

Recyclable Invaluable Solid Waste Segregation: From Mess to Order



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CERTIFICATE

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Abstract

When dirty cities overtake the natural beauties of grassy fields, lush green mountains, rivers, deserts, and sea; we have to think about the reason as well as solutions that could work in our case. Ever-increasing, unattended waste dumps can be seen if we travel from Peshawar to Karachi. Undesignated mixed waste dumps along 100s of kilometers railway tracks and GT roads are enough to invite attention that we must do something to eradicate this menace from our environment. As many valuable studies have been conducted on solid waste management and willingness to pay, this study endeavors to focus our attention on solid waste segregation at source, which if conducted effectively could result in better capture, participation, recycling and diversion rates. Through descriptive analysis, it became evident that if proper infrastructure is developed by the responsible agency, people are willing to segregate their waste. The authorities if begin to devise mechanisms we confidently foresee better environment and economy of virgin resources. Emphasis on waste segregation will be helpful in circular economy and creation of additional job opportunities without any extra burden on the national exchequer as segregation at source will give the solid waste management financial sustainability.

Keywords: segregation at source, segregating bins, recyclable, compostable, landfill

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Chapter 1: Introduction

1.1 Background of the Study:

Liquid waste is easily disposed of through sewerage system due to gravity. We only channelize the liquid waste and mostly it finally reaches where we intend to. This is not the case with solid waste as it does not move with gravity therefore, solid waste is perpetually required to be managed by action as it neither flow nor evaporate. Therefore, solid waste management (SWM) requires a lot of current expenditure, knowledge and awareness. World Bank (2018) reports that world generates 2.1 billion tons of solid waste annually. Here an alarming report has been presented that by 2050 global waste generation would grow to 3.4 billion tons annually.

According to various studies Pakistan generates from 54,795 to 87,000 ton of solid waste per day which is increasing @ 2.4% annually. It is obvious that population and waste generation are increasing year by year.

The substances that we waste—are not actually waste for all—they could be a valuable resource for others. Therefore, it is important to dispose of waste in a manner that their content value is conserved maximum. The wet waste e.g. residual food, vegetable or fruit scraps, residual juices, horticulture waste are biodegrade within foreseeable time but, to maximize their benefits these wastes should be composted. Quite a number of non-decomposing, non-biodegradable materials are in our daily use calling the need for in time solid waste segregation prior to primary waste collection and transportation.

Governments usually strive for the improved solid waste management practices to ensure clean environment and reduce greenhouse gas emissions. However, their efforts remain unsuccessful due to their limited knowledge of optimal waste management practices. Therefore, there is a need to investigate the success stories of zero waste management and to know which factors—institutional or cultural, are impeding in making our country ecofriendly.

Many studies on solid waste management have been conducted. These studies focused waste generation and phases of its management beginning from primary collection to final disposal at landfill site. However, of most studies waste segregation has not been the main focus. Any efficient waste management system will ultimately fail unless waste management begins with waste segregation at point of waste generation otherwise, the ever increasing quantities of waste could not be managed sustainably as desired. The result of this is litter in rural and urban dwellings, disease and environmental deterioration.

Besides many causes of mismanaged solid waste, one basic negligence that we are investigating in this study is the prospect of solid waste segregation. The situation becomes more frustrating when we see that all type of waste is mixed disposed of at the source and the same is transferred to crude dumpsites. It is emphasized that when recyclable, compostable, combustible, hazardous and infectious waste are mixed thereby the value of recyclable, compostable items is compromised resulting in (i) increased land requirement for dumping waste (ii) deteriorated underground potable water quality. There is a need to develop recycling and composting facilities in order to convert the invaluable/too inexpensive solid waste into valuable resource.

Hence, we need to understand today's complex solid waste management form project design to implementation and later evaluation. This thesis endeavors to explore the causes of mixed waste disposal at source and potential in the society to segregate recyclable invaluable solid waste for betterment of the environment. It is need of the hour that all municipal departments be empowered to make necessary arrangements for the collection of segregated solid waste from sources, to achieve a healthy environment that is free from aesthetic nuisance and disease.

It is to be noted that the people do not take care of the activities which benefit they do not have directly. Therefore, such activities e.g., solid waste management come under the purview of public policy.

As general waste consists of paper, plastic, fruit peels, vegetable leaves, cardboard, wood, metal, diapers, hairs, and dust etc. but, if all these are disposed of mixed the benefit from them cannot be exploited. As these items are not salable unless segregated for recycling, so nobody takes these items and these are lying here and there in our localities and become health and environmental hazard.

1.2 Laws on Waste Segregation

There are no waste segregation laws in Pakistan. In view of the increasing waste quantities due to increasing population it has become need of the hour that the we start with the basics of solid waste management i.e., solid waste segregation at source. In the cities of Pakistan uncontrolled increase of informal waste dumpsites here and there is not only a visual pollution but hazardous to environment, health and already stagnant economy. We are responsible of over utilizing our own virgin resources while knowledge and technologies exist to reap value from the waste.

No one would like to have waste room in our houses so why we tolerate waste 'room' on earth in the name of whatever dumpsite or landfill? Obviously, we would not like to maintain waste 'rooms' in our only dwelling planet the earth. To achieve this objective it is necessary that we strive to achieve the goal of zero waste approach. This approach has been adopted by Switzerland, Sweden in line with zero waste policy these countries are pursuing. Waste segregation policy help in 3R

policy i.e., Reduce, Reuse and Recycle. Lest more and more land will have to be reserved for waste storage along with waste`s environmental and health hazards.

Citizen can be trained to segregate their waste at source but citizen`s capability to recycle and compost is difficult. In view of complexity of recycling and composting it is rational that some authoritative organization at local level should intervene and provide facilities and opportunities for recycling and composting. It is to be noted that recyclable materials and compost must have its market otherwise increase in waste cannot be avoided.

1.3 Waste Management in Islam:

Islam emphasizes on cleanliness and Bukhari, narrates hadees

الطهور شرط الايمان

This hadees mean that the big part of belief is cleanliness.

Muslim (35)

عَنْ أَبِي بُرَيْرَةَ قَالَ قَالَ رَسُولُ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ: الْإِيمَانُ بِضْعٌ وَسَبْعُونَ أَوْ بِضْعٌ وَسِتُّونَ شُعْبَةً. فَأَفْضَلُهَا قَوْلُ لَا إِلَهَ إِلَّا اللَّهُ وَادْتِنَابَا لِطَائِفَةِ الْأَذَى عَنِ الطَّرِيقِ وَالْحَيَاءُ شُعْبَةٌ مِنَ الْإِيمَانِ

Prophet Muhammad (pbuh) has said that the lowest branch of belief is to remove harm from the way. We understand from this hadees that waste dumps cause harm to the environment and health of not only humanity but, they are as well dangerous to animals as well. So if we are believer we must make efforts to remove crude dumps from our localities. This objective could only be achieved by beginning waste segregation at source.

The nature maintains balance in the environment. Animal and plant life exists in the environment, therefore, they are produced and die but we do not see their biological or botanical waste very often one reason being responsible agencies dispose them of, secondly nature makes these waste extinct without in a much shorter period. Nature has mechanisms to adjust natural waste. Whereas, manmade waste is not removed by natural phenomena therefore, man has been given capacity and knowledge to remove such waste sustainably.

On the other had if man do not make effort to remove his own created waste properly then he is not a true believer of Allah swt and not fulfilling His commandments in letter and spirit.

Allah swt says in chapter 7 verse 31 says that “O children of Adam, take your adornment at every masjid, and eat and drink, but be not excessive. Indeed, He likes not those who commit excess.”

This verse of holy Quran command us that we must not waste.

The demand of this verse ideally couldn't be fulfilled until we effort to sort our waste at source to attain the target of zero waste. This idea is practical and in Japan, Switzerland is being practiced. Most of the researches have concluded that source segregation is key to effective and sustainable solid waste management system however, few researches might have research public willingness to segregate their waste at source. In this research, we have endeavored to explore the conditions wherein public would do 'at source municipal solid waste segregation', hence, environment and health conditions of the locality would improve.

1.4 Research Question:

To know whether households are willing to play their part in the waste management through agreeing to segregate the municipal solid waste. To identify a pragmatic sustainable solution for waste management by Municipal authorities.

1.5 Objectives of the study

- (a) To explore people's awareness regarding waste segregate as a waste management strategy.
- (b) To explore people's willingness to segregate if infrastructure to segregate waste is provided.

The aim of this thesis is to assess possibility of reducing the amount of waste that is increasingly going to landfill/dumpsites in Pakistan-that otherwise could be recycled or composted. It has been proved empirically that actions of reducing the amount of rejected waste ultimately make the environment beautiful, lowers diseases and less land is required for landfills/dumpsites and obviously such sites must be scientific/sanitary.

1.6 Hypothesis of the study

The objectives of this research are to explore people effects of waste segregation on environment, health and public willingness to carry out waste segregation in case infrastructure is provided.

H₀₁: There is no positive effect of municipal solid waste segregation at source on environment.

H₁₁: There is positive effect of municipal solid waste segregation at source on environment

H₀₂: Public will not use segregated bins provided by the responsible agency

H₁₂: Public will use segregated bins if provided by the responsible agency

H₀₃: Public has no awareness about solid waste segregation

H₁₃: Public has awareness about solid waste segregation

1.7 Significance of the Study

In view of increasing population and waste generation side by side this study tries to make public aware of the importance of waste segregation at source by informing them that that segregating waste at source improves environment, quality of life, health conditions and conservation of virgin resources through recycling and composting. This study can be considered by the responsible authorities to begin pilot projects for solid waste segregation to make more material available for recycling and composting.

There is a requirement that virgin resources are only utilized when recycled resources have been consumed. The industries should be required that in their production lines their first priority will be utilization of recycled raw material. To achieve the objective of quality recycled raw material at economic/competitive cost it is necessary to sort the waste at primary storage level. As mixed waste disposal lowers the possibility of recycling and composting due to contamination.

