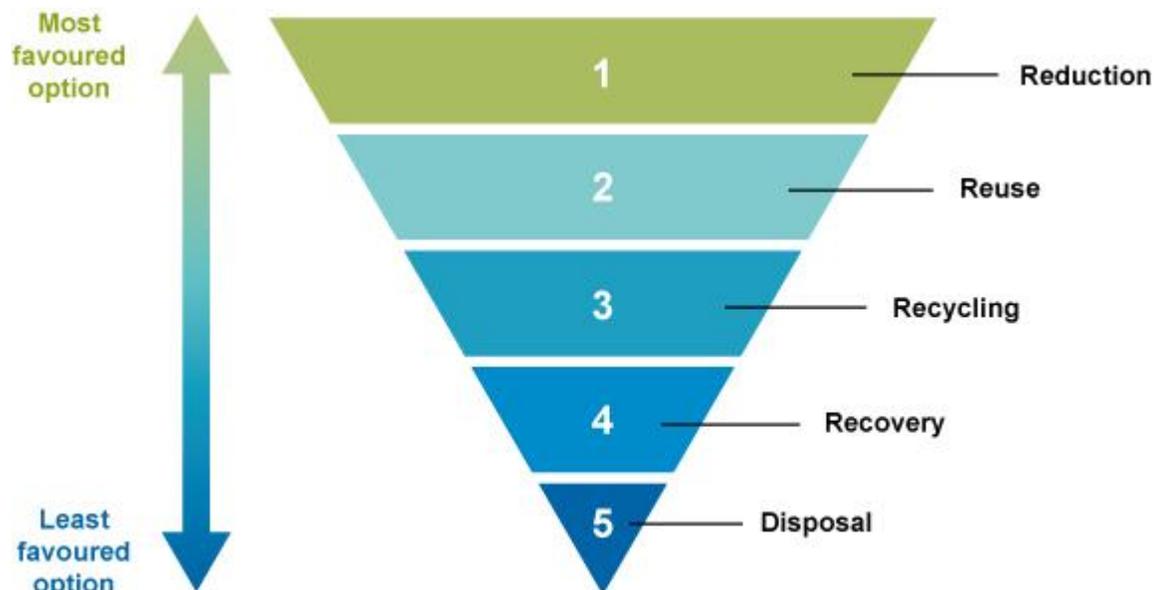
## **2 WASTE MANAGEMENT USING TRANSFORMATIVE SOCIAL INNOVATION THEORY**

### **2.1 Introduction to Chapter**

This chapter begins by discussing the transformative social innovation theory. It will then proceed and delve much in an integrated solid waste management system. Tables and figures will be used in the chapter in explaining ISWM more broadly. This chapter is concluded the chapter by presenting a literature review on social innovations with regards to the attainment of transition in solid waste management both at the societal level and the national level.

## 2.2 Conceptual Framework

According to Campos & Zapata (2014), one of the globally recognized comprehensive tactics for waste management in developing nations is integrated solid waste management (ISWSM). For fifty years ISWM has been put in use in countries of the world and acknowledged by universal organizations, associations, regulators and the academy with diverse explanations. Yet, in all the explanations, ISWM stands for the principle of "integration" of all the three scopes convoluted in the administration of dense garbage. According to Moore (2012), the three scopes are facilities and processes (gathering, carriage, treatment, and removal), stakeholders (service clients, service givers, regulators and governments), and facets influencing administrative actions (monetary, operative, legislative, political, communal and ecological aspects).



**Figure 1.** Waste management hierarchy

*Note: Retrieved from: Waste Investing in energy and resource efficiency, 2011, pp. 9, figure 1.*

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The ISWM is founded in the hierarchy presented in Figure 1. The waste pyramid exhibits a gauge of the most and less favorite choices to control community compact waste. The pyramid can be categorized into three clusters. The first cluster is devices to evade and lessen waste production. The second cluster is actions to inspire separation and to encourage resource consumption by founding efficient systems on the way to the “4Rs”: Reduce, Reuse, Recycle and Recovery

(Hoornweg & Bhada-Tata, 2012). The third and final cluster is the less favored choice. It is ultimate dumping, which primarily is the usage of hygienic scrapyards, and regulated abandons, that are considered as satisfactory choices. Nevertheless, unsuitable choices such as unrestrained throwing away exposed burning and marine dumping should be considered. Hoornweg and Bhada-Tata (2012) assert that those choices are not involved in the hierarchy since they do not carry any environmental advantage to waste service.

In summary, an ISWM system is founded on the values of the waste hierarchy. It should target to transfer the waste upward, to amplify the competence of the waste administration service, proffering appropriate choices to carefully manage waste as a resource. As a preparation instrument for an administration scheme, ISWM contains an extensive variety of aspects based on local circumstances for a specific place. A single strategy cannot be interchangeably applied across nations (UNEP. International Environmental Technology Center, 2009, p. 10). Likewise, a single ISWM aspect cannot also be applied even among metropolises within the same state. An ISWM strategy contains a bundle of laws and regulations, technologies and infrastructures, institutions, monetary mechanisms and a big diversity of stakeholders, which are symbiotic to one another (UNEP. International Environmental Technology Center, 2009, p. 10). The steadiness in the contact of those issues will command the efficacy of the entire administration scheme.

According to Smith (2011), an ISWM strategy has all the actions of waste management, from the user interface, assortment, transportation, separation, treatment, and disposal. Consequently, at the time of devising an ISWM plan, waste figures and information concerning all the aspects stated above are vital to develop a fruitful management system (Jewitt, 2011). Fredericks (2018) adds that world's institutions and global associations have been reinforcing the functioning of ISWM across nations as an instrument to generate sustainability in waste disposal management and to propose an answer to waste management issues and resource shortage experienced by society.

### **2.2.1 Waste in terms of ISWM**

Informally the term waste typically denotes a substance treated as not important, has no value or is no longer useful (Wilson et al., 2013). Conferring to the underlying definition, in nature, waste does not prevail, as everything is declined, everything is recycled or reused into other sequences inside the bionetwork. However, Jewitt (2011) explains that in our civilization, waste appears to be an unavoidable yield of our humanoid schemes, which at the conclusion, has robust insinuations concerning ecological, communal, monetary and legal matters for trades, local authorities, groups, and administrations.

On his part, Wilson et al. (2013) explains that due to sustainability, various human schemes are developed to alter the way waste products are disposed of. One of the methods is using ISMW. In ISWM, waste is considered as both helpful and undesirable, based on its possibility as a source earning or pecuniary value. ISWM identifies that both formal and informal areas that rely on waste as a method of creating revenue. The formal sector contains consumers of waste materials as industrial raw materials (van de Klundert & Anschütz, 2001). An example is the paper, cardboard and metal industries. The informal sector functions primarily in low and middle-earning nations where waste embodies the only free materials that deprived folks might utilize for earnings. The earnings are primarily by selecting and reselling the beneficial supplies originated in the waste flow. Despite this, (van de Klundert & Anschütz, 2001) explains that not all wastes can be acknowledged as decent or resourceful. According to the authors, non-useful suppliers should consider suitable pretreatment and harmless discarding choices.

### **2.2.2 Principles of ISWM**

The Dutch NGO has for a long time applied ISWM in different countries. According to the NGO, each waste management system should be based on four principles which include equity, effectiveness, efficiency and sustainability (van de Klundert & Anschütz 2001, 11). According to the authors, equity stands for entire the society, as waste services should be accessible to all the inhabitants without discrepancy. Beyond the ethical obligation, it is a fact that parts of the urban areas where waste stays accumulated have adverse effects on the air and water supply for the entire town (van de Klundert & Anschütz 2001, 12). According to van de Klundert and Anschütz (2001, 12), effectiveness represents service coverage in which the waste management model should target

to carefully eliminate all the waste and deliver appropriate methods where the supplies are recovered. *Effectiveness* represents the service coverage and resource recovery, where the waste of the precious supplies is recuperated. A WM model is not efficient when only central, commercial and visitor zones are hygienic.

Van de Klundert and Anschutz (2001, 12) explains that it is important that the remote and deprived parts should be given similar attention. This is because efficiency amplifies the advantages of the facility, by enhancing the charges and the resource utilization. A WM is well-organized when the town is correspondingly hygienic, and the whole society disburses ticket dues to uphold the service. van de Klundert and Anschutz (2001, 12) adds that WM can be considered well organized when the management system has satisfactory monetary, mechanical, working and labor resources to function. In the case of sustainability, it relates to the independence of the management system, concerning the usage of resources and how that fits to the local circumstances. van de Klundert and Anschutz (2001, 12) insist that a WM system should make satisfactory usage of labor, equipment and resources, such as air, water, and soil, according to the current and impending obtainability.

### 2.3 ISWM versus Conventional Waste Management

Table 1 shows a comparative synopsis amid the disadvantages of regular waste management and the advantages of implementing ISWM principles into a waste policy.

**Table 1.** Conventional Waste Management versus ISWM.

*Adapted from: UNDESA (2012), Chapter 5 - MUNICIPAL SOLID WASTE MANAGEMENT: TURNING WASTE INTO RESOURCES. p. 8. Box 5.1 Convencional Waste Management versus Integrated Solid Waste Management*

<b>Factor</b>	<b>Typical WM</b>	<b>ISWM</b>
Community well-being and ecological safeguard	Owing to ecological contamination in water, land, and air triggered by inferior WM, the public could be put in danger to:	Encourages the amalgamation of centralized and decentralized treatment choices, which should have efficient arrangements

	<ul style="list-style-type: none"> <li>- Water-borne ailments instigated by overflowing of uncollected trash</li> <li>- Breathing ailments owing to the breathing of downwind from exposed throwing away and garbage burning.</li> <li>- Diarrhea as well as malaria among others, because of the spread of insects in the scrapyards and the existence of leachate in the urban water supply.</li> </ul>	<p>for trapping of impurity and harmful materials (e.g. scrapyards with leachate handling and gas isolation arrangements), to advance competence and diminish contamination.</p>
Public consciousness	<ul style="list-style-type: none"> <li>- Emphasizes on eliminating garbage from eyesight, though little has been done to diminish waste bulks and to inspire isolation at the origin.</li> <li>- WM often depends completely on administrative institutions, thus the private sector and local people have a little contribution to the waste system.</li> </ul>	<ul style="list-style-type: none"> <li>- ISWM inspires stakeholder participation in the waste policy so that the public and the private sector can take part in the waste system.</li> <li>- It also recommends the idea of 'extended producer responsibility' in which, producers must be accountable for the expenses connected with the end of life of its products.</li> </ul>
Value waste	<ul style="list-style-type: none"> <li>- Former rational was that waste is an 'unwanted' substance without value.</li> <li>- Segregation of waste flows is nearly absent. Harmful substances from infirmaries, industrial sites, and small trades are frequently blended with</li> </ul>	<p>- Waste is a resource with pecuniary value. ISWM encourages the principles of resource effectiveness to evaluate waste and to reduce the growing burden in waste management locations.</p>

	<p>MSW, making nearly impractical to deliver appropriate treatment to each waste category and disturbing significantly material retrieval.</p> <ul style="list-style-type: none"> <li>- Precious materials effortlessly spread dumping.</li> <li>-Negligible recycling rates.</li> </ul> <p>Waste collectors and informal sector frequently perform recycling at the production point or in dumping locations.</p>	<ul style="list-style-type: none"> <li>- Integrates the practice of the waste hierarchy. In which waste hindrance and the 4R's are significant.</li> <li>- Suggests well-defined long-term policies to enable recycling of precious substances (for example plastic, glass, paper and cardboard, metals) and encourage energy retrieval (for instance biogas or fertilizer from biological waste, and Solid Recovered Fuel (SRP) from waste segment with high-calorific substance)</li> <li>- Promote the application of an isolated management scheme for perilous waste.</li> <li>- Pursues to tackle the broadening of wastes in which evolving waste streams</li> </ul>
Stakeholder participation	<p>There is negligible involvement of the public and private sectors in the policy-making procedure.</p>	<p>Implement multi-stakeholder Involvement in policy-making and acknowledge their contribution to the waste system. Policymakers, regulators and regional institutes are inspired to guarantee the involvement of NGO's, CBO's, waste collectors from the informal sector, private sector, residential and industrial societies in WM.</p>
Employment conditions	<p>Frequently labors and informal waste collectors</p>	<ul style="list-style-type: none"> <li>- Encourages the application and advancement of waste technologies</li> </ul>

	<p>were vulnerable to acute health hazards for example HIV, tetanus, PCBs, neural injury, wounds with sharp substances, premature drinking, anxiety, and complications in the skin, digestive contagions and respiratory complications. Other communal threats for example child labor are a public matter.</p>	<p>to manage the waste carefully and to amplify recycling and energy generation from waste.</p> <ul style="list-style-type: none"> <li>- Guarantee the application of actions to ensure salubrious and secure employment circumstances in the waste locations.</li> <li>- Pursues the acknowledgment of the informal sector (scavengers /waste collectors) in officially established associations, to outline their responsibility in the waste plan, and acknowledge their entitlement for a reasonable work.</li> </ul>
Service coverage	<p>The service was frequently non-fair. Slums and deprived parts of the town did not have similar community services.</p>	<p>Encourages the implementation of economic and Labor policies to ensure the waste service to all people.</p>
Treatment and dumping	<p>Unlawful throwing away inland, on water bodies, exposed disposal and burning were 'acceptable' ways to manage the waste.</p> <p>Trans-boundary transfer of wastes for dumping was deficient in a well-organized supervisory outline.</p>	<p>Arrangements for treatment and recycling of precious items are extremely inspired.</p> <p>Ultimate dumping is considered as the least favored choice to manage the waste.</p>

## 2.4 Background of the Notion of ISWM

ISWM as a terminology has been developed and continuously improved throughout the past five decades. According to Wilson, Rodic & Velis (2013), in the 1970s, for the very first time, the method of "integration" in waste management turned out to be familiar in education. Ever since, the concept of ISWM has been related in diverse means to the organization of typical waste and dense waste and has exponentially grown its presence (Wilson, Velis and Rodic, 2013). The table 1, abridges the key study methods connected to "integration" in ISWM throughout history.

As can be found in Table 1, most of the "integrations" were mentioning the technical fundamentals, for example, waste streams integration, treatment technologies integration, amenities integration, and more prominently, the WM system integration in a provincial level (Wilson, Velis and Rodic, 2013). Subsequently, in the mid-1990s, the "integration" overturned with significant impact, signifying the presence of the objectives of the waste hierarchy into the management system. The aim was to tackle all the waste difficulties in a distinct tactical proposal where the main concerns are waste deterrence, reusing, and harmless ultimate discarding.

Another significant issue was the initiation of sustainable expansion in the universal program. Throughout the United Nations Convention on Atmosphere and Growth organized in Rio de Janeiro in 1992, Agenda 21 comprised in the dialogues the matters of waste management through the metropolises of the world, particularly in developing nations. In response, numerous global organizations and non-governmental associations with existence in developing nations, started to comprehend that the method of "technical fix" was not adequate to resolve obvious disappointment of the present waste management systems (Wilson, Velis and Rodic, 2013). The World Bank, UN-HABITAT, UNDP and the Swiss Agency for Development and Cooperation imitated a cooperative scheme, where waste management in developing nations was the main concern.

In 1995, during a training organized in Ittingen, Switzerland cooperative scheme demonstrated a consequence to the primary theoretical outline of integrated community SWM in low-income nations that have the triple lowest level of sustainability is comprised (Wilson et al., 2013, 53). In the same year, the Dutch government founded a fresh plan called, Urban Waste Expertise Program (UWEP). The program required NGO WASTE to contribute to the responsibility by constructing a supplementary integrated structure. After six years of study, Van de Klundert and Anschutz (2001) introduced the idea of Integrated Sustainable Waste Management (ISWM), with its systematic instrument and precise context. This tactic was promptly extensively acknowledged

and implemented in developing nations (Wilson et al., 2013). Over time, the idea has been continuing to develop and was perfected with more precise calculation devices. The modern tactics of ISWM have been completed and comprise vital devices such as Life Cycle Assessment (LCA) and the viewpoint of the circular economy, emphasizing the significance of retrieval, and recycling of resources inside the entire supply chain.

#### **2.4.1 Technical Aspects of ISWM**

Williams (2005) explains that technology performs a noteworthy part in waste management. He adds that it is possibly the greatest noticeable characteristic in all the system, and might be the greatest pertinent physical constituent of the organization (Williams, 2005). The technical aspect of ISWM features all equipment and amenities, which are presently in usage or planned to be used for the production of the system's fundamentals (van de Klundert & Anschutz 2001,14). Consequently, this facet includes the varied range of technologies that allows isolation, gathering, move and transport, treatment and disposal of wastes, and the physical mechanisms that assist in elimination, re-use, reprocessing and recovery.

In ISWM, every technology has elements and capabilities that make it superior to others. However, the liking of one option over others is resolved by its appropriateness to accomplish the ambitions agreed in the waste plan. As Williams (2005) posits, a technology is desirable once it accomplishes the greatest ecological and pecuniary performance inside the system, whilst fine-tuning flawlessly with the local circumstances. The management of the mechanical mechanisms inside the outline of ISWM should target to guarantee the sustainability of the system. Schübeler et al. (1996, 49) explains that the supervision of practical characteristics should be: (1) economically worthwhile throughout its entire life-cycle; (2) state-of-the-art and comprehensible once devising the technical systems, so that the accountabilities of the stakeholders are aligned with the system' procedures; (3) ecologically liable, targeting and to advance the situations of the municipal atmosphere whilst diminishing contamination in air, water, and land (Williams, 2005). So, every practical constituent used in SWM, on the whole, should be purposefully strategic, addressing all characteristics of its procedure, upholding, operation and lifespan charges, since all are significant and may command the efficacy of the entire system. An inadequately organized technology may result in a minimal efficacy in costs and overall implementation.

Frequently the technical mechanisms of ISWM are categorized consistent with the system component where they function (Schübeler et al., 1996; Williams, 2005). For example, Van de Klundert & Anschutz (2001) distinguish eight *system elements* which are: generation & separation, collection, transfer & transport, treatment & disposal, and the 4R's. Correspondingly, Tchobanoglous et al (1993) as quoted by Williams (2005, pp. 369-370) recognized six '*functional elements*': (1) waste generation, (2) handling, separation and storage prior collection, which equals to the user interface, (3) collection, (4) Processing and transformation of solid waste, in other words, material recovery and treatment, (5) transfer stations and transport, and lastly (6) disposal. Even if both are nearly identical, both are clustered in to some extent dissimilar means. Therefore, for the current study, the author determined to fuse them both. Table 2, exhibits the system fundamentals with an explanation of the technologies frequently employed in each phase. The technologies and their classifications were pulled out from numerous foundations (Williams, 2005), (Schübeler et al., 1996, pp. 45-49) & (UNEP & CalRecovery, 2005).

**Table 2.** System Elements of ISWM and Technologies.

*Adapted by the author.*

Functional group or system element	Technologies
1.Generation and composition	Total input material entering the waste management system and its classification
2.User interface	Waste containers and collection points
3.Waste collection and transport	Vehicles used in primary and secondary collection
4.Resource recovery and recycling	-Mechanisms for recycling: paper, metals, textiles, and tires
4.Treatment options	-Biological treatment: Anaerobic digestion, composting and animal digestion. -Thermal treatment with energy recovery: pyrolysis, gasification, refused derived fuel (RDF) and combustion -Mechanical and biological treatment (MBT)

6.Final disposal	<ul style="list-style-type: none"> <li>-Sanitary landfill</li> <li>-Incineration</li> <li>-Uncontrolled dumping</li> </ul>
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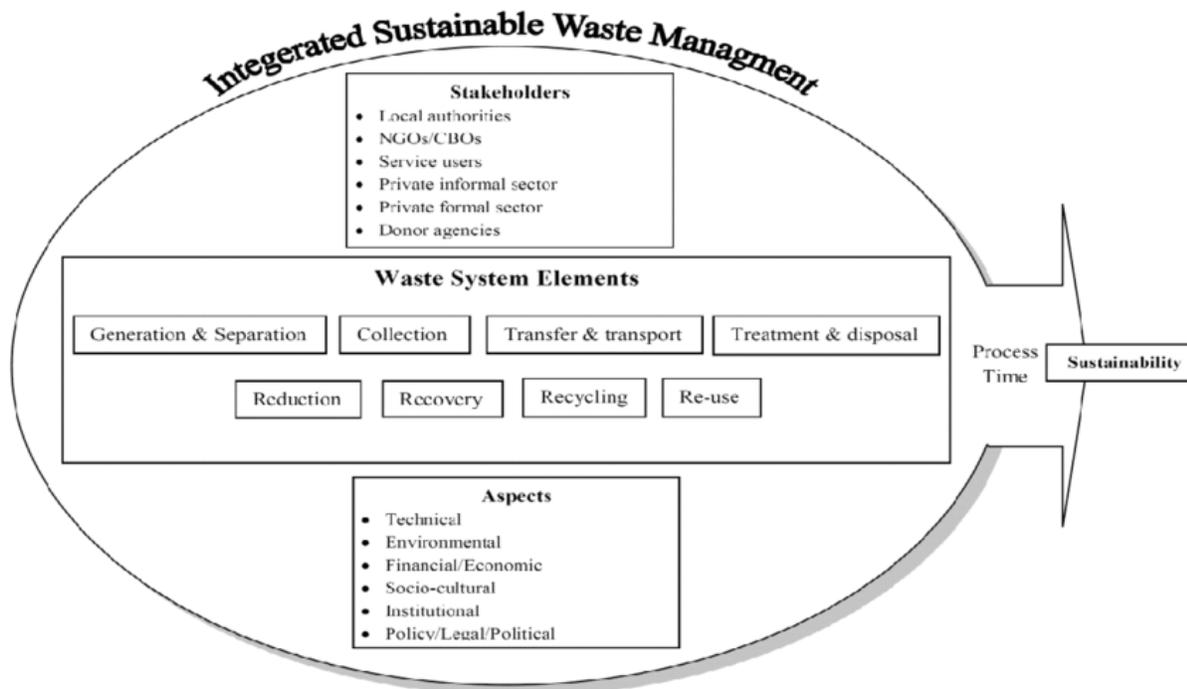
Unquestionably, amenities and technology to treat waste cause noticeably expensive in the majority of the cases. Still, within the context of ISWM, waste administrators and decision-makers are inspired to tackle the waste-oriented matters not only depending on attaining expensive facilities or apparatus but most significantly, executing instruments that permit waste deterrence, lessening and recycling, with the eventual aim to handle with fewer waste volumes in a more well-organized means (Corner and Dewan 2013). Currently, the capability and working lifespan of the facilities have been extremely disturbed by the growing volume of waste, and the nonexistence of appropriate land to construct new facilities, without reference to the growing existence of the outlook familiar as "Not In My Backyard" (NIMBY) amongst the municipal societies. Undeniably, to diminish the monetary load that waste management has turned out to be, metropolises are required to produce new areas of earning to the waste management system (Corner and Dewan 2013). For example, by establishing strong strategy guidelines to encourage waste decline in the supply chain, a more competent resource retrieval, and a recycle-based civilization, not only to produce supplementary earnings but to diminish the burden on landfill spots, and to make available a hygienic, salubrious and more pleasing city atmosphere.

#### **2.4.2 The Latest Approaches in ISWM**

To elucidate, it appears to be pertinent to consider the apparitions for the WM sector. Along the history, waste schemes have advanced from “*waste disposal thinking*” (the disposition and concealing-from-eyesight-thinking) to a “*waste management thinking*”, where the waste flowing to the system was gathered, arranged, treated, reprocessed or reused in the more well-organized manner before 'safe' ultimate dumping (Wilson et al., 2015). Today specialists in the sector request waste administrators to shift from that rational to '*resource management thinking*', in which is crucial to identify the waste as a resource to recuperate its complete pecuniary worth along the supply chain, and aid as well, to diminish the usage of the today's rare raw/virgin resources.

The previous rational in the sector had constantly distinguished the waste immediately an element is abandoned. Nevertheless, the present rational emphasizes in what occurs earlier that, and how to tackle the waste-difficulties from its origin (Ershad, 2014). Considering this, professionals started to pay unusual care to the source of the materials beforehand turning into waste, so it turns out to be obligatory to find out for example, under which circumstances the article was rejected? or how to avoid it?; then if it cannot be evaded consequently, is it recoverable or can be reused? and how should it be accomplished?; or if it is perilous, can it be formed with less harmful materials?, responses to queries identical to these are now just barely begun but are predictable to provide a new significant move to the waste sector (Ellen Macarthur Foundation, 2016). Such a technique of reasoning is acknowledged in modern literature as 'waste and resource management' in the outline of a 'circular economy.'

Initially, the economy has been a straight track of *taking* (natural resources), *making* (products and services) and *discarding* (waste), which has directed us to resource shortage and ecological ruin (Ershad, 2014). The notion of 'circular economy' intends to conclude the circle by enhancing the resource utilization alongside the entire 'value circle', the key values to conclude the circle are: (1) Conserving and regulating the limited supplies and sustainable resources. (2) Redistributing resources inside the supply chain. (3) Promising lengthier shelf life to the products by mending, distributing, renovating and reprocessing. Last of all, (4) offering an ecologically comprehensive waste management system with importance on the 4R's (D. Wilson et al., 2015, pp. 23-24). Figure 2 offers the comprehensive figure of a circular economy system.



**Figure 2.** Integrated sustainable waste management framework (van de Klundert and Anschutz, 2001).

The expression of 'circular economy' in waste management as presented in figure 2, denotes strongly to waste deterrence and resource retrieval in the structure of sustainable production and Consumption (SPC). The SPC structure pursues to advance the method things are constructed, manufactured, packaged, shipped, sold and consumed, to guarantee an aware and efficient usage of resources at the same time as taking into account the sustainability pillars (D. Wilson et al., 2015). In this substance, the part of waste management and its governance should be to encourage the usage of tactical systems in which, businesses can influence and promise to face the waste-related difficulties, by accepting accountability for the edge of the product's decline stage (Ellen Macarthur Foundation, 2016). This certainly takes us to the notion of '*producer responsibility*' that has turn out to be a significant subject for a prolonged conversation in several monetary areas in industrialized nations.

One more influential fact in waste management philosophy, moreover the implementation of circular economy and resource management, is the practice of a life-cycle assessment (LCA) (Ellen Macarthur Foundation, 2016). This method comprises a comprehensive summary from 'cradle' to 'grave' of the resources and goods, which comprises the entire course as the input mining

for industrial, all the way to the product's dumping. LCA lucidly delivers a comprehensive appraisal instrument to transfer in the direction of a circular economy and definitely, assurances to be very helpful for the waste sector, since assistances to examine the supplies stream (inputs and outputs) and their influence on the atmosphere. Despite the fact, all these methods are very lawful and advantageous, not all the nations are equipped for functioning on the way to such aspiring aims. Nations with extremely advanced waste management systems (e.g. Netherlands, Japan and Nordic Countries) are certainly directing the north on the road to all those significant notions. Yet, many situations (especially developing nations) are restrained owing to the early standing of their waste management systems and strategies.