In order to implement 3 R concept the study of waste segregation infrastructure and public willingness to segregate their daily waste will be instrumental to save virgin resources improve health and environmental conditions. Segregation provides more waste to be converted into recyclables and compostable. In addition to this effective segregation practice by the public under provision of law and necessary infrastructure will also provide economic benefit to the country through improvement in the environment, health and conservation of virgin resources. Segregation study will further guide researchers' ways to reducing waste and conservation of cultivable land. Additional out of use waste ultimately go on dumps which are made on vacant plots of land.

The purpose of this study is to research the circumstances wherein public will do solid waste segregation at their home. Earlier studies have researched willingness to pay for better solid waste management services.

1.8 Organization/Structure of the Study/Thesis

Chapter 1: In connection with increasing population and consumerism – importance of solid waste segregation at source is introduced.

Chapter 2: Different studies conducted on solid waste management are discussed. The studies emphasize need of effective and efficient solid waste management for Pakistan. The studies proposed solid waste segregation to obtain better efficiency for recycling and composting.

Chapter 3: Informs about sampling population and samples size. Sample is collected online in view of COVID-19 pandemic. Analytic framework has also been provided to understand current and

desired solid waste management. A questionnaire hosted on internet which finding have been evaluated and reported.

Chapter 4: Management of solid waste of Pakistan in general and of Islamabad in particular has been debated. As a sample SOPs of Management of Sanitation Services in Islamabad has been given.

Chapter 5: In view of respondents' responses results of research have been informed and explored.

Chapter 6: On the basis of the respondents' responses some conclusions have been drawn and policy objected have been recommended.

Chapter 2: Literature Review

Literature for this study has been obtained from internet and references have been mentioned. Waste generation quantities and their impact on health and environment in Pakistan has been discussed. To highlight the issue—how solid waste in the society can be decreased? What would be the impact of solid waste segregation at source in Pakistan? In this regard how public behavior could be affected. What advantages we could reap out of waste segregation are some questions we have tried to find from the literature.

Public has a tendency of littering not only outside their houses but into their houses as well. Small pieces of rubbish e.g., food items packaged in card boxes, wrappers cans, bottles, paper, tetra packs etc. People dispose of carelessly in one bin, most of the waste gets commingled so require more labor, time and energy to bring them in the form that is considered appropriate for recycling or composting.

Mixed throwing—in crude dumpsites (of solid waste), waste renewable resources i.e., organic waste which could have been used to make compost or, to produce energy through extracted biogas, will not only be wasted but also give out greenhouse gases i.e., CH₄ and CO₂ in the atmosphere. Greenhouse gases increase the temperature of our only planet earth to live in. Such careless disposal of rubbish deprives the community of valuable recyclable and compostable items.

2.1 Quantity of Waste Generation:

Currently, about 2.01 billion metric tons of municipal solid waste (MSW) is produced annually worldwide. The World Bank estimates that overall waste generation will increase to 3.40 billion metric tons by 2050. An estimated 13.5% of today's waste is recycled and 5.5% is composted (WasteDive. n.d. para. 3)

Department of Commerce, USA (2019. para 1) informs that about 48.5 million tons/annum of waste is generated in Pakistan with annual increase of 2%. It says that government of Pakistan estimates suggest that about 87,000 tons/day is generated from most major metropolitan cities of Pakistan. As such waste generation would not have been a big problem if the waste were being managed sustainably. Unfortunately, all the invaluable solid waste generated in Pakistan ends up either in remote crude dumpsites (as no scientific landfill sites exists in Pakistan), waste dumps in the city streets or vacant plots etc. Now and then, reports of waste giving shabby looks are published in daily newspapers but authorities don't pay any attention. Karachi, Lahore, Faisalabad, Rawalpindi, Hyderabad, Multan, Gujranwala, Sargodha, Peshawar and Quetta together generate 43,290 tons of waste per day.

2.1.1 The Decomposition of Waste in Landfills:

(Website: The Balance Small Business) Scientists have calculated decomposing time of different packaging materials. The longer the decomposing period the greater the disturbance in the eco system. The more recyclable materials go to landfill the more virgin resources are depleted. In this study we endeavored to emphasize sustainable consumerism where products which ingredients are recyclable or decomposable are preferred. To highlight what damage the items do which, otherwise would be recycled or treated, to the environment if dumped or buried in the landfill out of consideration of their disastrous effects.

2.1.2 Plastic Prospects of Recycling:

Hussain, S (2019). Daily The News informs that 50,438 tons of municipal solid waste is produced in Pakistan. According to a conservative estimate about 35,307 per day tons goes to landfill (70% of produced municipal waste). The article states that in Pakistan 6.41 million ton of plastic waste is produced annually.

2.1.3 Aluminum Cans Prospects of Recycling:

The website recycle across America, states that in America the quantities of aluminum cans thrown away in 3 months, are enough to rebuild the entire American commercial air fleet. Such examples clearly show that in case we segregate and recycle waste the enormous quantities of virgin resources we would be able to conserve.

2.1.4 Decomposition Life of Different Packaging Materials:

Waste Item	Decomposition Time
Tinfoil	Does not biodegrade
Styrofoam	Does not biodegrade
Glass	A million years
Plastic bags	10-1,000 years
Plastic	1,000 years
Sanitary pads	500-800 years
Monofilament fishing line	600 years
Plastic bottles	>= 450 years
Aluminum cans	200-250 years
Batteries	100 years
Rubber boot soles	50-80 years
Foamed plastic cups	50 years
Tin can	50 years

Waste Item	Decomposition Time
Nylon fabric	30-40 years
Leather shoes	25-40 years
Painted board	13 years
Lumber	10-15 years
Cigarette butts	10-12 years
Milk cartons	5 years
Wool clothing	1-5 years
Plywood	1-3 years
Ropes	3-14 months
Canvas products	1 year
Food waste	1-6 months
Cotton gloves	3 months
Cardboard	2 months
Paper	2-6 weeks
Train tickets	2 weeks

Table 2.1

2.2 Impact of Waste on Public Health in Pakistan:

Lew, R. (2019) reports that about 5 million people in Pakistan die each year due to waste related diseases. The article also explains that Pakistan is the 6th most populous country of the world in accordance with the population there exists consumerism and waste generation both are at increasing rate. The solid waste generation growth rate in Pakistan is 2.4 %. The site also writes that different type of waste is not collected separately is also a problem.

A study conducted by Nisar, et al., (2008) provided valuable information on the problems of waste management in Rawalpindi city of Pakistan. The study also concluded that mixed throwing of waste expose waste pickers to infections, skin cut on touching/picking sharp metal items, chemicals dioxin which are severely injurious to health.

Lew (2018) informed that more than 5 million people in Pakistan die each year due to waste related diseases. The writer attributes the problem of urban waste to mix collection, inadequate planning, obsolete infrastructure, lack of public awareness and corruption. He said that in the city of Lahore 27% waste is informally recycled by scavengers and 8% is composted.

2.3 Solid Waste Segregation:

Árnadóttir et al., (2018) undertook a study in Netherlands to know the determinants of solid waste segregation behavior. The study had pre-/post-test design. In study 1 determinants of waste segregation behavior was explored then, an intervention was done, later a semi-qualitative study of 59 students was conducted to evaluate the intervention. The second study showed that (a) students have little knowledge about waste segregation. (b) Only just above half of the waste is recycled. (c) Though students evaluated the intervention positively but: the study revealed the gap between intention to segregate waste and actual waste segregation behavior.

Study concludes that if on each product waste color is given corresponding to the stream the waste should go to it would improve the waste segregation behavior at the time of disposal by the consumer.

The research appreciated the part of the city Maastricht to eliminate unsorted household waste collection by 2030. A very relevant research for this thesis. If intervention in such developed countries are required to promote waste segregation behavior we may understand the amount of work in countries like ours is required.

Yee, (2016) conducted research in Malaysia and emphasized that waste segregation before primary collection of waste by the waste collector is of prime importance as it improves the quality of recyclable and compostable waste material. The study also noted that continuous information on waste segregation be given to the public. The study devised 4 waste segregation attributes namely (1) Accessibility to recycle bins, (2) Waste Segregation Information, (3) Waste Segregation Incentive, (4) Waste Segregation Reminder. The study is helpful to promote waste segregation behavior in Pakistan. Yee, (2016) informs of study Masson (2004), that segregation of waste at source increases recycling rate by 84% in the open area of Massey University, New Zealand. The university has 9,000 enrollment.

Malakahmad (2010) conducted a study pointing out that all the dwellers dislike development of landfill site near their housing. The outcome of survey also shows that only 53% of the respondents practice waste segregation although 75 to 80% willing to segregate their waste but fail due to non-availability of enough waste separating bins. The results of the survey showed that if enough recycling bins are made available most of the people will separate their waste, which will make more recyclable and compostable available. The adequate number of recycling containers will help in reducing the waste generation.

Amjad (2015) a study conducted in two tehsils of Quetta to determine willingness to pay for better solid waste management. Total sample size of the study was 260. Using probit model it was found

that 63% respondents are willing to pay Rs. 227/month. 68% of the respondents are aware of the waste problem. The study shows very little willingness of public i.e., 3.1 % to segregate waste. The government in collaboration with the universities should conduct studies to determine the causes of mixed waste disposal.

Pakistan Low Carbon Analysis (2016) discusses that if waste segregation at source is undertaken, we could have more organic waste for compost generation. The CH₄ gas if collected systematically from the organic waste could be used as fuel. Pakistan Low carbon analysis (August 2016) the report suggest that composting of food waste is not possible at the point of generation therefore, it is proposed that at household level food is stored separately for collection which will help central composting facilities to convert quality composts. In the like manner if households are expected to separate their waste they need to be given awareness regarding separation of waste in some major categories so that commingled/recyclables are ready for primary collection. The households need to be made aware that segregation at source improves the quality of goods which base raw material from commingled waste.