By 2015, low and middle-earning nations are still implementing the *waste-management-thinking*, notwithstanding all their labors, there are still key problems to provide assurance to an entire coverage of the waste gathering service, and to apply harmless ultimate disposal systems to guarantee an absolute elimination of open burning and haphazard disposal inland and ponds, lakes, rivers, and oceans. Municipalities and administrators should perform promptly and proficiently to handle those difficulties immediately. Predictions indicate that, waste quantities will amplify twofold in developing nations in less than 20 years from today because of financial growth and/or populace outgrowth. Some nations are anticipated to have a monetary growth, which will be replicated in an upsurge of the earning per capita and therefore in greater utilization of goods (Wilson et al., 2015). Conversely, some other nations (primarily low-income nations) will have a striking growth in the populace, only 20 years from now the residents are predicted to grow twice as much. Additionally, the importance of developing nations is to continue the intense effort of constructing an integrated waste system with ground-breaking strategies and practices to guarantee waste deterrence from now on.

### **2.4.3 Application of ISWM Tool**

The implementation of ISWM will be employed in developing a resource recycling arrangement in Dhaka. An innovative arrangement will be established since Dhaka has a deficit of an effective waste gathering arrangement. The instrument will be utilized in scrutinizing input-output scrutiny of resources and waste movement in the town. Strategic facts of heavy waste dumping will be traced and collection containers will be positioned nearby these bases as possible. Household waste is a pivotal point as it is the key source of biological waste that will be reprocessed to manure to be consumed as fertilizers and similarly in the production of energy. The physical infrastructure

of the town was considered in accomplishing the most efficient method of gathering waste. This caused the impression of pneumatic tubes as an effective method of gathering waste. Consequently, the technology employed will support the source segregation of waste and will necessitate the collaboration of the inhabitants. This will be accomplished through generating consciousness of the advantages of a purer atmosphere and inspire them in inappropriate dumping of waste by giving motivations to engage them encouragingly in the evolution sequence. Besides, in an eye to accomplish an effective evolution sequence, the innovative recycling arrangement will be constructed on prevailing actions to guarantee we transport along with all stakeholders for a better sustainable arrangement (Scheinberg et al. 2001, 17 - 20).

The ISWM instrument was additionally applied in scrutinizing the acceptability for reprocessed items. From the scrutiny, we established a ready and existing market for the reprocessed items as biological waste will be reprocessed to manufacture manure which is a crucial component in biological farming. This will assistance advancing the farming segment in Dhaka and also excess manure will be exported. Furthermore, energy can be regained from urban waste which correspondingly helps the energy business in Dhaka and diminishes the quantity of energy importation to the town. Likewise, solid waste is reprocessed which will support amplifying resources and decreasing waste (Scheinberg et al. 2001, 26). The source division technique will be advantageous in producing sufficient amount and superiority of waste products that will assist in cost-effectively nourishing the arrangement. Therefore, the pneumatic tube technology utilized will support eliminating some supply chain charges for example carriage charge. Dhaka the capital of Bangladesh is segregated into a rich region and poor region. So, we scrutinized that the rich region will disburse extra to accomplish impartiality of the system. Other aspects that were considered in selecting the finest ground-breaking technology for the resource reprocessing arrangement is presented below.

**Table 3.** ISWM features and the selection of waste management technology

ISMW Feature	Areas to Scrutinize
Technical	<ol style="list-style-type: none"> <li>1. Amount of waste, waste structure, thickness</li> <li>2. Capability of gathering or treatment technology (quantity of waste can be gathered, the number of individuals can be aided, which regions can be aided with it)</li> <li>3. Physical Infrastructure (situation of streets, transportation)</li> <li>4. Durability of apparatus/technology</li> <li>5. Regional accessibility of spare parts</li> </ol>
Ecological	<p>Influences of technology on the ecology:</p> <ol style="list-style-type: none"> <li>7. Impacts of technology on chances for reuse and recycling</li> <li>8. Operational situations and ecological health of waste workforces</li> </ol>
Financial-Economic	<ol style="list-style-type: none"> <li>9. Investment and workers expenses</li> <li>10. Functional and maintenance expenses matched with waste administration budget</li> <li>11. Viability of meeting up depreciation expenses of substitute</li> </ol>
Socio-Cultural	<ol style="list-style-type: none"> <li>12. Usual level of consciousness among public</li> <li>13. Enthusiasm and capability to disburse</li> <li>14. Cultural approaches towards waste and effects tor waste management, segregation at origin, recycling</li> <li>15. Gender and sex responsibilities concerning the administration of waste inside the household</li> </ol>
Institutional	<ol style="list-style-type: none"> <li>16. Ability level of waste administration employees</li> <li>17. Purchasing procedures for imported spare parts</li> </ol>
Policy/Legal/Political	<ol style="list-style-type: none"> <li>18. Political importance (e.g. creating employment, decrease imports, enhance atmosphere)</li> <li>19. Strategy and guidelines concerning technology and apparatus</li> <li>20. Agreement guidelines; prejudices in agreement dealings</li> </ol>

Source: Tools for Decision-makers; Experiences from the urban waste expertise program (1995 - 2001).

## **2.5 Social Innovations within Transformative Social Innovation Theory**

Transformative Social Innovation Theory (TSIT) shows how different actors are empowered or disempowered in the social innovation process. Some of the actors presented in the theory include individuals, intermediary organizations, and transitional networks (Swearer, 2006). According to Haxeltine et al. (2013), different dimensions determine how the transformative social innovation of actors are limited in the process. One of such dimensions is governance. Despite these limitations, there is a reprieve for actors, and this comes in the form of a government initiative. The government has the role to empower the actors within its arms to solve societal challenges (Mawdsley, 2004). This can be done in different ways, but the most prevalent form is by encouraging several actors within the government to participate in the transformative social innovation process.

The other dimension that would influence social innovations is social learning. To achieve social innovation, individuals need to develop new ways of thinking and executing an action that would enhance the proper management of solid waste through recycling. Haxeltine et al. (2013) asserts that there should be specific ways of learning to empower citizens to transformative social innovation. Apart from governance and social learning, the other dimension that determines the transformative social innovation of actors is funding. According to Swearer (2006), one of the hindrances to social innovation in society, which subsequently hinders sustainable development, is the inadequacy of funds and proper funding. Proper funding entails devising the channels used in disseminating funds for transformative social innovation.

Mawdsley (2004) adds another dimension, monitoring, which is perceived as another factor to attain social innovations that would enhance sustainable development. Mawdsley (2004) postulates monitoring as a crucial element of the empowerment process of social innovations for sustainable development. Additionally, Haxeltine et al. (2013) postulate that it is crucial for actors of social innovation methods to succeed if those in charge understand the undertaking of the processes that enlighten the society on sustainable development. Swearer (2006) also writes that it is crucial for those in charge to know and monitor the methods needed to monitor the transformative process for social innovation.

Social innovation is a nature-based solution that has huge potential to transform our lifestyle through planning and completion. Social innovation can foster the transition initiatives to create a relationship between new urban realities such as sharing economy, green economy and sustainable lifestyle. Social innovation is an important phenomenon that should be viewed as something marginal (Mawdsley 2004; Swearer 2006). Social innovation can provide significant value to the communities involved in this research work. In this thesis, it is argued for the requirement to develop a transformative social innovation theory of transformative social innovation, by finding out how networks of social innovation families' and social entrepreneurs come to contribute to the general social amendment. Social innovation can provide a systematic change as with the help of social innovation it is possible to transition and emphasize the important role by the communities.

A board analytical framework can be achieved that can conduct an integrated analysis of social innovation. Social innovation is now the European policy agenda. A recent report by the BEPA 2010 (Bureau of European Policy Advisors) on social innovation set an agenda: "Social innovation is the innovation that refers to the social in their meaning and ends as it provides the new ideas such as products, services, and models that meet the social needs and create a new social relationship. In this manner social innovation is not only beneficial but also increases the tendency among the community to follow the act." BEPA (2010) adds that "It is possible to have the new response to the new demands by the social innovation that can play an important role in the process of social interactions. The approach of social innovation is not only a governance mode of working on the traditional field of responsibilities but also engage the communities to active participation to challenge the climate mitigation, social injustice. The culture of trust and risk-taking among the people is essential to promote the social innovation"

In Europe social innovation in the technological field has become the indicative policy agenda. In terms of motivation, ends, means, and processes social innovation has the two common elements (BEPA 2010). One is new social relationships which are related with the process related whereas the other is new social value creation which is outcome related. The new social relationship can be mentioned as the process elements that are an important part of the innovation process. In terms of some important cases it is an invaluable part. (Haxeltine et al., 2013)

Social innovation can be classified into three categories:

1. Grassroots social innovation refers to social demand directed by the vulnerable group of society.
2. Broader level initiative refers to findings to challenges between social and economic conditions.
3. Systematic type initiatives refer to the core changes in the behavior, attitudes, values, structure and processes of organizations, strategy and policy, services and delivery systems.

According to (Haxeltine et al., 2013), Social innovation can analyze the systematic sustainable transition and societal challenges to have a sustainable society. Thereby a new theory of transformative social innovation (TSI) can be addressed here to discuss the social innovation properly here. In the financial and economic context, we can start to face the social challenges that are creative and diverse, more efficient and cost-effective. TSI theory should have the capability to analyze the process of social dimension and societal changes and the relationship between policy and governmental organization. The scope of social innovation is to enhance the capability of empowerment and transformative systemic transition.

In conclusion, if social innovation can be used properly, the outcomes and impact of social innovation can play a significant role in social learning and increase the empowerment of social innovation actors. Monitoring, evaluation, empowerment and learning have no guarantee to the policymakers but it may not be the same as the social innovation process. However, the impacts of this play an important role in empowering the social innovation actors. Through social innovation it would be possible for people to be empowered and motivated to engage themselves in systemic transition. As a result, they will value the impact of their endeavors. Due to the presence of disempowering of the actors, the present mechanisms of monitoring and measuring social valuation cannot capture the perception of the added value of social innovation. To have the great potentiality of social innovation new valuation methods and concepts are needed that are combined with prospective and retrospective envisioning and evaluation. By disseminating such a

kind of methods research can empower actors involved in the social innovation process that enhances the contributions to positive systemic transition. (Haxeltine et al., 2013)

## **2.6 Summary of Chapter**

This chapter is delved into the ISWM framework and the different clusters that exist within the framework. The waste is defined with regards to ISWM. Thereafter, a comparison between the conventional waste management system and ISWM is presented, with the objective of highlighting the latter's competitive advantage. He then discussed the latest approaches in ISWM and how it can be applied in contemporary society. The chapter is concluded by presenting a discussion on social innovations with regards to ISWM. Additionally, the section discussed TSI theory and found out four themes that can be used to create a bridge between the development of TSI theory and the application of social innovation processes.

## **3 RESEARCH METHODOLOGY**

### **3.1 Introduction to Chapter**

Chapter three will comprise the various methods used to meet the research objectives and answer the research questions as set forth in the introduction paragraph. It begins with the research design utilized in the thesis. Therefore, the research strategy and the study context have proceeded. It will then present the data collection methods, the procedure adopted in selecting the sample population and the analysis method of data collected. Through the chapter, a justification for the choice of the method used will be provided.

### **3.2 Research Design**

To achieve set objectives, it is important to have a research design as it integrates different methods used in the thesis in a logical manner to obtain a regular flow of the thesis. The research is meant to offer an analysis of the transition in waste management. According to Creswell and Creswell (2017), it is vital that a research design is included in a thesis because it provides the leeway to the procedures of sampling the population, methods of collecting data, and the method of analyzing and presenting data with the goal of answering the research questions and research objectives. It is from the research design that the it will develop a strong conclusion and valid recommendations toward better ways of ensuring transition in waste management.

This thesis made use of the primary data collection method. To efficiently conduct the research, the questionnaires (APPENDIX 1) are developed and an interview schedule that offered a guideline on data collection (APPENDIX 2). The need for up to date information prompted the researcher to opt for a quantitative data collection method which involves the researcher going to the field to collect data or a facilitator collecting data on behalf of the researcher.

### **3.3 Research Strategies**

The research strategy is guided by the type of research objectives set forth as in the introductory paragraph. According to Saunders et al. (2009, 90), the definition of a research strategy needs to include a plan. Therefore, Saunders et al. (2009, 90) defines it as a plan developed and followed intending to answer the research questions. Therefore, to achieve the set objectives and research questions, it is important to select the ideal research strategy.

There are other factors that limit the research strategy. Some of the factors include the time set for conducting research, the availability of funds, available information in the specific research area and ethical considerations. In this thesis, two objectives are developed. The first objective was to establish that social innovations leads to a sustainable transition. Another objective was to identify some of the innovations that Dhaka can use to enhance sustainable transition. The last objective of the research was to make recommendations based on the prevailing trends with the view of showing the need for social innovation to enable sustainable transition. All the mentioned objectives were put into consideration when selecting the research strategy.

Two research strategies are adopted. The first one was experimental research while the second one was the survey method. According to Williams (2007, 68), the survey method is largely applied in natural sciences because it enables to distinguish how changes in the dependable variable influence the independent variable. In experimental research, according to Williams (2007, 68), the procedure involves marking two groups with a unique code and studied. A comparison will be made between the groups and outcome changes recorded. A simple experimental research example is the one that involves client satisfaction on a service. In such an instance, it begins by studying the different satisfaction rates exhibited in the groups. In such a strategy, the research is practical because respondents are divided into groups and put to taste the services then the outcome is

measured by various parameters. In this thesis, the selected household members and the general population in Dhaka and experimented with them.

The other research method adopted by the survey. Williams (2007, 67) postulate that the survey method uses a sampling technique to collect data from a population. It is vital to settle on the survey method when conducting research that involves many people. Therefore, and discussed by Williams (2007, 67) researches in the field of environmental science often adopt the survey method. Williams (2007, 69) is of the opinion that descriptive of inferential tools can be put into use for data analysis if the survey method is chosen. Williams (2007, 69) gives an example of the use of a survey method that utilizes questionnaires to collect data from samples of a population to determine the satisfaction rate of users of car models for a multinational company. In this thesis, the survey method is primarily used that able to sample the population and make generalized conclusions.

The research carried out in this thesis is descriptive. The research is explanatory because the thesis is aimed at providing an explanation of the transition in waste management. Therefore, the survey method is carried out to answer the research questions and research objectives. To achieve the intended aim of the research, questionnaires are developed and included both structured and semi-structured questions (APPENDIX A). Besides, the Dhaka population is large thereby making it vital to adopt the survey method. Therefore, it finds the research method ideal to appropriately answer the research question and research objective and draw strong a conclusion and recommendations to transition in waste management.

In this thesis, the researcher's unit of analysis was the individuals sampled. The sample included household members in Dhaka. The selected population sample is appropriate because it has direct involvement with waste production and disposal.

### **3.4 Study Context**

The validity of research largely depends on the population sample. The research covers a large area and involves many people. It is important to sample the population in order to best understand it. After sampling, it is studied, develop findings and make generalized recommendations for the entire population. The sample population and the method of sampling were presented in the previous section of the chapter. In this section, the research population is defined. Creswell and Creswell (2017) define a research population as a specified number of individuals put under study.

When the population has a large number of individuals, it is unable to collect data from everyone. Therefore, the essence of a target population arises. It is from the target population that samples are developed, studied and analyzed to give a generalized picture of the population (Creswell & Creswell, 2017).

In this thesis, it is studied a population of inhabitants of Dhaka. It narrowed down to households within Dhaka and random street users within the town. The study population is appropriate as it reflects the stakeholders taking part in waste production and disposal. Therefore, the sample from those engaged in waste production and its disposal is selected.

### **3.5 Data Collection**

To effectively address the research questions and the research objectives, two data collection methods were utilized in the research. The first method was the use of existing data while the second method was the use of questionnaires. Research on existing information stored in journals, websites, articles and books on transition ion waste management was presented in chapters two and three of the thesis. Generally, a credible source has been used to answer the research questions and research objectives. Studied existing literature was presented and formed chapters two and three of the thesis. For primary data, the use of questionnaires was applied. The questionnaires were distributed in Dhaka, then feedback is collected carefully.

Alluding to the outline set forth in the introductory chapter, it aims at identifying the state of solid waste recycling in Bangladesh and the opportunities for sustainable recycling. Initially, use a specific research method for each objective had been opted. However, during data collection, he found out that a strong link existed in all objectives towards the two research methods discussed earlier in the chapter. The first objective was to establish that social innovations lead to a sustainable transition. The second objective is to identify some of the innovations that Dhaka can use to enhance sustainable transition. The third objective of the research is to make recommendations based on the prevailing trends with the view of showing the need for social innovation to enable the sustainable transition. All three objectives were answered based on collected data from the field. It was important to extract up-to-date data hence the need for the primary method of data collection. Questionnaires distribution and collection were conducted by a facilitator (APPENDIX 3). Finding were then emailed and visually presented in Graphs and charts in chapter 5.

### **3.5.1 Data Collection using Secondary Data Collection Methods**

The first data collection was based on existing literature written by researchers and scholars on waste management. Journals, articles, publications and websites with information that could aid to shed more light on waste management and develop appropriate questionnaires to answer the research questions and research objectives were used. The major reason for the inclusion of document analysis was to enable to find out the extent of transition in waste management. The information was written down and made up the literature review part of the thesis.

### **3.5.2 Data Collection using Primary Data Collection Method**

The second method of data collection was by use of questionnaires (APPENDIX 1). The questionnaires were developed and sent by mail to a facilitator in Dhaka and used to collect data. Being away from Bangladesh sought the help of a facilitator to distribute questionnaires following a set schedule (APPENDIX 2). The facilitator followed the research schedule and consultation as mentioned (APPENDIX 3).

Due to the limited time caused by the outbreak and quick spread of COVID-19, it sought to carry out the research in the shortest time possible before the virus reached Bangladesh (APPENDIX 2). Therefore, the questionnaires and included a majority of dichotomous questions were drafted (APPENDIX 1). Besides, dichotomous questions are ideal because they enhance accuracy and are easy to fill (Romero and Han 2004, 616). According to Romero and Han (2004, 616), it is vital that the items are in boxes, allow the respondents to mark them by a tick and be able to show the strength of agreement. Romero and Han (2004, 616) proposes for the adoption of the technique because it simplifies the questionnaire filling process. Besides, they propose the method because it makes it easy to compare findings and develop strong and valid conclusions with ease. Other than the dichotomous questions, it also includes semi-structured questions. According to Romero and Han (2004, 618), the inclusion of both semi-structured and dichotomous questions is vital when conclusive evidence is required from respondents.

The limitations of using dichotomous questions in a master's thesis necessitated the need to include semi-structured questions. Therefore, and as presented by Romero and Han (2004, 618), it is important to use different methods because they counter the weakness of one method to balance the effects of that particular method by the strengths of the other methods. It is important to note

that the questionnaires supplied to respondents had both semi-structured and dichotomous questions.

### **3.6 Sample and Sampling Procedure**

As earlier outlined, the research population was sampled. A well-selected sample gives the real information of a population and inference made. According to Acharya, Prakash, Saxena & Nigam (2013, 338), an important factor in sampling is that every individual has an equal chance of being selected for the research. Therefore, a population put under study should comprise of individuals with equal chances of selection for the sample.

The research sampling technique that exists is divided into two. The first one is probability sampling while the second one is a non-probability sampling. In probability sampling, eligibility for inclusion in the sample is established by first selecting individuals randomly from the population. In non-probability sampling, selection is based on a particular section of the population other than the entire population. Therefore, non-probability sampling means some people in the population do not have equal chances to be selected for research. For that reason, there are possibilities of ending up with results that do not represent the views of the population is high. One drawback to the use of probability sampling, on the other hand is its usage of more resources and time when compared to non-probability sampling. (Acharya, Prakash, Saxena & Nigam 2013, 343.)

In this research, a simple random sampling method was applied to select the sample for research. Some of the reasons that that choose simple random sampling was the high number of individuals involved in solid waste production and disposal. Another reason was due to the need of collecting data from a sample to accurately represent the views of the population. Therefore, respondents were randomly chosen from the population and handed questionnaires by the facilitator. Random selection means every individual within the population had an equal chance of selection to make up the research sample.

### 3.7 Administration of Questionnaires

The data was collected from respondents through the use of questionnaires (APPENDIX 1). Gilham (2008, 3) writes that a questionnaire as a document with a fixed scheme and comprises of standardized questions which aim at data collection from a sample population by concentrating on a single or multiple predetermined topic. It is therefore expected of the questions to induce a stimulus that is similar to respondents so as to aid in the analysis of data.

Different channels may be used to collect data from respondents through the use of questionnaires. For instance, approaching respondents with an introductory letter from the school and asking them to fill the questionnaires. Another way is by meeting respondents for the first time and without an introductory letter, ask them to fill the questionnaires. Therefore, delivering questionnaires can be done differently and include the use of electronic media such as emails, telephone calls or personal delivery. (Gilham 2008, 45.)

A facilitator has been used to disseminate questionnaires to respondents in Dhaka (APPENDIX 3). Therefore, a bunch of prepared questionnaires was sent to the facilitator in Dhaka. The facilitator was advised to provide guidelines for filling the questionnaires in areas respondents had the hardship to understand.

The questionnaire that the facilitator supplied to respondents was developed based on the literature review of the status of transition in waste management. A pre-visit plan was conducted by the facilitator to observe the research area as instructed to guide in developing the interview schedule and the facilitator in disseminating questionnaires to respondents (APPENDIX 4). The feedback from the questionnaires formed the conclusion and recommendation on transition in waste management in Bangladesh. Data collection was conducted in 6 days. A sample of 38 respondents was selected. However, 8 were screened out by the facilitator as they did not deem fit for the research. Therefore, 30 questionnaires were supplied to respondents. 3 respondents did not submit completed questionnaires. Therefore, only 27 questionnaires were obtained. Out of the obtained questionnaires, 2 were wrongly filled. It was only 25 questionnaires that were analyzed.

### **3.8 Rate of Response**

It is important to establish a response rate (Baruch & Holtom, 2008). Rate of response is vital because it makes the effectiveness of collected with regards to its adequacy in answering the research questions and research objectives and that internal surveys often record higher response rates than external surveys (Baruch & Holtom, 2008). In an internal survey, the rate of response can skyrocket to above 85 percent. A score of 85% means for every 50 respondents, 43 responses are recorded. Similarly, the rate of response from respondents can be as low as 2%. Such a score means that a single response in every 50 respondents is recorded (Baruch & Holtom, 2008). According to Baruch and Holtom, (2008) various factors determine the response rate which includes the appropriate target audience, availability of incentives for respondents and the channels of communication between the researcher and the respondents.

According to Hartge (1999, 106), various methods exist and can be used to increase the response rate. One of the strategies is ensuring that the survey time is 10 minutes or less. However, it is still appropriate to conduct the survey for 11 to 15 minutes. Hartge (1999, 106), writes that it is common to carry out for more than 10 minutes to score low rates of response. A clear value can be proposed. According to Hartge (1999, 106), clear value ensures that respondents are enlightened with the research data collection stages. Clear value enables the respondents to have the general picture of their intended activities during research and also help them plan for the research (Hartge 1999, 106).

In this research, there was a good response rate. One factor that attributed to the high response rate is the small number of questions filled by respondents (APPENDIX 1). The respondents were able to fill the questionnaires for 12 minutes. Another factor that might have improved the response rate is the use of a facilitator who hails from the locality in Dhaka (APPENDIX 3). The facilitator translated to the respondents the questions and where need be, he showed them how to fill the questionnaires.

To correctly present the response rate, it is important that the values are presented statistically for easy interpretation. According to Baruch and Holtom (2008), to a statistical presentation of the response rate is done by dividing the respondent's number with the number of questionnaires analyzed. Baruch and Holtom (2008) also write on the return rate as another statistical factor to be calculated. According to them, the obtained return rate is calculated by dividing the questionnaire

number received at the end of the research period by the number that was previously distributed to respondents. In this thesis, a total of 30 questionnaires were supplied by the facilitator to respondents. 27 questionnaires were retrieved by the facilitator. The return rate, therefore, was 90%. Consequently, 25 questionnaires were analyzed. This recorded an 83% rate of response.

### **3.9 Data Analysis**

Qualitative analysis is methodological approaches that are based on diverse theoretical principle as it employs the non-quantitative data collection and analysis that explore the social relations as well as describe the reality experienced by the respondents (Sarantakos,1998). The focus of qualitative analysis is to assess the subjective phenomena as ideas, opinion and pattern. A qualitative analysis will be used as the research methodology shall examine some of the available literature that addresses the concept of waste management and some of theories that could be productive when implemented in Dhaka. According to (Johnson, Sholes & Whittington 2008), within the qualitative analysis, a PESTEL analysis can be used to understand some of the political, technical, environmental, legal, and economic or financial factors. This analysis would have impact the implementation of the proposed method of waste management in Dhaka. The different aspects all work in unison and are the areas that this section seeks to examine in relation to the paper's objective. The present condition of waste management in Dhaka will be investigated, and the composition of waste and how it is generated. By studying the aspects, there will be possible to create a linkage with findings from PESTEL analysis for the formulation of the appropriate ISWM model for Dhaka.

#### **3.9. Aspects of PESTEL**

PESTEL is a tool that marketers use to monitor and analyze the macro-environmental factors that might affect an organization. The objective is to identify some of the weaknesses and threats that might affect an organization and use them for future analysis. Some of the areas that are considered during PESTEL analysis are the political factors that an organization might face in meeting its objectives, or the political environment and how it facilitates the achievement of the organization's goals. The second area is the economic factors, which examines the economic reasons that would either promote or inhibit the achievement of an organization's objectives. Other areas that are analyzed in a PESTEL analysis include technical aspects, legal implications, and environmental factors. (Johnson, Sholes & Whittington 2008, 54-56)

### **3.9.1 Technical Aspects**

The technical aspects considered to influence the technical functioning of our system comprise the functional condition of existing resource recycling schemes and how satisfactorily our innovative scheme will perform in the town and correspond to the topology and regional bodily situations (Scheinberg et al. 2001, 19). Similarly, it was judged whether the system will operate in line with or against any other systems. Nevertheless, there is no municipal resource recycling system in Dhaka, consequently, our enterprise will be most appreciated. Besides, the technical implementation of our system will be appraised via the proportion of waste amassed and the attention of gathering in contradiction of the overall waste engendered (Scheinberg et al. 2001, 19). Additionally, the zones deficient waste gathering baskets will be documented.

### **3.9.2 Environmental Aspects**

The environmental aspects considered for environmental sustainability are the degree of contamination triggered by inappropriate dumping, and retrieval proportion of waste as a proportion of the total quantity of waste engendered (Scheinberg et al. 2001, 19). Others are strategies supportive of recycling, actions on ecological consciousness and well-being standing of the general people of Dhaka assessed by waste associated illnesses for instance cholera, typhoid, and dysentery.

### **3.9.3 Socio-Cultural Aspects**

The socio-cultural aspects that were taken into account to influence the social and cultural functioning of the resource recycling schemes comprised the standing of stakeholders in Dhaka by placing into remembrance the stakeholders that will promote and be influenced by the scheme (Scheinberg et al. 2001, 20). Furthermore, the interaction between stakeholders is very pivotal so as to derive a response on the system implementation and functioning. Consequently, the grievance instrument will be enhanced to guarantee the superiority of the response (Scheinberg et al. 2001, 20). It is not sufficient to focus on the waste conversion procedure but also on the mental conversion procedure of the inhabitants.

### **3.9.4 Financial Aspects**

To safeguard financial and economic functioning, the aspects considered comprised of how the money will be collected to develop the resource recycling system and if the town of Dhaka has a prepared funds for waste management (Scheinberg et al. 2001, 20). Furthermore, financing and operational outlay were examined to support in the allocation of expenditure by associates (Public-private partnership) and examining the proportion of outlay that will be retained by way of waste recycled as manure, solid waste recycling and energy retrieved from waste (Scheinberg et al. 2001, 20). Thus, understanding how much time it will take to achieve a return on investments.