Asian Development Bank (2013) analyzed the ever growing municipal solid waste problem of southeast Asia and found that by 2025 about 1.8 billion ton of mixed municipal solid waste would be generated per day in the region under consideration. The publication calls for investment in material recovering facilities under local government. It was also cleared from the publication that disposing of mixed waste makes material sorting more expensive and affects waste diversion i.e., availability of fewer materials for recycling and composting.

2.4 Waste segregation situation India:

Kansal (2002) discusses that no waste segregation practices exist in India. Still waste recycling sector is growing due to demand of low priced products made out of recycled materials. In this connection due to increased consumption pattern plastic and paper recycling is increasing. The study considers waste management as composed of 3 components i.e., (a) storage and segregation of waste at source, (b) primary collection and (c) secondary collection. It was emphasized that the waste at source must be separated in biodegradable and non-biodegradable streams. The study promotes segregation at source. In order to make waste segregation successful and to stop mixing of waste at any stage it suggests that waste not only stored in different stream bins but their primary and secondary collection should be carried out on different days to ensure synchronization at all stages of segregated waste collection. The practice expects more availability of recyclables, compostable and the final residue–non-compostable, non-recyclable, would go to landfill sites.

The Asian Productivity Organization (2007) reported that “in India residents were encouraged to separate their waste and bring it to the appropriate locations for collection. Paper, scrap metal, glass, and plastic are the common items segregated and collected by the waste pickers. Waste pickers play a significant role in recycling activities. They—individuals or groups—collect saleable items from the waste-collection bins, households, and dumpsites. Organic waste is converted into compost in several cities as a part of their recycling activities. However, the rate of recycling in Asian developing countries is far from satisfactory. The low recycling rate can be attributed to poor strategic planning and to the implementation and enforcement of the policies. Lack of good incentives can also be a main factor in the poor waste recycling rate.”

2.5 Waste Segregation and Public Behavior:

Agarwal et al., (2015) has rightly identified waste management strategy by providing information on type of wastes i.e. dry waste, wet waste and the items that did not come under any of these categories. It also put light on hazardous and non-hazardous waste. The authors concern that by sending waste to landfill/dumpsite is not an ideal solution of waste problem instead it actually, later pose much bigger problem. The study suggests a sustainable solution to waste problem that in public the behavior to refuse, reduce, reuse and recycle should be inculcated which begins by segregating waste at source. Otherwise, waste that goes to landfill would be out of control. It also recommended that in order to make source sorting viable, waste bins for different waste streams should be provided so that occupants could sort their waste easily. The places where provision of sorting bins is not possible the same may be provided at some designated spot for a certain number of households. This initiative should be taken for public wellbeing. The academic paper calls for public behavioral change as the writers have no control on governmental agencies with regards to policy making and regulations.

Singhirunnusorn, et al., (2012) conducted a study in the city-Maha Sarakham, Thailand, demonstrated that social-economic factors play little role in waste separation instead environmental knowledge has a bigger impact on the behavior of public. To explore the recycling and social economic situations 151 number of questionnaires got filled from two communities of Song-Nue and Ban-Maad. The survey was conducted in view that a project (waste recycling bank) in one community (Song-Neu) had been continue since 2003 the other (Ban-Maad) where no such project was in progress. The municipality started the project with 10,000 baht (USD\$320). The participant members were given option either to sell their sorted waste for cash or credit their accounts. The members could get profit at the end of the year or may enjoy loan facility for daily use and for emergency as well. Later the municipality sold the recyclable to private

recyclers/scavengers. The respondents from Ban-Mad showed better knowledge of household solid waste its collection, recycling and disposal than Song-Neu.

The respondent from Ban-Mad represented better attitude level. Study proves that environmental knowledge is more important and public attitude contribute more in waste segregation than their demographic and socio-economic factors. From the study we explained that in past waste was utilized in agriculture but in the modern age the materials consumption pattern have changed and number and categories of disposable items have increased therefore waste segregation is need of the hour otherwise environment would deteriorate more and more rapidly.

Necessity for initiation of waste segregation pilot projects: In Pakistan metropolitan corporations etc. if empowered may initiate waste recycling projects to promote waste separation sense in the public with some seed money. Khattak, et al., (2009) reported that in Peshawar 49% of the household respondents were willing to pay for better solid waste management services while, 53% of the household respondents were satisfied with the prevailing situation of solid waste management services at that time. In the study logistic regression model was used to find the determinants of willingness to pay (WTP) for better solid waste management services. The study recommends the government to encourage material management behavior in the people. In order to inculcate such behavior people should be made to sort their waste at source so that valuable items could be recovered and environment is healthy. The study emphasized that the people’s willingness to pay should be utilized to provide the people better environment by implementing better solid waste management system.

2.6 Waste Segregation Facilitate Provision of Bio Mass:

Rafiq, (2016) explained that if biodegradable waste (refuse of cattle) is not mixed with other waste it could be helpful in generating bio-gas which could be utilized for heat energy and power generation. The study informed that 1 cubic meter biogas generates 2.5 kWh of electrical power. In Islamabad, about 660 ton of municipal solid waste is produce out of which about 57% is organic waste which may be used as bio fuel. The study apprised on the use of municipal solid waste for power generation.

Waste to Energy			
Amount of organic MSW	380 ton	Net present value (NPV) Rs.	1,113.9 million
Amount of biogas	51,322 meter ³ /day	Discount rate	12%
Electricity generation	104,973 kWh/day	Internal Rate of Return (IRR)	22%

Waste to Energy Tariff	11.22/kWh	Benefit Cost Ratio (BCR)	3.28
Benefit from sale of electricity	289 million/annum	Payback Period (PBP)	4.8 years

Table 2.2

It was estimated that if such project had been installed then 206.84 ton of CO₂ equivalent emission could be reduced or saved by 2030. CO₂ is a greenhouse gas increased quantities of which in the atmosphere increase earth temperature. The data for this study was collected from energy related government departments like, NEPRA, AEDB. Biomass on burning generates CO₂ which plants absorb in the process of photosynthesis. CH₄ is produced when organic waste is decayed which may be extracted for energy generation.

The point here is that we should not mix non-organic/biodegradable waste with inorganic/non-biodegradable waste in order to provide quality organic content for biogas. In the like manner combustible high energy content may be available to be used as fuel.

2.7 Management of Waste in Lahore:

Masood et al., (2014) reveals that LWMC is only responsible for secondary collection of mixed waste from designated dumpsites. They do not collect mixed waste from cantonment and private housing societies' areas. The study also reports that government do not facilitate scavengers to sort the waste and contribute to reduce inert waste (rejects). The government behavior is that the size of storage containers has been reduced which makes it difficult for scavengers/waste pickers to sort the mixed waste to gather some salable items for their livelihood.

Still because of voluntary and not officially recognized efforts of waste pickers 'environmentalists' the LWMC has to lift 27% less of mixed waste. Another 10% of the salable waste generated (per day), is forehand sorted by the households (at source). The study has presented a holistic picture of solid waste management system in Lahore, Pakistan. The government agencies must introduce prototypes for waste management companies to develop sustainable solid waste management systems all over Pakistan. The study stated that 30% of people of Lahore are willing to sort their waste for recycling purposes however, this low percentage is not appreciable.

The study apprise that the governance in respect of waste management is not good as it doesn't promote local investors in the industry (municipal solid waste). Public is not given awareness about solid waste management on regular basis. The efforts of itinerant waste pickers are not exploited.

Waste generators are not burdened with any responsibility relating to waste. Because of gap between waste generators and waste managers the waste problem is increasing day by day.

Masood et al., (2014) informed on the financial aspects of the solid waste management in the context of Lahore. The budget of the LWMC was 2.9 billion in the year 2009-10 which was raised to Rs. 6 billion for the year 2011-2012. The issue in the finances of the solid waste management services is that LWMC receives its remunerations/charges from two sources. First, it is the 'City District Government, Lahore (CDGL)', for regular operations and secondly, from the Provincial Finance Department, for outsourcing field operations such as solid waste door to door collection and transportation etc. Charges for waste collection services are collected by Water and Sanitation Agency (WASA) which transfers 85% of the amount to the CDGL.

The government should establish a separate department for solid waste management responsible for primary collection, secondary collection, transportation, recycling, composting, landfill site development and its management. Solid waste management is no more a petty department to remain clipped with clean drinking water provision. In order to monitor solid waste problems and timely solution clean water provision should be separated from the water utility i.e., provision of clean drinking water and solid waste management recognized as two independent disciplines. In the like manner household should be billed separately for solid waste services so that public know what standard services it must secure.

Masood et al., (2014) also emphasized (i) policies (ii) the degree of municipal control (iii) control over waste management budget and (iv) management control of the responsible waste management department are critical for sound institutions and proactive policies. It is a pity that most of the budget of solid waste management goes to salaries, collection and transportation to dumpsites. No formal investment or allocation is reserved for recycling and composting purposes.

No matter how efficient waste collection system is developed it will certainly fail unless the amount of waste comes equal to recycling and compost. In order to achieve this goal waste segregation at source is not an option but mandatory.

For the betterment of the environment, virgin raw material should only be used when recycled raw material fall short. The study titled 'An assessment of the current municipal solid waste management system in Lahore, Pakistan' also conducted a pilot activity with sample size 60 as part

of the project on the role of 'informal waste sector' (IFWS) in solid waste management (SWM), has successfully adopted a holistic approach to analyze solid waste management system of Lahore.

2.8 Main Cause of Environmental Pollution in Pakistan:

Mahar et al., (2007) asserts that no proper garbage/trash disposal system exists in Pakistan. The study highlights improper solid waste management is the main cause of environmental pollution in Pakistan. In the study the authors noticed that no solid waste regulation exist in Pakistan. In the like manner there is a dire need to create awareness about solid waste problem in masses while, provision of financial and administrative authority to manage solid waste is essential. Besides this proper sanitary landfill sites are also required to minimize waste negative impacts on environment. Paper expresses that detailed law must be made in order to manage the solid waste situation in Pakistan. Some NGOs in Pakistan i.e., Safai Kamai Bank, Waste Busters, Pakistan Environment Welfare and Recycling Program (PEWARP); are working to exploit the income potential hidden in the mixed waste but only the NGO Shehri is working to promote awareness in the public regarding solid waste management. Study reports that about 51% to 69% of the daily generated waste was picked/collected. Generally all kind of waste in Pakistan are treated same when it comes to be handled by the official organization. The emphasis, where given, is only on three aspects of solid waste i.e. collect, transport and dump. The study has analyzed waste generation secondary data Pak-EPA (2005) of 5 big cities of Pakistan – Karachi, Faisalabad, Hyderabad, Gujranwala and Peshawar the data shows collection efficiency from 51% to 69% and in capability to collect waste for 31% to 49%.

The above approach to waste management is miss leading which neglects masses behavior towards segregation of waste. In fact ad-hoc approach no sooner than later creates bigger problems for citizen of the city. The aim of sustainable waste management is—to recycle all the generated waste either for composting or recycling and only use virgin raw materials when availability of recycled raw material is impossible. This sustainable approach requires waste segregation at source.

2.9 Law for waste segregation in Japan:

Ministry of Environment, Japan, realizing the need of municipal solid waste segregation has made an Act titled 'Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging, 1996' to collect PET bottles etc. separately in the light of 3R Policy. The Act also provides a mechanism to penalize the offenders as well.

2.10 Recycling potential of Islamabad:

Qasim, M. et al., (2010) explores in case waste sorting is practiced in Islamabad, how much recyclable, reusable materials can be recovered from waste as most of the recyclable or reusable materials are lost in dumpsites. The study based its findings on primary data as waste generation pattern of similar income group are same authors of the paper utilized 2% sample size. Sampling technique utilized stratified sampling. The study reports that 91% municipal waste of Islamabad is green waste. Though literacy rate of Islamabad is 90% but waste disposal behavior of Islamabad population are no different than other cities of the country which shows that in order to change the behavior of public a lot of awareness should be given on continuous basis. The household waste survey was conducted for 7 days to find the quantities of green waste and other waste for analysis. 118 household out of total household 6,563 of sector G-7 were provided two plastic bags one transparent for kitchen waste, and other black for other waste. The study concludes the importance of waste sorting at source. It suggest that kitchen waste has a great potential for composting (manure) which should be exploited by the formal and informal sectors. In the like manner sorted collection would facilitate recycling plastic and paper waste into usable products.

2.11 Crude waste management in non-developing countries:

Developed countries follow a hierarchy to reduce waste i.e., reduce, reuse and recycle the essence of which is also in accordance with Islamic ethics of waste management. The approach diverts waste from dumpsites and landfills–impacting environment positively. Though we might see waste dumps in developed countries’ oceans however, their practice of solid waste management within land is reasonable. In non-developing countries like our there is a practice of dumping waste in crude dumpsites. Ordinary dumpsites have no liner, greenhouse gas or leachate management system. Such waste dumps contaminate surface and ground water which becomes main cause of many diseases. Leachate is generated due to decay of biodegradable waste. In addition to this, in non-developing countries like ours waste is also dumped in waterways and inhabitants who live on river waters are expose to various skin, cancer or other diseases. Plastic debris is problem for marine life. Iterant waste pickers have to face more chemical and biological health hazards. Skin problems, gastrointestinal disease and respiratory problems are more common in those who pick waste.

2.12 Present vision of waste management in non-developing countries:

Ahsan (2014) concludes that with the increase in the population and urbanization it has become difficult to manage huge quantities of waste through existing waste management vision, economic support, human resources, infrastructure, and technological capabilities. Government should

support recycling/composting efforts. In Bangladesh a huge quantities of organic waste is available which processes are self-sustainable. In the like manner varieties of articles in literature are available for recycling. Solid waste management should be integrated due to infinite number of waste categories, local needs, socioeconomic situations and technological capabilities.

Malik (Dawn) The newspaper article highlighted the importance of waste sorting. Waste sorting helps to reduce the amount of waste that ends up in dumpsites. Primary sorting of waste provides quality wet and dry waste for composting and recycling respectively.

2.13 Waste Management and Local Government:

As solid waste management is a grass root subject therefore, local government could better manage it being close to masses. The local governments should be given legislative, administrative and financial powers to handle the solid waste management in view of their local needs. Relevant environment protection agency will only provide guidelines. The local government should be given mandate and confidence to manage their solid waste issues themselves. They may be allowed to create department, decide requisite qualifications and experiences for the purpose. The local governments with the cooperation of local administration should be entitled to contract out segregated solid waste collection services etc.

As waste sorting is key to reuse, recycle, reduce in some countries governments have made regulations to sort waste at source (house, shop, offices, factories etc.) before primary collection. After primary collection waste is transported to material recovery facility (manual/mechanized) the waste is sorted into at least two streams recyclable and compostable. Recyclable are further sorted into metal, paper, plastic or glass etc. Compostable are transported to facilities that prepare compost. The final residue is transported to landfill sites. Hence the amount of waste that goes to landfill is decreased. The website–Earthlink (2017) informs that Bahria Town—a private housing society segregate waste after primary collection and emphasized to segregate waste before primary collection/storage.

In the literature there is a gap that mostly researches are on solid waste management system in a holistic fashion however, this research is different from other researches that it has made the household awareness regarding solid waste segregation as well as their willingness to segregate recyclable invaluable solid waste in case infrastructure is provided.

World Bank Institute, Improving Municipal Solid Waste Management in India. The book has been found a very good effort done by the World Bank Institute in India. The civic habits of people of subcontinent are the same therefore local governments/responsible agencies may take advantage

of this resource to make policy on solid waste management in Pakistan. The resource book emphasizes that solid waste segregation at source is the 1st step/cornerstone of any effective, sustainable solid waste management system.

Chapter 3: Methodology

This chapter discusses the theoretical framework, data and estimation technique for analysis and regression. Tchobanoglous & Keith (2002) explains performance criteria, which will be of most help to analyze the complexed garbage/waste situation in Pakistan.

3.1 Measures of Recycling Performance

Tchobanoglous & Kreith (2002)¹ express that though it is difficult to quantitatively measure performance of recycling, the following criteria will be helpful:

(a) Capture Rate

Capture rate or source recovery factor shows what percentage by weight of a particular material has been separated from the respective total weight of solid waste at source.

(b) Participation Rate

Participation rate shows the percentage of households/businesses in a particular community that separates recyclables from non-recyclables and set out for collection. Participation rate shows contribution of citizen in recycling but not actual quantities of waste that are recycled.

(c) Recycling Rate

Recycling rate shows either weight of recyclables collected per household per month (e.g., 70 Kg/HH . month) or as percentage of weight of recyclables of total MSW collected without regard to contamination.

(d) Diversion Rate

Diversion shows the weight of total solid waste that is not sent to landfill in a particular locality. It is usually represented as percentage of weight or volume of waste of the total solid waste that is not landfilled in a particular community. It is better that diversion rates are reported as %age of volume as landfills get exhausted far early than they are too heavy.

The research will study what segregation policies could be adopted to increase segregation and thus ease recycling to solve health and environmental, city cleanliness issues, the cause of which is mixed waste collection and disposal. In order to assess public attitude towards waste segregation, households of Islamabad have been randomly studied in the surveyed through a questionnaire, in the light of which policy idea for waste segregation will be presented.

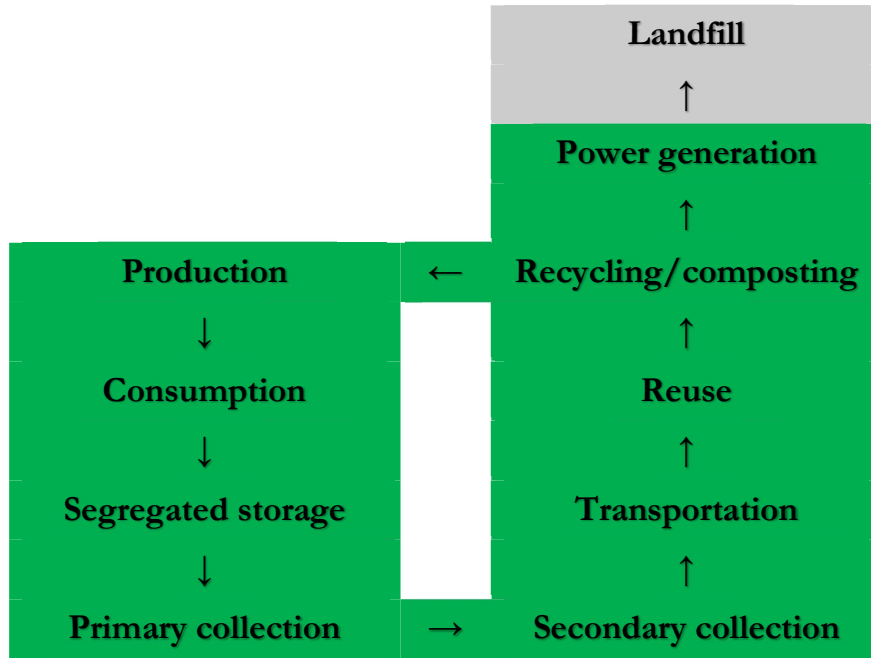
The conceptual map below presents the circular flow of waste management with and without primary waste segregation. As obvious, the primary waste segregation reduces the final residue

¹ in the 'Handbook of Solid Waste Management'

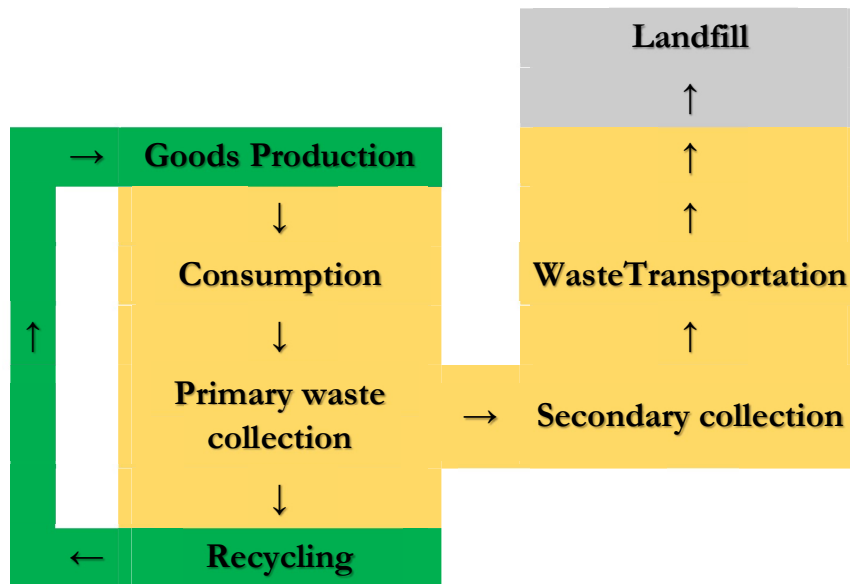
destined for landfills, thus reducing environmental burden. Thus there is obvious benefits attached to primary segregation.