### **3.9.5 Policy and Legal Aspects**

Policies and legal aspects for example regulations of law, a municipal outline in resource recycling, authority to maneuver, finance and manage resource recycling system are some issues that will apparently impact the implementation of the scheme (Scheinberg et al. 2001, 20). Other aspects contain enough laws and regulations obliging resource recycling, if they're even now is a strategy for resource recycling in Dhaka, planning prerequisites and how efficient is the application of the laws and regulation.

### **3.10 Summary of Chapter**

Chapter four began by presenting a short description of what the research intends to cover than provided the research design. The research population, methods used to sample the population and the exact sample studied were then described. Thereafter, a presentation was made on the field research methodology, which was used to collect data, and how the data will be used to answer the research questions and objectives.

## **4 EXPERIMENT, DATA ANALYSIS, AND DATA VISUALISATION**

### **4.1 Introduction to Chapter**

Chapter five contains visually presented data that was collected from the field by the use of tables and graphs. Microsoft office word 2016 software was used to present data in an intelligent and simplified manner to ease the interpretation and develop findings. The findings were used to answer the research questions, objectives and determine the appropriate research hypothesis. The research findings were also applied to develop recommendations on the measures to be taken to boost the state of solid waste recycling in Bangladesh and the opportunities of sustainable recycling.

### **4.2 Experiment Description**

Microsoft office word analytical tool was used to present data in tables and graphs from questionnaires sent by the facilitator. Form the questionnaires, it was only 25 of them whose data was analyzed. The collected data was visually presented to provide a pictorial representation of the status of waste management in Bangladesh for easier interpretation. It was important to interpret the data collected to enable to answer research questions and objectives efficiently and with ease.

### **4.3 Experiment Execution Details**

It is important to discuss the research process. Research has various sections that include the pre-experimental planning phase that improves the research quality of the final findings before the research begins (Farooq, Nóvoa, Araújo, & Tavares, 2016, 155). According to Farooq et al. (2016, 158), the pre-experimental stage is important because it enables to find out the research problem, develop the appropriate methodology to address the res4erch questions and objectives and also develop recommendations that are applicable to day to day life in the sector linked to the research. In the thesis, the literature review provided a great amount of information on transition in waste management. It is from the literature review that the questionnaires were developed to address areas that needed further insight. Ultimately, with the assistance of the facilitator, disseminated questionnaires in Dhaka where primary data was collected. The collection of data was through face to face interaction with respondents and was guided by the research schedule (APPENDIX 2). The facilitator then emailed the results that were analyzed the data using Microsoft office word software. To visually present the findings, the figures were imported to the

thesis and presented the findings. Importing figures was important because it made it easy to report findings based on the analyzed data. Recommendations and a strong conclusion were then developed based on the findings.

#### 4.4 Data Analysis

In this thesis, the analysis was carried out on the collected data by the use of questionnaires dispatched at Dhaka (APPENDIX 1). The data were collected by mail, entered it in Microsoft office word and projected findings based on the questionnaire data. The succeeding paragraphs hold the analyzed data.

##### 4.4.1 Demographic Data Analysis

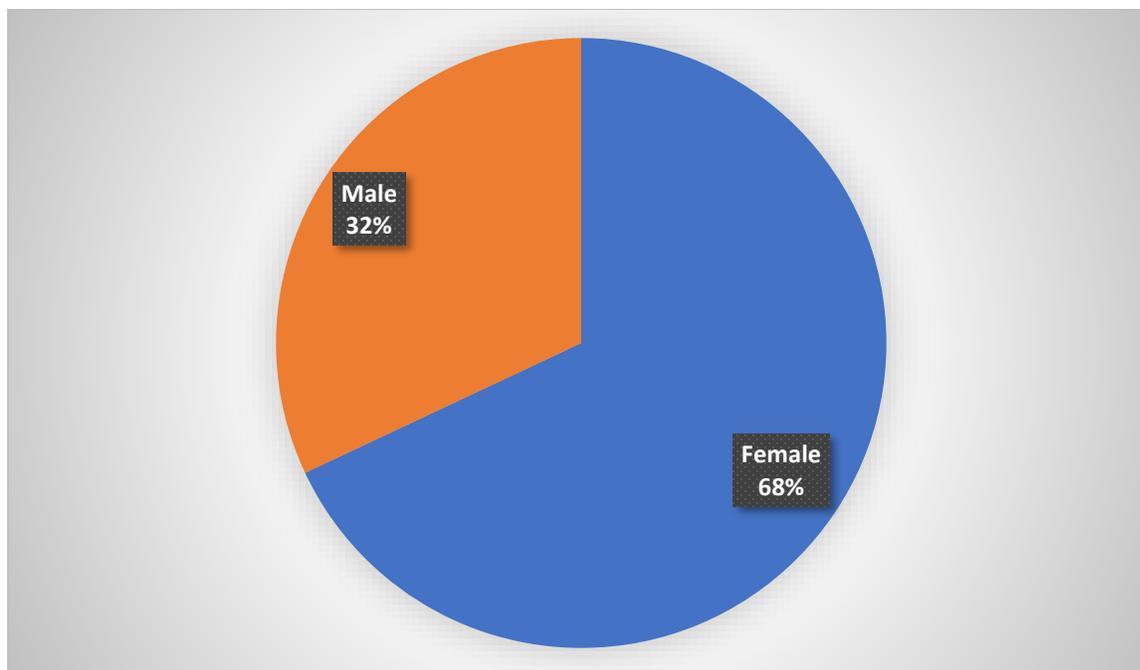
Analyzing the respondents' biodata was important because it enabled to understand the research population. Farmer (2007) reports that the respondent's view of a particular issue is based on age. Farmer (2007) also postulates the importance of considering gender analysis because it is influenced by social situations; waste management is a societal issue. Figure 1 visually presents the study population.

#### A. Gender

**Table 4:** Gender of the respondents

Gender	Number	Percent
Female	17	68
Male	8	32
Total	25	100

Based on Table 4, the data for 25 respondents that were supplied with questionnaires indicated that 17(68%) were female while 8 (32%) were male. The gender representation is visually presented in the pie chart below.



**Figure 3.** Gender of the respondents

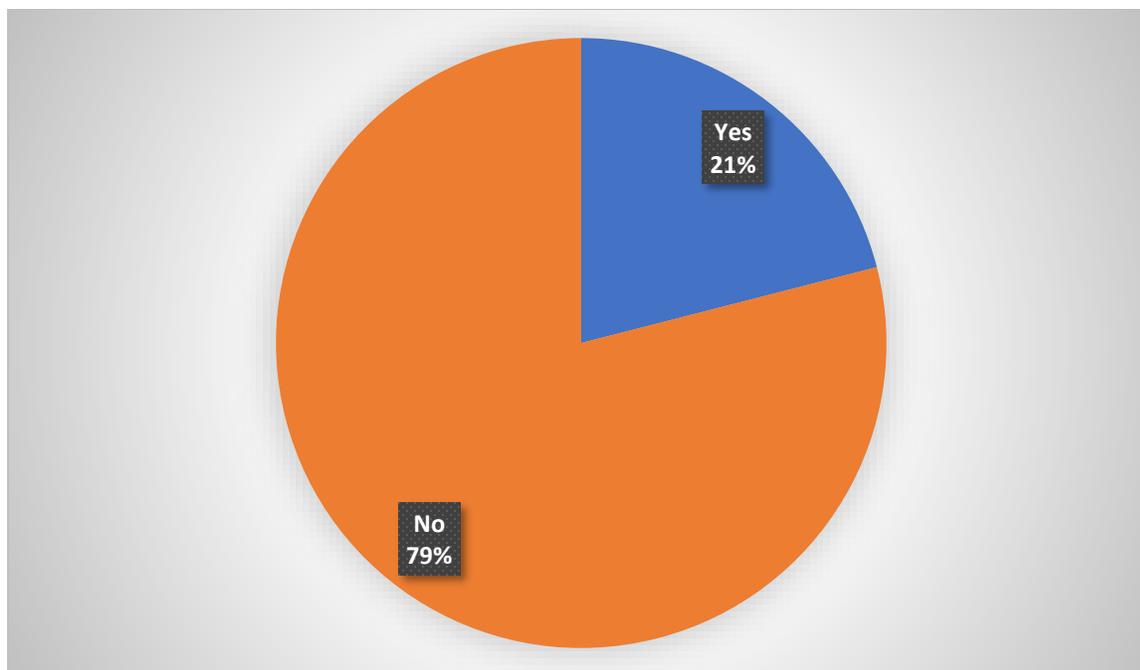
#### 4.4.2 Satisfaction rate on the current state of solid waste management among respondents

The question was the tester and determined the respondents included in the research.

**Table 5.** Rate of satisfaction

Satisfaction rate	Number	Percent
Yes	8	21
No	30	79
Total	38	100

Based on Table 5, it is evident that the majority of Bangladesh residents (79%) are not satisfied with the current state of transition in solid waste management. It was only 21% of the respondents that were satisfied. The outcome is presented in a pie chart below.



**Figure 4.** Rate of satisfaction

Evidence of seen poorly disposed solid waste in Dhaka

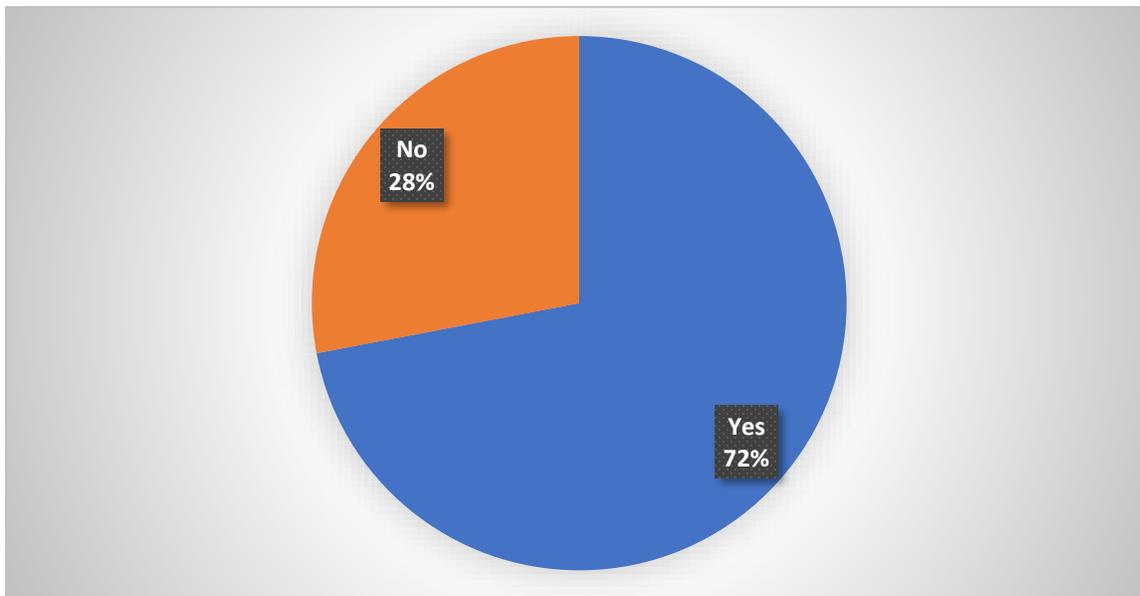
The question on the evidence for poorly disposed of solid waste in Dhaka was analyzed in Table 4 before being presented in chart 5. The outcome from the respondents is presented in Table 4 below.

**Table 6.** Evidence of seen poorly disposed solid waste in Dhaka

Poorly disposed	Number	Percent
Yes	18	72
NO	7	28
Total	25	100

From Table 6, feedback from the 25 respondents indicated that a majority of Bangladesh residents (72%) see poorly disposed solid waste in Dhaka. It was only 28% of Dhaka residents

that were unaware of the poorly disposed of solid waste in the capital city. The outcome is visually presented in the pie chart below.



**Figure 5.** Evidence of seen poorly disposed solid waste in Dhaka

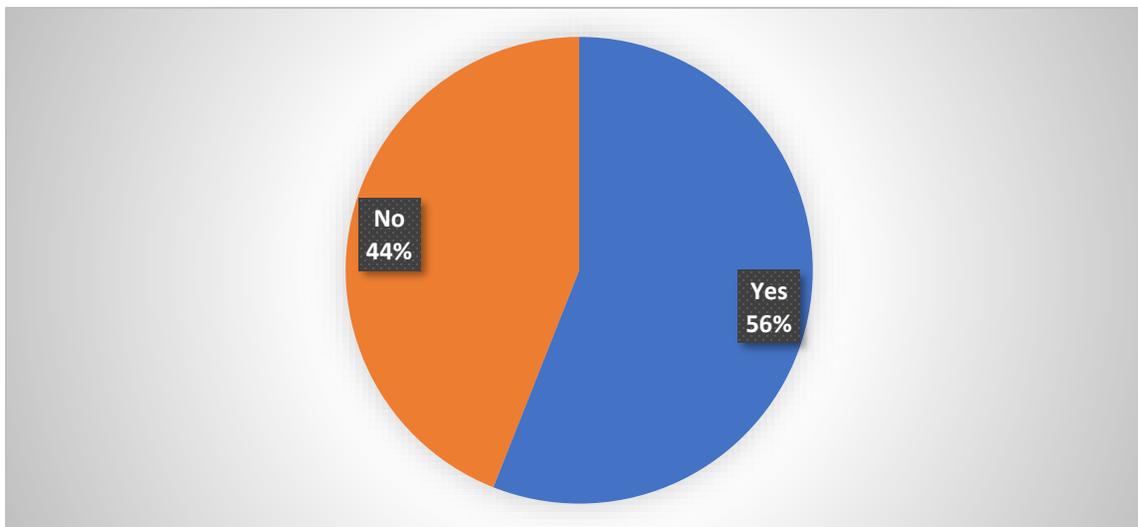
**Q 3. Do you have plastic bags which you use to store solid waste awaiting transportation to a single disposal point?**

**Table 7.** Availability of Plastic bags

Possess plastic bags	number	Percent
Yes	14	56
No	11	44
Total	5	100

Table 7 shows that a majority of Bangladesh people (56%) are provided with plastic bags store solid waste awaiting transportation to a single disposal point. Consequently, another large

population the Bangladesh (44%) report to lack plastic bags store solid waste awaiting transportation to a single disposal point. The outcome is visually presented in the pie chart below.