Analytical Framework

Waste cycle (Circular economy)



Waste disposal (General practice)



3.2 Data

Data for this study is collected from Households (HHs). It was planned to survey 400 HHs would be surveyed through questionnaires, using stratified random sampling to understand their readiness (willingness) to participate in waste segregation drive. However, the unexpected outbreak of Covid-19 affected the data collection process. Initially, every effort was made to collect data following the stated stratified random sampling technique but in most of the instances (and rightly so) HHs refused to come out and give time. Resultantly, along with continued efforts to contact and visit HHs, questionnaire was circulated electronically to every possible official email. Email addresses were collected from the offices and ministries working in Islamabad. After all efforts, 227 questionnaires were filled and the same are used for analysis ahead.

3.3 Sampling Area:

Evolutions in packaging industry with the invention of plastic shopper bags and increasing availability of packaged goods the waste generation pattern of public though having diverse backgrounds of education, geographic location, income level, carrier position etc. are same. Many studies to investigate willingness to pay for solid waste management have been conducted and concluded that higher education and higher income families tend to pay more for the improved services. However, it was also noted that some less education and less income level people are also willing to pay for improved solid waste management. Proving that public attitude towards solid waste management matters more for their participation in solid waste management services.

As such Islamabad is more developed city and inhabited by the people from all areas of Pakistan, mostly formally educated, city being capital of the country, it is expected that the city may provide some representative response of public regarding their awareness of solid waste segregation as well as their intention to segregate subject to provisions of appropriate infrastructure.

Basically it was thought to gather samples by surveying door to door applying stratified sampling technique however, in view of COVID-19 pandemic door to door survey found to be hazardous therefore data has been collected by hosting questionnaire on the internet and people have filled the forms randomly and independently. A sample of 227 respondents has been collected.

3.4 Valuation technique:

Contingent Valuation Technique is adopted to quantify the readiness for physical participation of Households to become a part of segregation drive. Central tendency measure i.e., percentages have been considered to explore the readiness of respondents to physically participate in household segregation.

3.5 Questionnaire

Survey form of this study has been prepared maintaining the privacy of participant. Therefore, the form does not record any identification of participants. Participants have filled out the form thoughtfully in the comfort of their place therefore, more dependable data has been obtained. Waste segregation (storage at point of waste generation), primary collection, secondary collection, transportation, recycling/composting, transportation residue waste to landfill sites/dumpsites are different stages of solid waste management. Whereas this study has focused waste segregation at source of its generation.

Public preferences to participate in segregation function of solid waste is not quantifiable therefore, we use contingent valuation method (CVM) to assess impact of segregation on health and environment. Contingent Valuation Method is survey-based technique which tries to explore preferences of individuals (or households) for goods or services which could not be measured (Parajuli, 2020). The problem is that if such non-quantifiable matters are not considered while making related policies the result could be greater losses. The losses which inflicted for not accounting for such matters might impact the quality of life e.g. health and environment. This in turn would badly be affected due to mismanagement of such matters like solid waste segregation at source, inevitably incurring exponential monetary and losses to health and natural resources.

3.6 Theoretical Framework

We theorized that public willingness to participate in solid waste segregation is based on:

- (a) Awareness
- (b) Infrastructure at house
- (c) Infrastructure in community
- (d) Provision of law

In the like manner we also researched the circumstances when public will do construction/demolition waste segregation in their area. We investigated using the above parameters except infrastructure at house as it is difficult to develop infrastructure for storing construction/demolition waste there. For all the above, descriptive analysis have been depicted, using bar/pie/line charts.

Chapter 4: Situational Analysis of Waste Management of Pakistan and Islamabad

4.1 Situation in Pakistan

According to the 6th population and housing census-2017 the population of Pakistan is 20,77,74,520 with annual average growth rate of 2.40 the census also apprised that there are 3,22,05,111 households (Pakistan Bureau of Statistics 2017). The census further shows that the highest annual average growth rate is of Capital-Islamabad which comes to 4.91. According to the census 2017 the population of Islamabad is 20,01,579 comprising of 3,35,408 households.

The website–Pakistan–Waste Management (2018) presents a more serious picture of current solid waste condition of Pakistan. It informs that about 48 million tons (48 billion Kg) of solid waste is generated annually in Pakistan. The growth rate of which in the country is more than 2% annually, due to which health and environmental problems emerged. The causes of increase in solid waste are attributed to: (i) bureaucratic hurdles, (ii) lack of urban planning, (iii) inadequate waste management equipment, and (iv) low public awareness.

Contemporary discourse asserts for the realization of the 3Rs (Reduce, Reuse, Recycle) of waste management. The beginning of 3R concept is—waste segregation. If we do not segregate waste at the point of generation it is likely that most of recyclable waste will ultimately end in here and there from where those recyclable materials will be hard to recover.

In order to optimize the solid waste problem this study is being undertaken to mitigate the fatal impacts of solid waste on the human health and environment. The focus of this research is to identify feasibility for such a mechanism where segregation of waste takes place at source and at any transitory stage before the waste is either recycled or ultimately dumped. Such a system would contribute to environmental balance by expecting every household/business/industry etc. a small waste management entity.

However, a study conducted in Lahore showed that informal sector helps to generate an amount of 271 million by collecting recyclable and thereby their recycling. It is thought that about 65 million would be saved if recycling is carried out formally. In addition to this, the study determined that an amount of Rs. 530 million will be generated if recycling is adopted as industry which will help not only in energy conservation but natural resources conservation as well. If we can save this huge amount of money in one mega city then the amount that could be saved through source segregation is unprecedented. Thereby the recycling industry will become self-sustainable (Batool et al., 2008).

SOP for Management of Sanitation Services in Islamabad (CDA, 2008) Following are waste parameters of Islamabad:

	Waste Generation metric ton/day	Waste generation kg/capita/day	Waste generation kg/house/day	Waste generation rate
Pakistan	20 million			
Islamabad	500~550	0.283 ~ 0.613	1.896 ~ 4.29	2.4 %

Table 4.1

The SOP defines mixed waste as mix of municipal, organic, green, domestic, commercial, construction demolition material and other scrap. The SOP also presented waste characterization %ages as follows.

Household	Green	Plastic (PET and other)	Cloth	Glass	Paper	Construction waste	Others
64%	27%	3%	2%	1%	1%	1%	1%

Table 4.2



Fig. 4.1 Source: Google Map

The data presented on CDA website is not latest and was collected/transformed from 2004 – 2006. SOP for solid waste management covers only Zone-I of Islamabad.

Official website of CDA apprise that arrangements are being made for recycling of household waste after its proper segregation. It is necessary for effective management of solid waste that waste characterization survey is carried out once a year. And waste waited on daily basis so that latest data for waste management is available.

4.2 Strength of Islamabad Sanitation Department:

CDA sanitation department has 1,064 employees out of which are 853 are cleaners/truck loaders. Hierarchy is given at Appendix-I. CDA sanitation directorate informs about the following for door to door solid waste collection. For each sector there are 1 Sanitary Inspector, 5 Sanitary Supervisors, 10 Mates and 150 Cleaners. Similarly, for every Sub-Sector the composition of team will be as follows:

- 1 Sanitary Supervisor
- 2 Mates
- 30 Cleaners (15 Cleaners per Mate)

CDA, SOP for management of sanitation services in Islamabad defines beat as “One Cleaner shall be assigned to every beat. Each beat shall consist of either a minimum of 150 small houses (20x40 to 30x60) sft or 75 large houses (30x70 to 80x120) sft. For the purpose of solid waste collection the SOP further bifurcate Zone-I into 3 zones. The only addition is that in each zone there is Chief Sanitary Inspector (BPS-13).

In spite of having the above staff and hierarchy for solid waste collection, CDA still outsourced the contract for “Primary and Secondary Collection of Municipal Solid its Transportation in Metropolitan Area, Islamabad, Pakistan” in summer 2017. The incumbent contractor has been performing the door to door solid waste collection duties with 300 skips and 1,500 unskilled labor whereas the door to door collection services are being provided in Islamabad’s Zone-I only.

Abbasi, K. (2018) Dawn newspaper published a report that MCI collects 84 million on account of conservancy charges in its quarterly water bills however, spends about 2 billion on sanitation for sanitation services provided in Zone-I only. Municipal Corporation Islamabad was formed following local government elections on November 30, 2015 however, no government since then has given the Corporation funds. The government also did not notify rules and regulations of the Corporation. In actual the corporation is defunct.

Zone	Area	
	Acres	km ²
I	54,958.25	222.4081
II	9,804.92	39.6791
III	50,393.01	203.9333
IV	69,814.35	282.5287
V	39,029.45	157.9466

Table 4.3

Zone-I Map

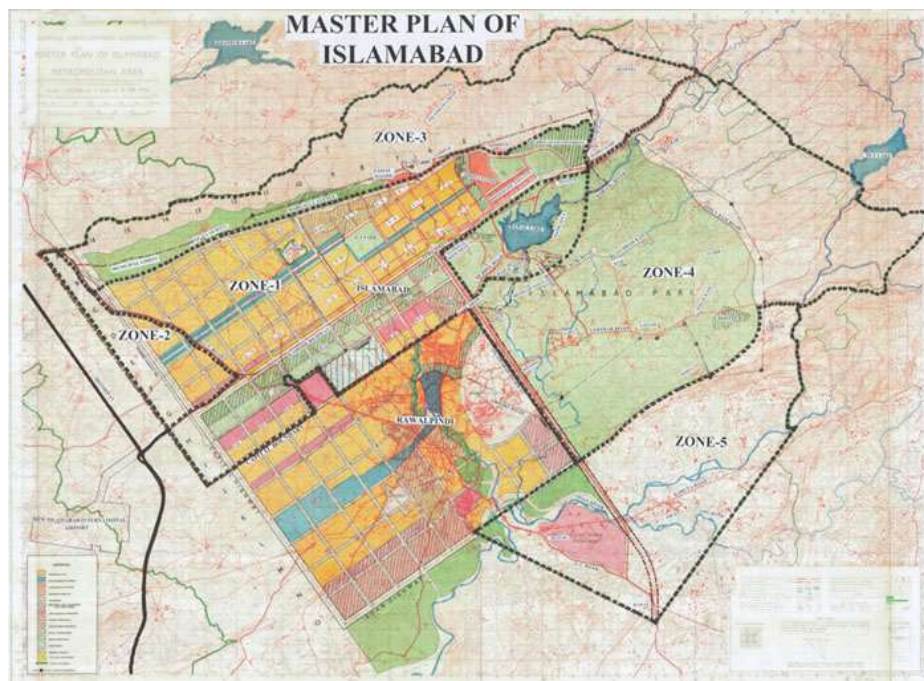


Fig. 4.2 (Source: CDA website)

Dawn Newspaper reports that CDA has about 1,500 employees in its sanitation department through its employed cleaners only collects waste from F-sectors only. Whereas, CDA has contracted out the garbage collection of I and G and is paying about Rs. 700 million per annum (Junaidi, 2019).

Accordingly, if we divide the Contractor's payment upon residents per household share comes to Rs. 2,087. This huge amount government pays out of public tax and the result is moving of dumpsites from sector to sector, deterioration in environment and health conditions. On the other hand household on average are willing to pay Rs. About 250 ~ 300 (as many studies on willingness to pay in Pakistani cities conclude). It seems that the expense on solid waste management is actually buying of environmental misery.

Dawn Newspaper, (Jan 29, 2020) reported that MCI cancelled the bid opening of the contract for solid waste collection in response to objection raised by Ministry of Climate Change. The current Contract will be expired in June 2020. Director Sanitation informed that Ministry of Climate Change (MoCC) was thinking on the necessity of household waste recycling in Islamabad, might be on this observation MCI called of the municipal solid waste collection bid on 29.02.2020 which had to be opened on 30.03.2020 (Urdupoint, Feb 16, 2020). CDA also offers Sanitation Helpline 1334:

Dawn (May 01, 2018) CDA Dumping Sites: CDA dumping sites shifting form sector to sector H-10, I-12, I-14, I-15, I-17; H-12 frequent shifting of dump sites is not a solution rather a failure of civic authorities in providing sustainable solution of generated waste.

4.3 Education of Lower Staff:

In view of complexity of waste and its type, CDA give education/training to its staff from Director (Sanitation) to cleaner. The management is expected to have clear concept of the hazards of waste to environment; knowledge of recycling, composting; sanitary landfill sites; waste treatment etc. In addition to this the cleaners should be trained to characterized the waste and enhance their capacity for sorted collection of waste.

4.4 Situation of Solid Waste Segregation in Islamabad:

No solid waste segregation infrastructure exists in Islamabad. Neither public segregate their waste at primary level nor do MCI workers collect segregated waste from houses. In the like manner segregation bins are not available in the community. MCI dumps general waste collected from houses through its sanitation workers and transports to ordinary dumpsite sector I-12. Such bad situation could not prevail long as it is a constant threat to health, environment and city aesthetic.

4.5 Public Awareness about the Issue:

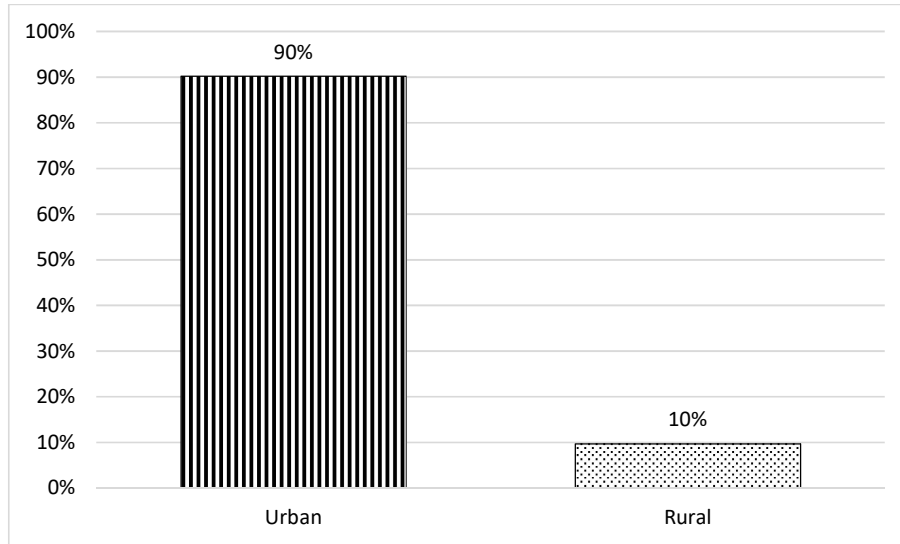
Target population is aware of the importance of solid waste segregation we surveyed it through the questionnaire but unable to practice it due to non-availability of necessary law and opportunities.

Chapter 5: Estimation Results and Discussion

5.1 Descriptive Analysis

Following is the graphical representation of respondents' responses.

Figure 1: Respondents' residential status



This chapter presents the data to communicate the qualities of the sample and analyze the topic. The findings will help in understanding the awareness and readiness of the people and agency to tackle the solid waste management issue through at source segregation. *Figure 1*, presents the residential status of the sample. According to *Figure 1*, ninety percent of the sample consisted of urban areas while only 10 percent of the response was collected from rural areas. Although, the sample is uneven but we could not bring it to symmetry due to circumstances after Covid-19.

Figure 2: If infectious diseases spread because of dirtiness/littering in surroundings?

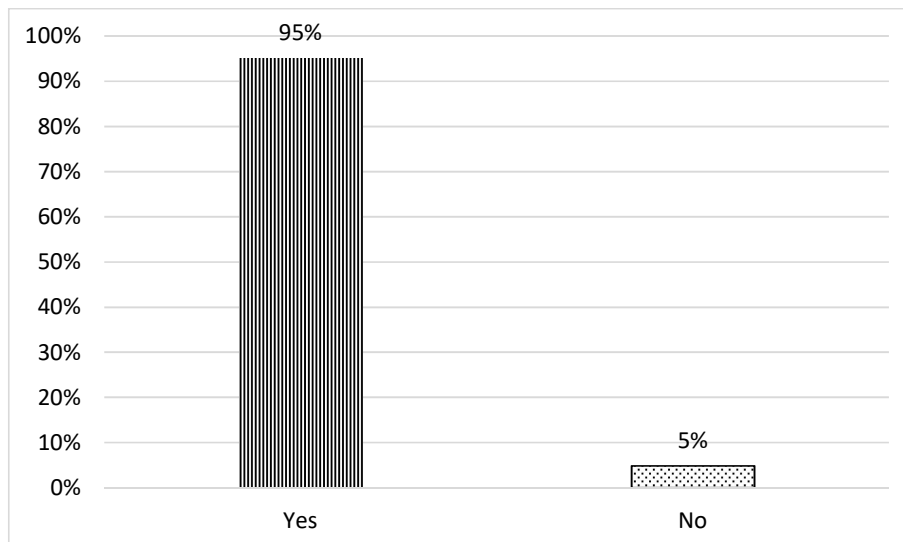


Figure 2 shows that 95% respondents think that infectious diseases spread because of throwing waste in undisciplined way. Only, 5 % respondents disagree that cause of infectious diseases is not connected to throwing waste. It may be possible that such respondents live in localities where they rarely see waste so have no idea of such consequences. It is hoped if government do some regulation to prevent littering most of the public will support the move.

Figure 3: If mixed throwing of waste spoils health and environment?

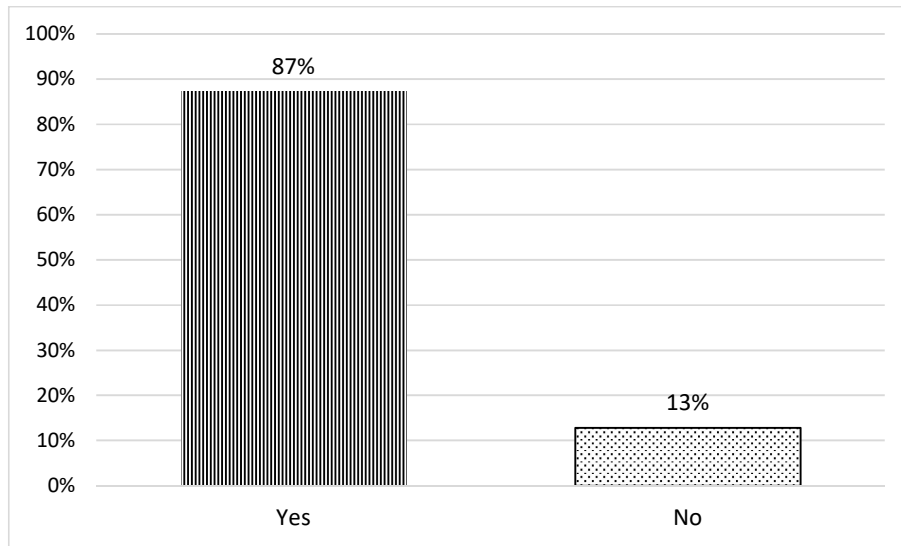


Figure 3 indicates that 87 % respondents agree that mixed throwing of waste is a danger to health and environment. Whereas 13 % are of the opinion that mixed throwing of waste does not affect health or environment. It may be possible that 13% respondents have no idea of mixed throwing or its hazards. There is a need that government create awareness about hazards of mixed waste throwing in the environment. It is believe that education helps to change public way of thinking and behaviors.