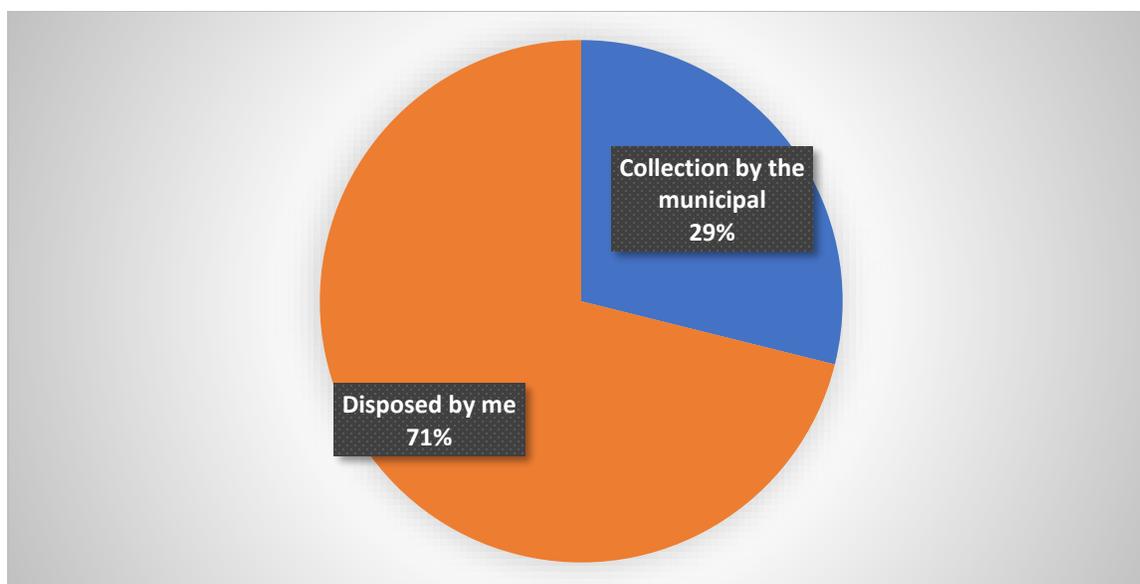
**Figure 6.** Availability of plastic bags

#### Q4. How do you get rid of solid waste?

**Table 8.** How solid waste is disposed

Disposing waste	Number	Percent
Collection by the municipal	13	52
Disposed of by me or family member	12	48
Total	25	100

Based on Table 8, a majority of Dhaka residents get rid of solid waste through the collection by the municipal (52%). Consequently, another large minority group of Dhaka residents standing at 48% get rid of solid waste through disposing it themselves of by a family member. The outcome is visually presented in the chart below.



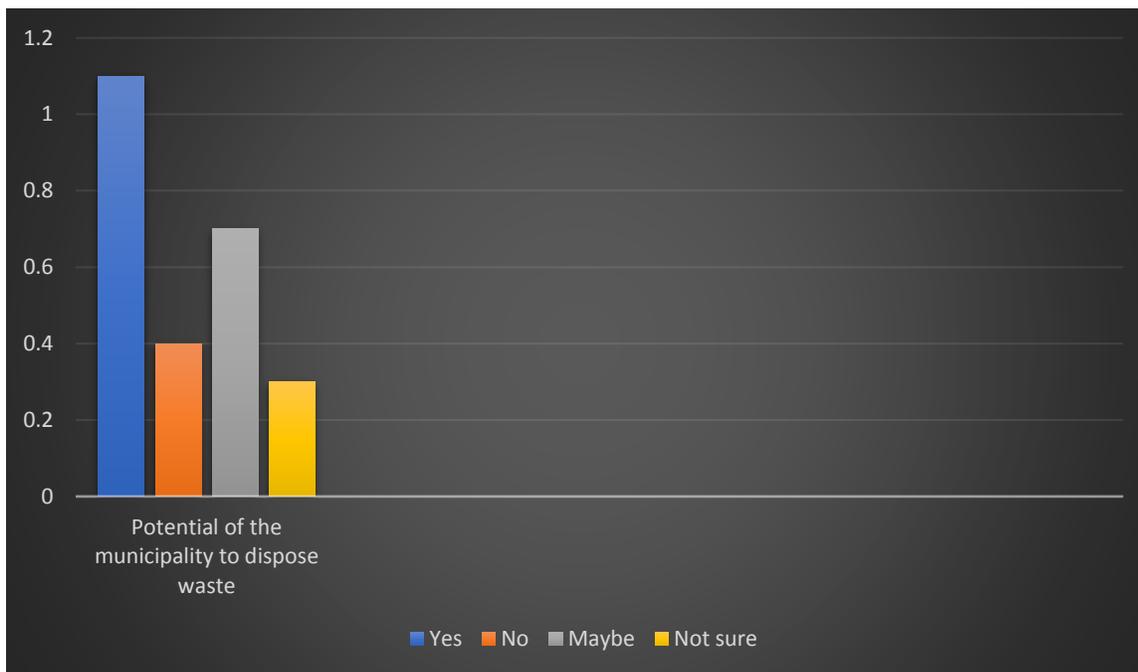
**Figure 7.** How solid waste is disposed

**Q 5. Do you think the municipality has the potential to reduce poor solid waste disposal?**

**Table 9.** The potential of the municipality to reduce poor solid waste disposal

Municipal potential to reduce solid waste	Number	Percent
Yes	11	44
No	4	16
Maybe	7	28
Not Sure	3	12
Total	25	100

The question on whether Dhaka residents think the municipality has the potential to reduce poor solid waste disposal also received different responses. 44% of respondents agreed that the municipality has the potential to reduce solid waste while 28% of the respondents were unsure. 16% of respondents on the other hand declined to the statement while 12% of the respondents were totally unsure. The outcome of the respondent's data is visually presented in figure 8.



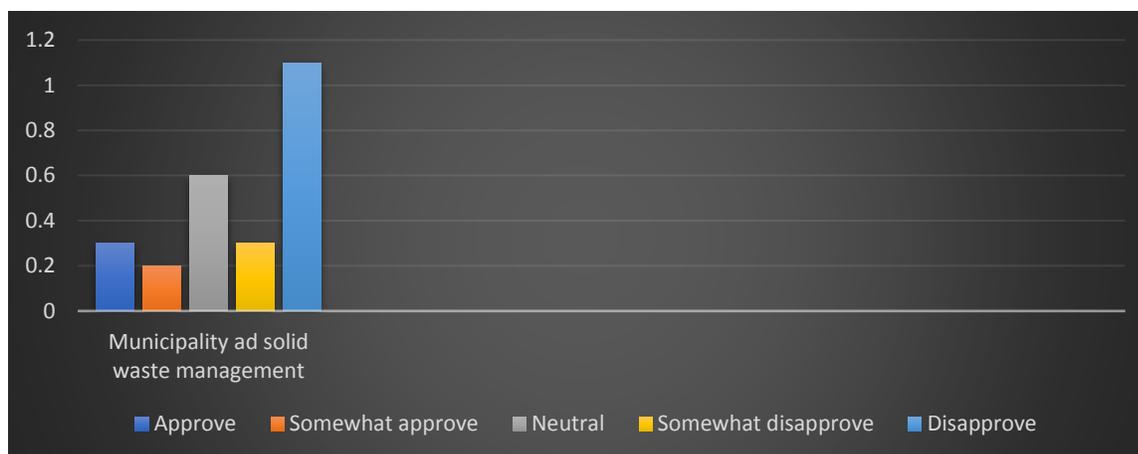
**Figure 8.** The potential of the municipality to reduce poor solid waste disposal

**Q 6. How do you feel right now about the effort of the municipality in combating poor solid waste disposal?**

**Table 10.** Effort of the municipality in combating poor solid waste disposal

Municipality Efforts	Number	Percent
Approve	3	12
Somewhat approve	2	8
Neutral	6	24
Somewhat disapprove	3	12
Disapprove	11	44
Total	25	100

The next question that was analyzed and visually presented was on the respondent's feelings about the effort of the municipality in combating poor solid waste disposal. Based on the feedback, a majority of respondents 44% disapproved of the point. It was only 12% of the respondents that thought the municipality was putting enough to effort in combating poor solid waste disposal. 24% of the respondents were neutral of the trivial issue. The finding is visually presented in the graph below.



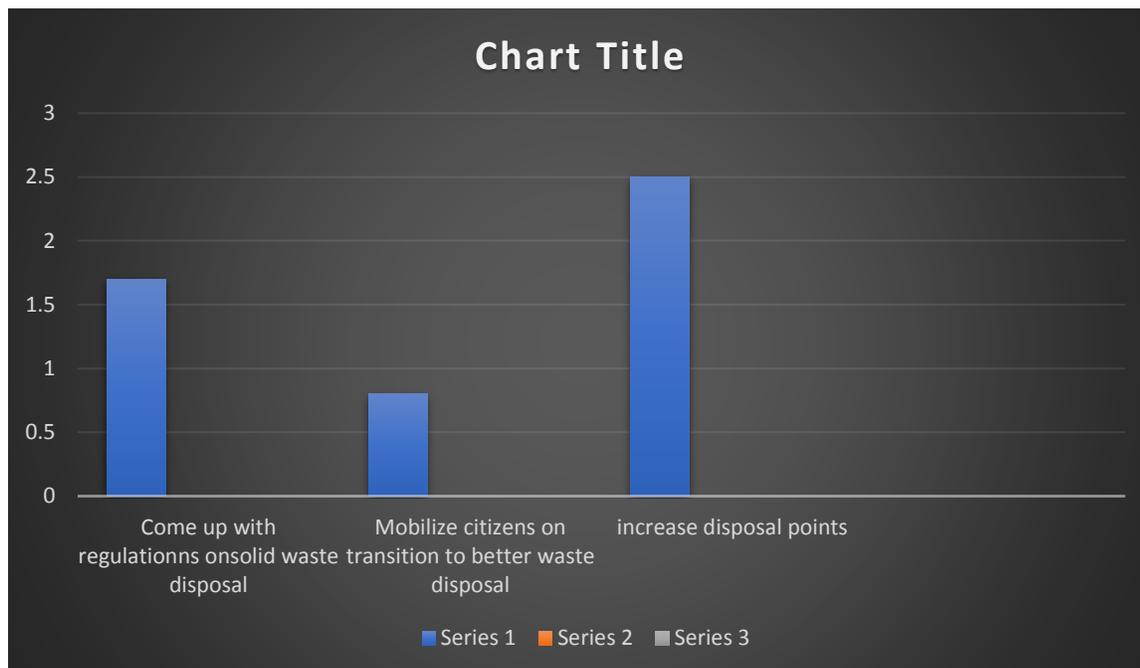
**Figure 9.** Effort of the municipality in combating poor solid waste disposal

**Q 8. On Dhaka streets, do you think that the municipality should?**

**Table 11.** What the municipality should do on Dhaka streets

Should the municipality;	Number	Percent
Come up with regulation regarding how waste is disposed of?	6	24
Mobilize citizens on transition to better waste disposal?	11	44
Increase disposal points?	8	32
Total	25	100

The analysis on question 8 touched on a number of aspects revolving around respondents' daily interactions with solid waste. The research aimed to find out which one was more important to be conducted. The first aspect was to pose to respondents was to find out whether the municipality should develop regulations with regards to how waste is disposed of. The highest aspect that respondents thought would bring fast transition was mobilizing citizens on the transition to better waste disposal which scored 44%. It was followed by increasing disposal points that scored 32% while the last aspect was on changing regulations which had 24% of the respondents in support. The outcome is visually presented in the graph below.



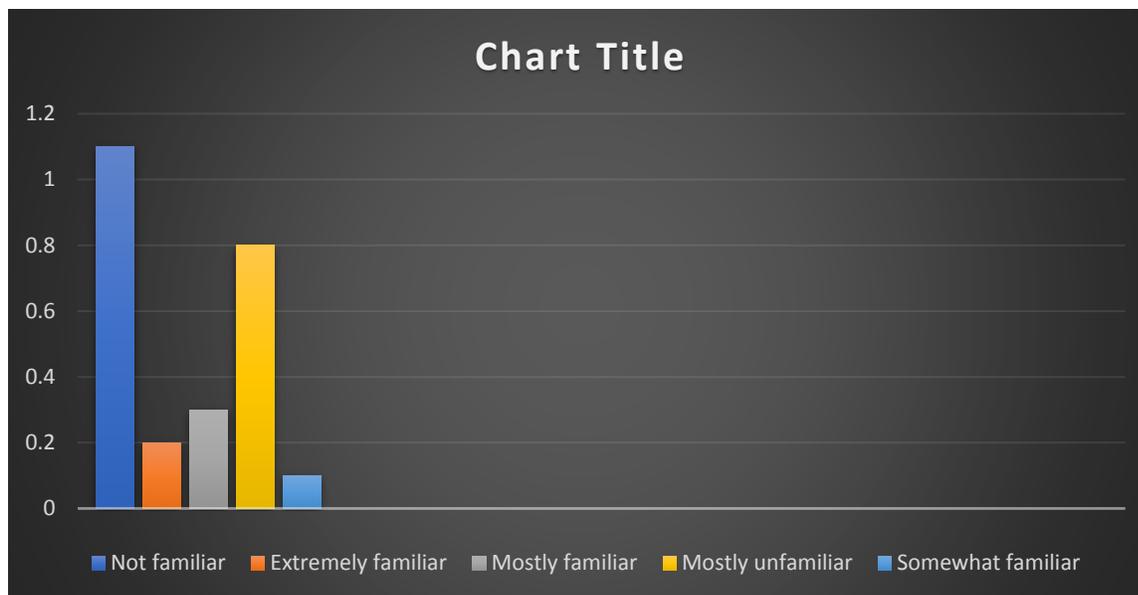
**Figure 10.** What the municipality should do on Dhaka streets

**Q 9. How familiar are you with transition in waste management?**

**Table 12.** Familiarity with transition in waste management

Familiarity with transition in waste management	Number	Percent
Not familiar	11	44
Extremely familiar	2	8
Mostly familiar	3	12
Mostly unfamiliar	8	32
Somewhat familiar	1	4
Total	25	100

The next question was sought to analyze was on the respondents' familiarity with the transition in waste management. In this question, a majority of respondents (44%) reported that they were not familiar with the concept of transition in solid waste management. It was only 8% of the respondents that reported to be extremely familiar with the concept. Another majority of respondents at 32% were mostly unfamiliar with the concept of transition in solid waste management.