Figure 4: If segregated waste disposal provides more recyclable and compostable?

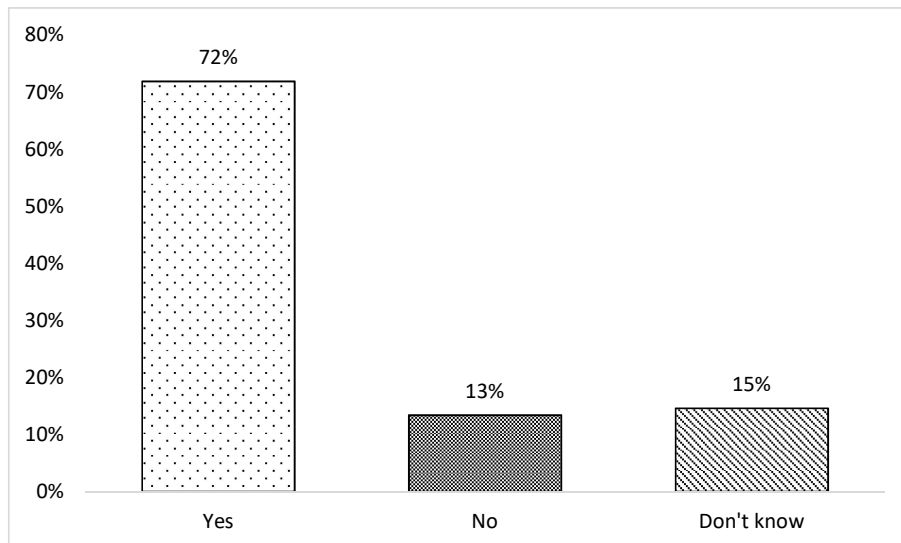


Figure 4 summarize graphical representation of the advantage segregated disposal where 72% respondents understand that segregated waste disposal facilitates provision of more recyclables and compostable. 13% respondents think opposite of it. While 15% have no idea whether segregated disposal gives more recyclables and compostable. Making 72% our base a successful waste segregation program may be launched.

It has also been observed from respondents' reply that regardless of level of formal education generally all are of the view that segregated disposal of solid waste provides more material for recycling and composting.

Figure 5: Respondents response on environmental deterioration

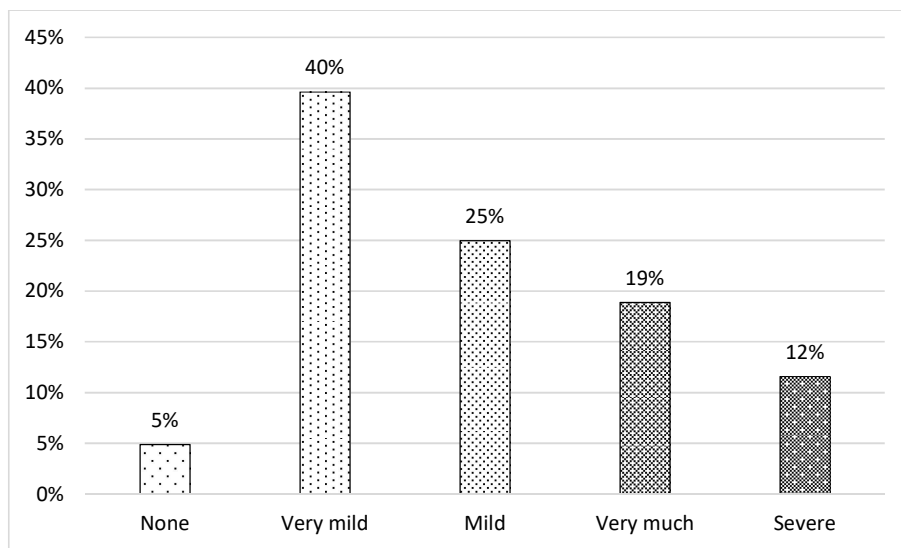


Figure 5 represents that 95% of the respondents are of the opinion that the environment of cities and villages is being deteriorated due to haphazard throwing of waste. Only 5% respondents think that there is no environmental degradation. In view of this opinion collected randomly the authorities should move forward to bring essential integrated solid waste management system.

Figure 6: What concern people more in view of environmental pollution?

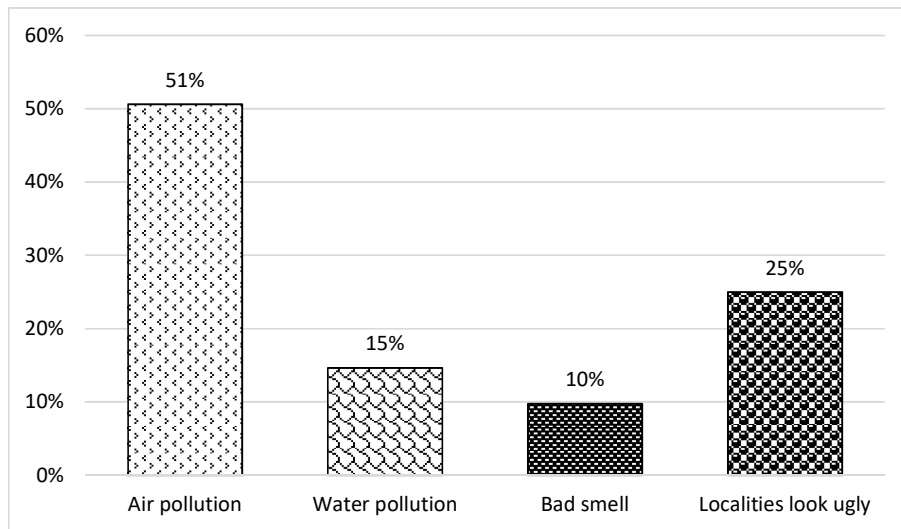


Figure 6 shows that 51% respondents are more concerned about air pollution, 25% said that they do not like ugly localities. 15% are concerned about water pollution whereas, 10% respondents were found not feeling well because of bad smell. Mixed disposal of waste causes all these pollutions. As actual environment of our cities and villages is obvious we could depend on the above respondents' response to correct the wrong.

Figure 7: Respondents' opinion if all type of waste be thrown in the locality?

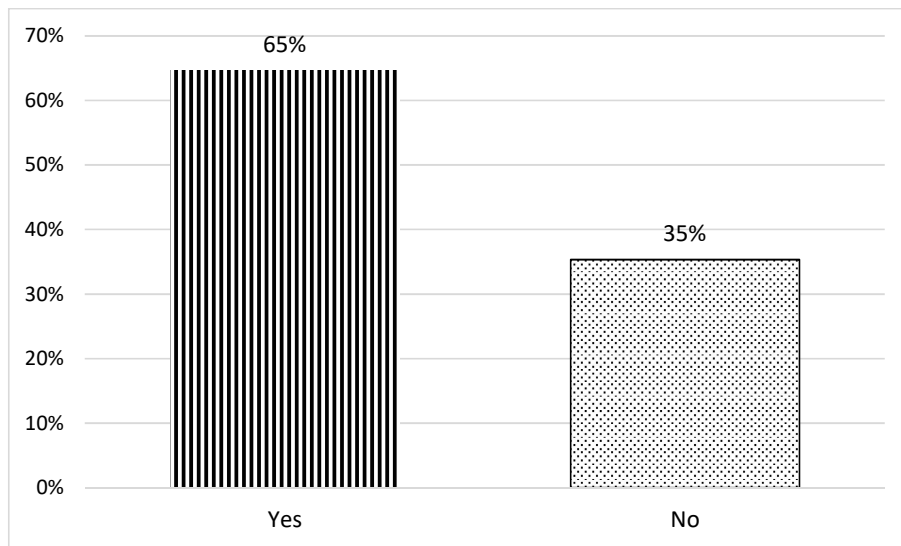
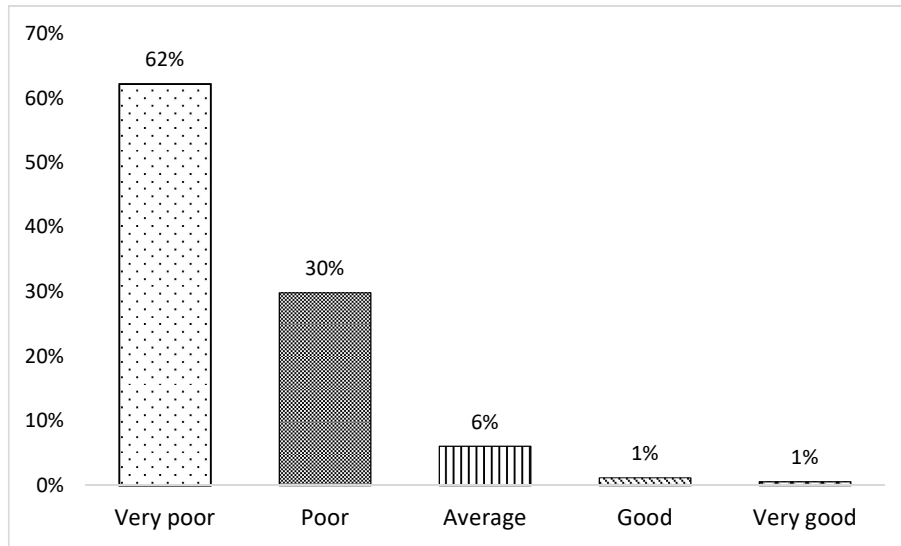


Figure 7 shows that 65% respondents know that mixed waste throwing deteriorate health and environment. Whereas, 35% still think that mixed throwing of waste is not detrimental to health and environment. It is very shocking that 78% of our respondents' formal education is either graduation or more than graduation up to PhD. This lack in their knowledge clearly indicate that our educational curriculum does not appropriately address the issue of environment.