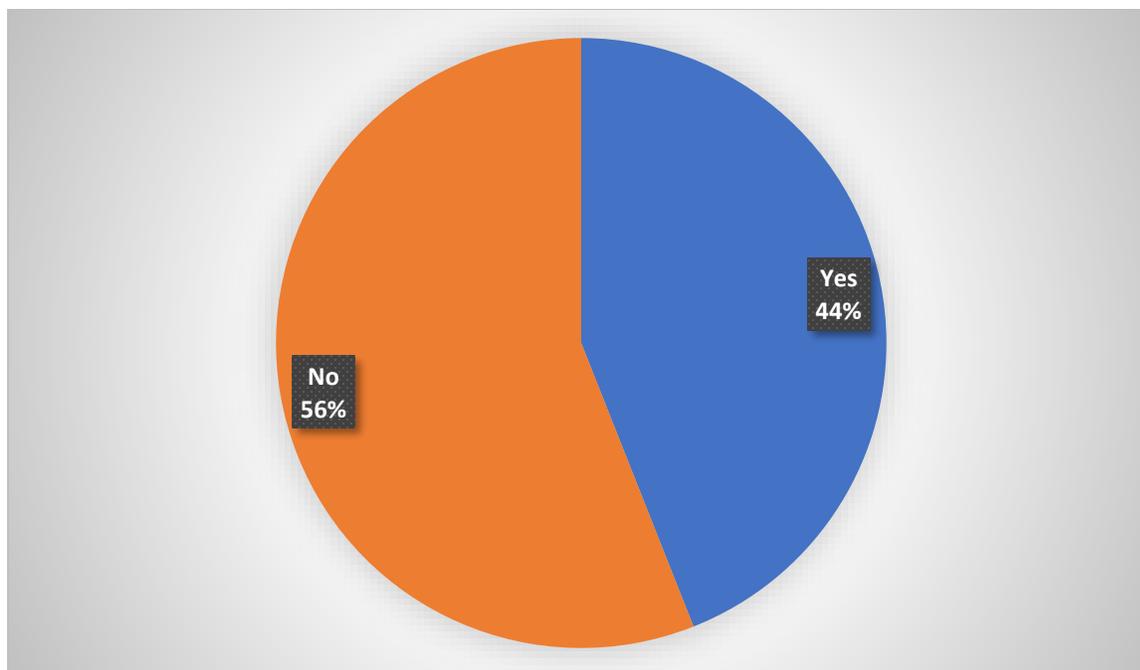
**Figure 11.** Familiarity with transition in waste management

**Q 9. Do you think the private sector is doing enough to help in transition waste disposal?**

**Table 13.** Actions of the private sector with regards to in transition waste disposal

Effectiveness of the private sector	Number	Percent
Yes	11	44
NO	14	56
Total	25	100

The next question was analyzed whether the private sector was effective enough to initiate a transition in waste management. The feedback indicated that 44% of respondents thought the private sector was doing enough while 56% thought that the private sector was not doing enough. The visual presentation of the respondents' feedback is presented in the pie chart below.



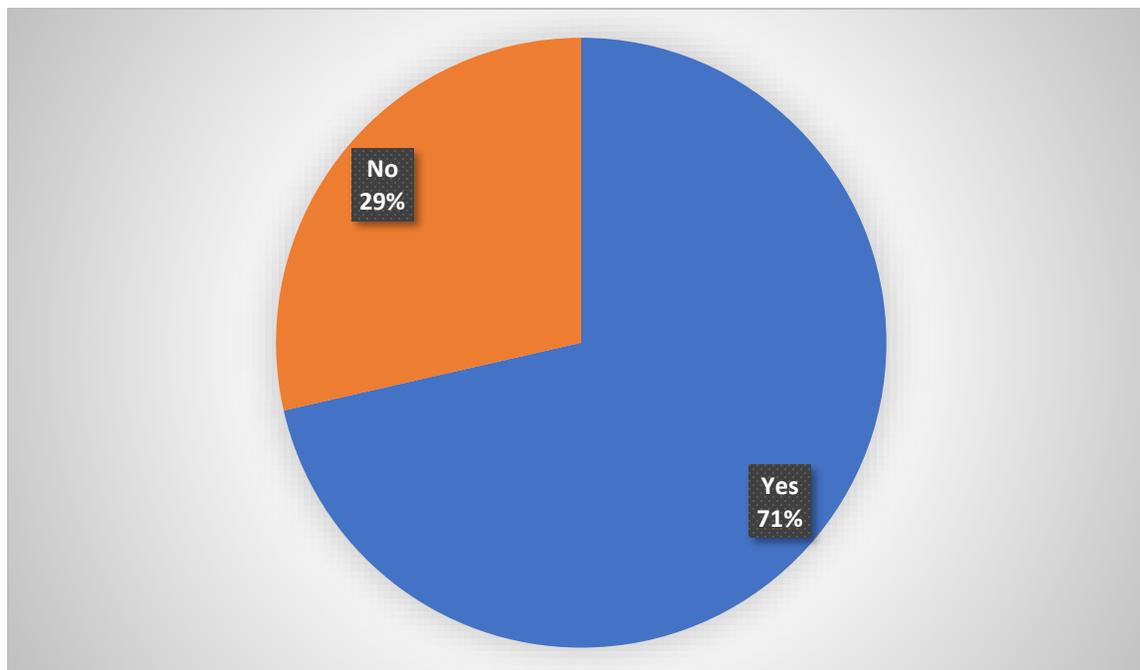
**Figure 12.** Actions of the private sector with regards to in transition waste disposal

**Q 11. Do you think the Private sector should be restricted from owning landfills?**

**Table 14.** Restriction of the private sector from owning landfills

Restriction of the private sector from owning landfills	Number	Percent
Yes	4	29
NO	10	71
Total	14	100

The other question that looked at was on the respondents take on the restriction of the private sector from owning landfills. A majority of respondents were of the opinion that they should not be restricted from owning landfills (71%). The remaining 29% were in support of the exclusion of the private sector from engaging and owning landfills. The results are visually presented in the pie chart below.



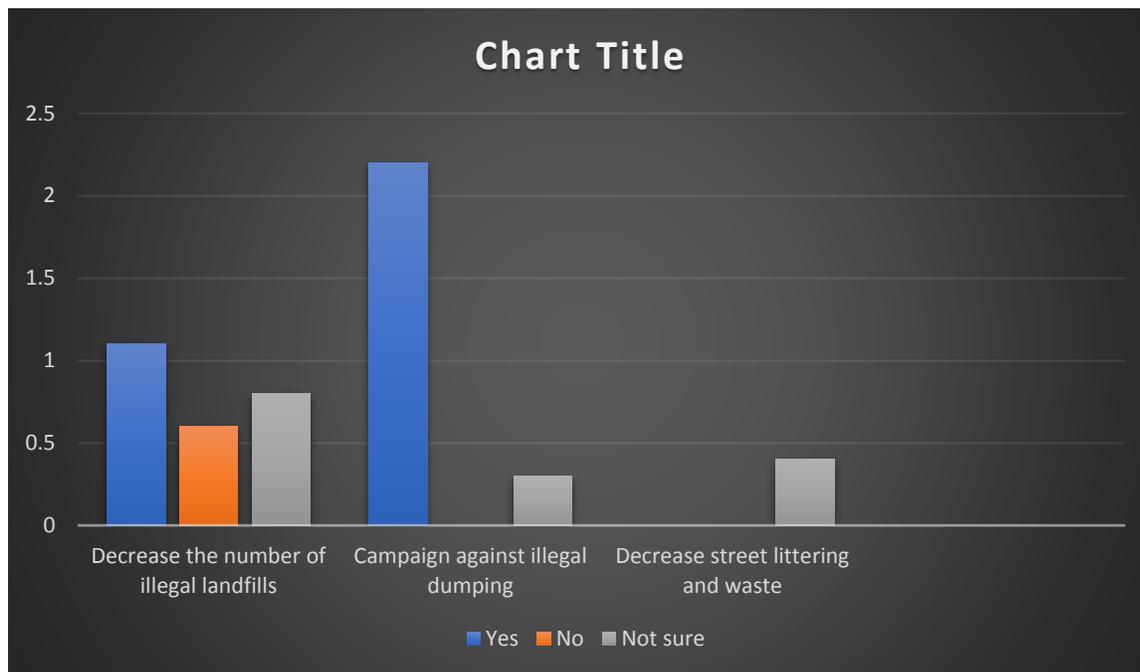
**Figure 13.** Restriction of the private sector from owning landfills

#### Q 12. Do you think the government should?

**Table 15.** Government and transition in solid waste management

	Yes	No	Not sure
Decrease the number of legal landfills	11	6	8
Campaign against the practice of illegal dumping;	22	0	3
Decrease street littering and waste	25	0	0

The last question was analyzed to touch on three different aspects. The first one as on whether the government should decrease the number of legal landfills in the Dhaka. The second question was whether the government should campaign against illegal dumping and the las was on whether there should be a decrease in street littering and waste. The result was visually presented in the graph below.



**Figure 14.** Government and transition in solid waste management

#### 4.5 Advance Data Visualization

Microsoft office word 2016 software was used to present collected data using questionnaires (APPENDIX 1). Visualizing data portrays the situation in Bangladesh on the state of transition in waste management based on the research sample responses. The appropriate data were selected that required to answer the objectives of the research and the research questions from the projections and used them to write findings of the research. Therefore, the research findings, recommendations, and conclusions are based on the data visualized.

#### **4.6 Results**

A few results were found based on the visualized data which he used to answer the research questions and objectives. One finding was that the majority of people involved in waste management and waste disposal are females. Farmer (2007) postulates that gender is affected by the social situation. In Bangladesh, waste disposal is often associated with women. According to Gutberlet (2008), sustainable development is a form of social innovation. Additionally, Moore (2008) writes that social innovation can enhance sustainability by formulating new methods of carrying out activities at the societal level that would have an effect on the people's lifestyle and the economy. Therefore, one way of embracing social innovation is by encouraging both genders to involve themselves in transition in solid waste management.

Another finding was most Dhaka residents are not satisfied with the current state of solid waste management. It is attributed that the situation to a lack of social innovation in Bangladesh with regard to solid waste management. To initiate social an appropriate social innovation, it is important, according to Haxeltine et al., (2013), to integrate the four themes of governance, social learning, funding and monitoring that lack in Bangladesh municipality. The four themes, according to Haxeltine et al., (2013) would create a bridge between the development of TSI theory and the application of social innovation processes. This would ultimately result in an efficient and applicable solid waste management structure and improve the current state of solid waste management.

Another finding is that solid waste is poorly disposed of in Dhaka as a majority of Dhaka residents reported to see waste in the streets of the town. One factor that can be attributed to the phenomena is based on the findings in Table 6 that shows almost an equal number of residents in Dhaka dispose of their solid waste by themselves as those that get the privilege of the municipality disposing of their garbage. According to Campos & Zapata (2014), one of the globally recognized comprehensive tactics for waste management in developing nations is integrated solid waste management (ISWSM). This tactic lacks in Bangladesh hence the lack of hierarch in solid waste management leading to both residents and the municipality involved in almost equal measures in solid waste management.

Another result from the research was that nearly half of Dhaka residents lack plastic bags used to store solid waste awaiting transportation to a single disposal point. Consequently, it was only a slight majority that reported to possess plastic bags for disposing of solid waste. According to Swearer (2006), one of the hindrances to social innovation in society, which subsequently hinders sustainable development, is the inadequacy of funds and proper funding. The government, through the municipality has shown a lack of proper funding and inadequate funds to provide adequate plastic bags.

Consequently, it is found out that most Dhaka residents think that the municipality has the potential to reduce poor solid waste disposal. One factor that could be attributed to the find is that the municipality is in the best position to enhance proper solid waste disposal is based on the postulation by Haxeltine et al. (2013) who think that the government can influence social innovations through social learning. Also, Mawdsley (2004) adds another dimension, monitoring, which is perceived as another factor to attain social innovations that would enhance sustainable development. Therefore, the government, through the municipality has the potential to enhance proper solid waste management through methods of social learning and monitoring.

Another result that emerged from the research was that a majority of Dhaka residents do not approve of the efforts the municipality is putting in place to ensure proper solid waste management. Consequently, it is found out that a majority of Dhaka residents think that the municipality is not doing enough with regards to mobilizing residents to carry out the transition to better ways of carrying out waste disposal. According to the residents, it is important that the municipality takes up the role of mobilizing the citizens to the endeavor than it should concentrate on increasing disposal points and coming up with regulations with regards to methods of waste disposal.

Attribution of one factor associated with the finding to research conducted by Swearer (2006) that describes transformative social innovation theory (TSI) to show how different actors are empowered or disempowered in the social innovation process. According to Mawdsley (2004), the government has the role to empower the actors within its arms to solve societal challenges. Therefore, the municipality, which is the governing body for waste management in the city is best suited to solve poor solid waste management in the city and is blamed for the deteriorating state.

Also, it is found out that a majority of Dhaka residents are not familiar with the transition in waste management. Only a handful of residents were fully aware of what it means with regards to

transition in solid waste management and almost an equal number of Dhaka residents have a different opinion with regards to what the private sector is doing to help promote transition in waste management. Based on the finding, it is evident that Bangladesh is applying a conventional waste management system. One factor associated with the conclusive assertion made that is based on the postulation made by UNDESA (2012) who writes that conventional waste management often depends completely on administrative institutions, thus private sector and local people have a little contribution in the waste system (TABLE 1).

Another result from the research was that a majority of responders think that the private sector is an important input in the transition in solid waste management and should be allowed to own landfills. Based on the finding, it is evident that the residents of Dhaka are ready for transition in solid waste management through ISWSM, which unlike conventional solid waste management, as written by UNDESA (2012) advocates for the involvement of the society in waste management (TABLE 1).

#### **4.7 Summary of Chapter**

This chapter described the experiment which involved outlining how the collected data would be presented. After then the research process was proceeded and described which outlined the procedure used to achieve the research objectives and the research questions outlined in the introductory chapter. Thereafter, it is proceeded and conducted data analysis by the use of Microsoft office word 2016 software. Ultimately, he presented findings based on the visually presented data collected from the field.

## 5 RECOMMENDATIONS FOR THE FUTURE STUDIES

### 5.1 Introduction to Chapter

This chapter will present the recommendations based on findings discussed in chapter 5. It will also try to provide a justification for why it is important to adopt the recommendations. Ultimately, it will offer a solid conclusion based on the findings and recommendations with close linkage to the secondary data collected and presented in the second and third chapters.

### 5.2 Recommendations

One of the recommendations put forth is transformative social innovation theory should be adopted in Bangladesh under the ISWM model. TSI theory outlines the roles that specific actors play in the achievement of transition in society. Presently, Bangladesh uses a conventional waste management system that is less efficient as it proposes for exclusive government involvement in solid waste management, does not value waste and practices negligible involvement of the public and private sector in the policy-making procedure.

Another recommendation made is that transformation in solid waste management should be carried out in Bangladesh with immediate effect. The recommendation is proposed because the prevailing situation and conventional waste management system is not effective enough to get rid of solid waste from the streets of Dhaka. Therefore, the transformation should be as swift as the prevailing condition of solid waste management is alarming.

It is also recommended that the municipality should ensure that residents of Dhaka and Bangladesh, in general, are provided with plastic bags which they would use to store solid waste awaiting transportation to a single disposal point. The provision of plastic bags would reduce the rate of throwing litter on the streets as they would have a place to store garbage.

Additionally, the recommends are that the municipality should take up the role of solid waste disposal. At present, the municipality has not fully initiated this move resulting in some residents of Dhaka disposing of their waste by themselves. It is recommendable that solid waste disposal is exclusively done by the municipality as it would ensure that all the garbage is collected and

disposed at a single point. Besides, the municipality has the potential to carry out this task because it has the means to initiate ISWM efficiently.

Moreover, the municipality should put more efforts in ensuring proper solid waste management and disposal. One way to ensure this is through adopting proper channels in transitioning to solid waste management. Some of the channels as recommended are documented in the ISWM system. For instance, the ISWM model proposes a hierarchical model in solid waste management. Hierarchy minimizes waste and saves on costs.

Another objective of the research is for Bangladesh to allocate more funds to the municipality for the attainment of the adoption of the much-needed transition in solid waste management. Sustainable development through social innovations is a long-term investment, whose effects are likely to be felt after years. Besides, reshuffling the entire system in place and replacing it with an ISWM model needs enough funds. For instance, recycling would yield returns, but before conducted, the government needs to invest in educating the citizens on the various methods of recycling waste to make products that are harmless to the people.

Ultimately, it can be recommended that the municipality should mobilize its citizens on why it is important to ensure proper disposal of waste through adopting new methods of solid waste management. Some of the methods include the use of media campaigns such as Facebook advertisements. The platforms, according to Soron et al. (2013, 3) has a majority of subscribers in Bangladesh with both male and female users accounting to 53.2% and 46.8% of users. Another method to propose is the use of billboards, posters and magazines to show residents the importance of proper solid waste management and methods of transition.

## 6 CONCLUSIONS

The world is in constant change. New innovations are adopted by countries and they cause a change in the global environment. Bangladesh is not left out. She too has her own innovations that span from the industrial waste, which is largely produced, to the home-based waste, which is often ignored. Innovation is inevitable. Bangladesh too needs to enrich her industries, but it is key to consider innovations with regards to sustainable development, which lacks in Bangladesh.

Sustainability depends on the way a nation conducts its activities. In Bangladesh, the government utilizes the conventional method of solid waste management which gives precedence to the administration to carry out solid waste management; ignoring the residents. This technique is blamed for the current status of deteriorated solid waste management in Bangladesh. Research indicates that it is common to find litter scattered across the streets of Dhaka. Also, the nation lacks a properly formulated policy document that discusses social innovation for sustainable solid waste recycling.

This research aimed at identifying the state of solid waste recycling in Bangladesh and the opportunities for sustainable recycling. Bangladesh, a third world country that is richly endowed with resources greatly suffers from solid waste management. The potential of the country is dependent on the resources, which when recycled and disposed of in the right manner would lead to a sustainable transition from the present degraded solid waste management status. In Bangladesh, the conventional method of solid waste management currently in use hinders the involvement of the society in solid waste management. Yet, research shows that sustainable development is a form of social innovation. Therefore, Bangladesh does not practice social innovation. Social innovation, which has been found by this research to help in formulating new methods of carrying out activities at the societal level that would have an effect on the people's lifestyle and the economy. Bangladesh has centered her approach on the application of the process of waste management by local government authorities. She has to establish a place where waste collected from households would be stationed and then disposed of. The nation has not focused on the applications of social innovations and the use of technology to improve the process of waste management. makes it challenging for countries that desire to apply the use of technology through

social innovations to apply a more robust means of waste management. Therefore, the research has found out that the ideal way to change the current status is by adopting the ISWM model.

One of the objectives of the research was to establish that social innovations lead to a sustainable transition. Another objective was to identify some of the innovations that Dhaka can use to enhance sustainable transition. Research has indicated that truly, social innovations lead to sustainable development. For instance, ISWM, which is the research's recommended model for adoption with regards to sustainable transition focuses on the involvement of the public in solid waste management. The people of Dhaka contribute a huge amount of solid waste at the household level. Besides, this research has indicated that waste manners such as scattering are connected to communal standards, especially in public areas. Teaching them the essentials of the ISWM model would serve to enhance the development of innovation at the societal level for a sustainable transition to better waste disposal methods.

The last objective of the research was to make recommendations based on the prevailing trends with the view of showing the need for social innovation to enable sustainable transition. One of the essential features of the ISWM model is that it efficiently utilized is recycling. In ISWM, waste is considered as both helpful and undesirable, based on its possibility as a source of earning to both the industries and individuals at the small scale level. Unlike at present where waste typically denotes to a substance treated as not important, has no value or is no longer useful, ISWM model defines waste as an unavoidable yield of our humanoid schemes, which at the conclusion, has robust insinuations in relation to ecological, communal, monetary and legal matters for trades, local authorities, groups, and administrations. Therefore, through social innovation inline to ISWM model discussed in the thesis, Bangladesh will develop sustainable waste management through social innovations guided by the ISWM model. Based on the research, it is evident that Bangladesh has done little with regards to social innovations in solid waste management. What exists is a model propelled by the small scale traders who often collect solid waste and sell it to other traders for recycling, and the individual initiative of residents of Dhaka to collect household waste in bins. Bangladesh citizens lack a well-stipulated system to guide in solid waste management.

ISWM proposed by the research foster the transition initiatives to create a relationship between new urban realities such as sharing economy, green economy and sustainable lifestyle. In this thesis, it is argued for the requirement to develop a theory of transformative social innovation, by finding out how networks of social entrepreneurs and families of social innovation comes to contribute to the general social amendment. This is because through the help of social innovation it is possible to transitioning and emphasizing the important role by the communities. Some of the measures that Bangladesh needs to take in relation to social innovation include initiating change at the grassroots level among the vulnerable group of society, broader level initiative and systematic type initiative and systematic type initiatives which looks into the core changes in the behavior, attitudes, values, structure, and processes of organizations, strategy and policy, services and delivery systems.

Conclusively, social innovation can analyze the systematic sustainable transition and societal challenges to have a sustainable society. Therefore, for sustainability, Bangladesh needs to shift from the conventional solid waste management system to the ISWM model. The ISWM needs time as it aims at developing social innovations, which take time to be adopted by the society but yield unsurmountable returns that include sustainability in solid waste management, cheaper means of solid waste and a source of income through recycling. Ultimately, ISWM will make Bangladesh and the world a better place to live through reduced emissions and a cleaner environment. Although not all research questions were answered, it can be comfortably concluded that the strategies adopted to validate social innovation as a strategy for a sustainable transition. All areas in transition in solid waste management in Bangladesh was not exhausted. Therefore, the area is open for more researchers to explore.

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## APPENDICES

### APPENDIX 1

#### Questionnaires

#### Interview Schedule

##### I. Opening

A. (Establish Rapport) [shake hands]. My name is.....I am a student completing my Master's degree dissertation. I thought it would be a good idea to interview you so that I can understand your viewpoints on the transition in waste management.

B. (Purpose) I would like to ask you some questions about your background, your education, some experiences you have had with solid waste management , especially the transition from the traditional solid waste disposal methods to the current trends .

C. (Motivation) I hope to use this information to understand transition in solid waste management because it will assist me develop strong recommendation of what is needed to achieve the transition for a better Dhaka. .

D. (Timeline) The interview should take about 15 minutes. Are you available to respond to some questions at this time?

(Transition: Let me begin by asking you some questions about where you live and your family and the mode of solid waste disposal you use and intend to use)

##### II Body

A. (Topic) General demographic information

1. How long have you used new methods of waste disposal?
2. Do you have a small or large family? Based on your response, what is their attitude towards new methods of waste disposal?
3. Is proper waste disposal becoming increasingly difficult?

### III Closing

A. (Summarize) Are you involved in solid waste collection?

B (Maintain Rapport) I appreciate the time you took for this interview. Is there anything else you think would be helpful for me to know so that I can successfully incorporate in my research?

C. (Action to be taken) I should have all the information I need. Thanks again.

### APPENDIX B/1

#### Questionnaire Disbursed at Dhaka

#### TRANSITION IN WASTE MANAGEMENT

#### Demographic Data

**Name (optional):** \_\_\_\_\_

**Age:** \_\_\_\_

**Gender:** \_\_\_\_

**Occupation:** \_\_\_\_

#### Number of Family Members (Optional):

1-2

3-5

6-10

More than 10

**Email Address (optional):**

## Questionnaire

### [SCREENING QUESTION]

**Q1. Are you satisfied with the current state of solid waste management?**

Yes [end survey]

No

### [END SURVEY SCREEN]

I surely appreciate and value your response. I'm seeking to understand the opinions of people of Dhaka who are not satisfied with the current state of solid waste management. **Thank you for your time.**

## Continued Survey

Thank you for agreeing to take this survey. The survey is conducted as part of the fulfilment of my undergraduate degree program. The funding for this survey comes from my resources as well as my family. The purpose of the survey is to collect opinion from residents of Dhaka on current state of transition in waste management.

All of the answers you provide in this survey will be kept confidential. No identifying information will be provided to the university or any other institution that accesses the information outlined here. Equally, the survey data will be reported in a summary fashion only and will not identify any individual.

This survey will take about 12 minutes to complete.

**Q 2. Have you seen solid waste poorly disposed while walking on the streets of Dhaka?**

Yes

No

**Q 3. Do you have plastic bags which you use to store solid waste awaiting transportation to a single disposal point?**

Yes

No

**Q4. How do you get rid of solid waste?**

Collected by the municipality

Disposed by me or a family member.

**Q 5. Do you think the municipality has the potential to reduce poor solid waste disposal?**

Yes

No

Maybe

Not sure

**Q 6. How do you feel right now about the effort of the municipality in combating poor solid waste disposal?**

Approve	Somewhat approve	Neutral	Somewhat disapprove	Disapprove

**Q 7. On a scale of 1 to 5, how happy are you with the way the municipality is applying transition in waste disposal?**

**(1 being very unhappy and five being very happy).**

1	2	3	4	5

**Q 8. On Dhaka streets, do you think that the municipality should:**

	Yes	No	Not sure
Come up with regulation regarding how waste is disposed?			
Mobilize citizens on transition to better waste disposal?			
Increase disposal points?			

**Q 9. How familiar are you with transition in waste management?**

Not familiar	Extremely familiar	Mostly familiar	Mostly unfamiliar	Somewhat familiar

**Q 9. Do you think the private sector is doing enough to help in transition waste disposal?**

Yes

No

If yes, proceed to question 12

**Q 11. Do you think the Private sector should be restricted from owning landfills ?**

Yes

No

**Q 12. Do you think the government should?**

	<b>Yes</b>	<b>No</b>	<b>Not sure</b>
Decrease the number of legal landfills			
Campaign against the practice of illegal dumping;			
Decrease street littering and waste			

## APPENDIX 2

**Questionnaire Dispatch Plan**

No of Questionnaires	Date	Number collected	Sign
5	20 <sup>th</sup> February 2020	4	
5	21 <sup>st</sup> February 2020	5	
5	24 <sup>th</sup> February 2020	5	
5	25 <sup>th</sup> February 2020	4	
5	26 <sup>th</sup> February 2020	4	
5	27 <sup>th</sup> February 2020	5	
Total:			

**Facilitator Biodata**

Name: Abdul Khaled

Age: 37

Marital Status: Married

Religion: Islam

Occupation: Teacher