Figure 8: Status of public awareness towards solid waste management



Public awareness is depicted in *figure 8* where the response of respondents on this aspect of public awareness is very disappointing. It looks that respondents respond to the question of public awareness towards solid waste management keeping in view the actual conditions prevailing in our cities and villages. Only 2% said that public awareness regarding solid waste management is good/very good. Whereas 98% respondents; opinion is that the public awareness regarding solid waste management is very poor/poor.

It is obvious to start a new system of solid waste management which waste segregation is beginning component the authorities are required to gear up their efforts using all possible mean of information and communication means.

Figure 9: If government gives waste segregation awareness through media to public?

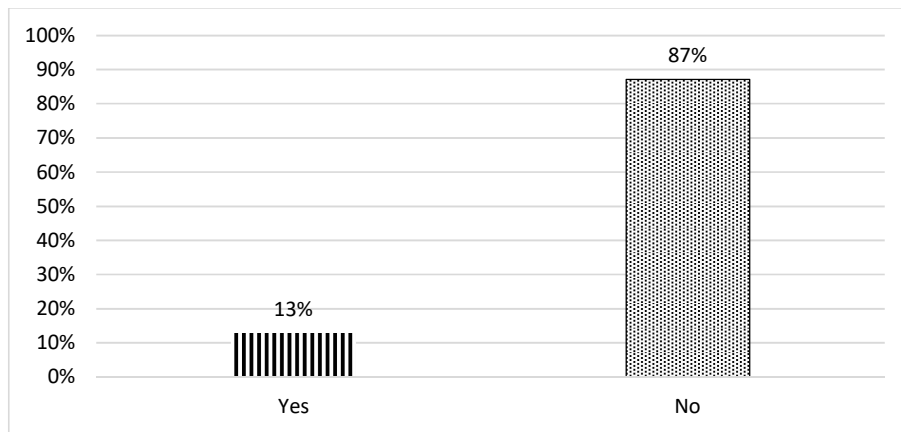


Figure 9 depicts that 87% respondents say that government does not give waste segregation awareness through media to public. 13% say that it gives. Government who controls print and

electronic media has a opportunity with authority to create awareness among the masses regarding public/social issues e.g., solid waste segregation.

Figure 10: Should government give awareness to public for waste segregation through media?

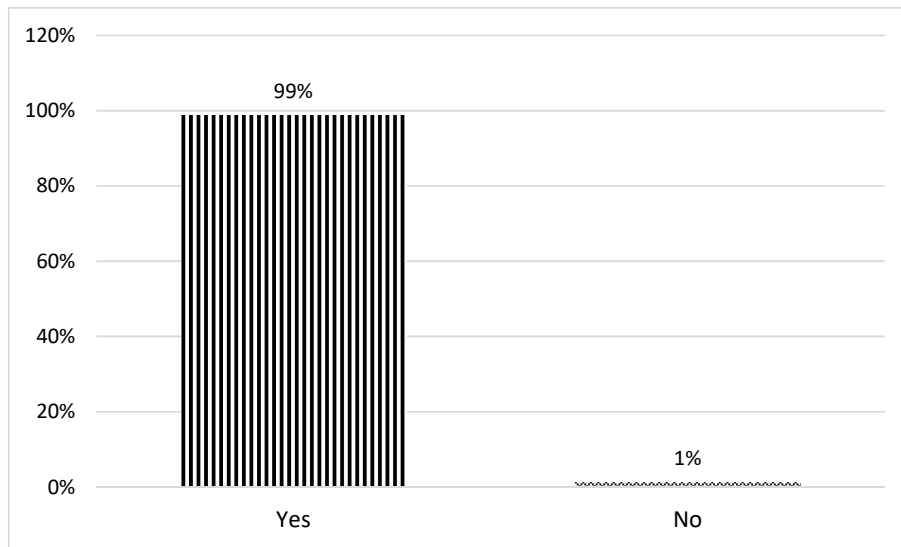


Figure 10 graphs 99% respondents' opinion that government should give awareness to public regarding solid waste segregation.

Figure 11: What is the most effective medium for creating awareness among people regarding solid waste segregation?

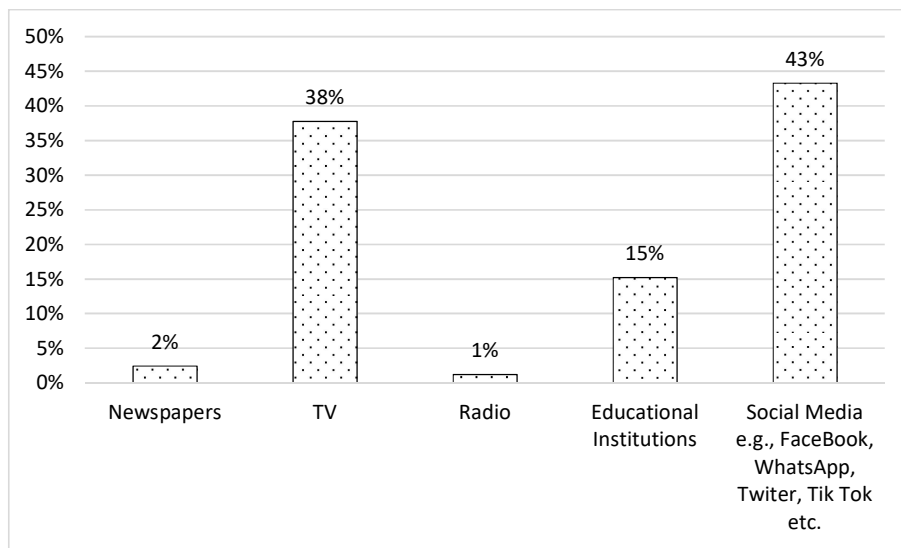


Figure 11 shows that since the start of Internet a crucial development in information and telecommunication technology the use of TV to create awareness among the masses on public issues has lagged behind. Hence, respondents' opine that social media e.g. Facebook, WhatsApp, Twitter and Tik Tok etc. should be used to create awareness among the masses for solid waste segregation. On the other side as per respondents view newspapers and radio together make 3%

to create awareness for waste segregation. Social media and TV are leading with 43% and 38% respectively in terms of creating awareness among the masses for solid waste segregation.

Figure 12: People knowledge about the ending of solid waste

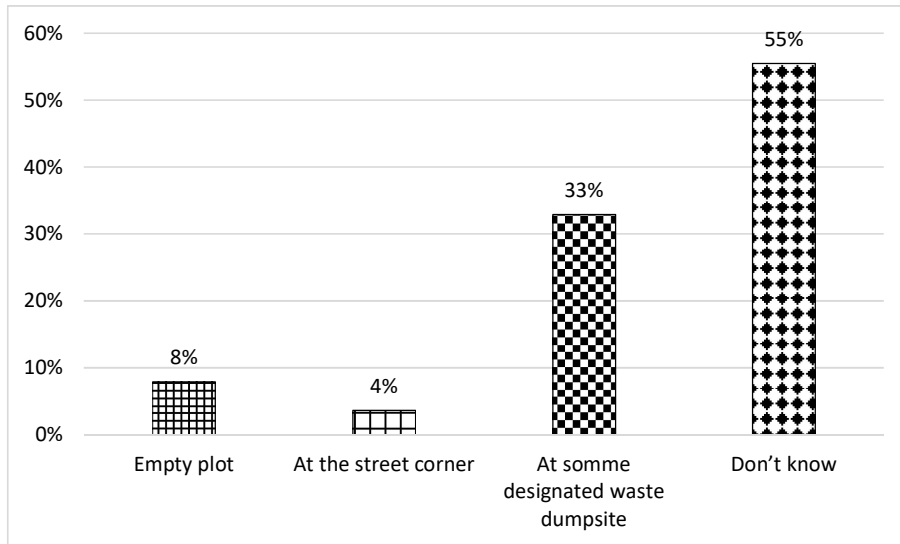
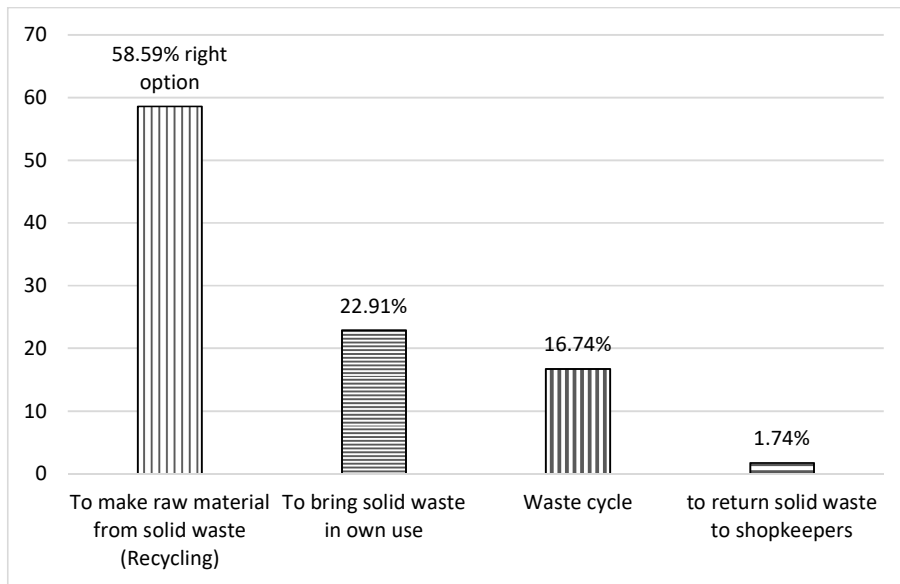


Figure 12 shows that The responsible agencies do not inform citizen about their working, in this context 55% respondents do not know where there solid waste after primary collection ends.

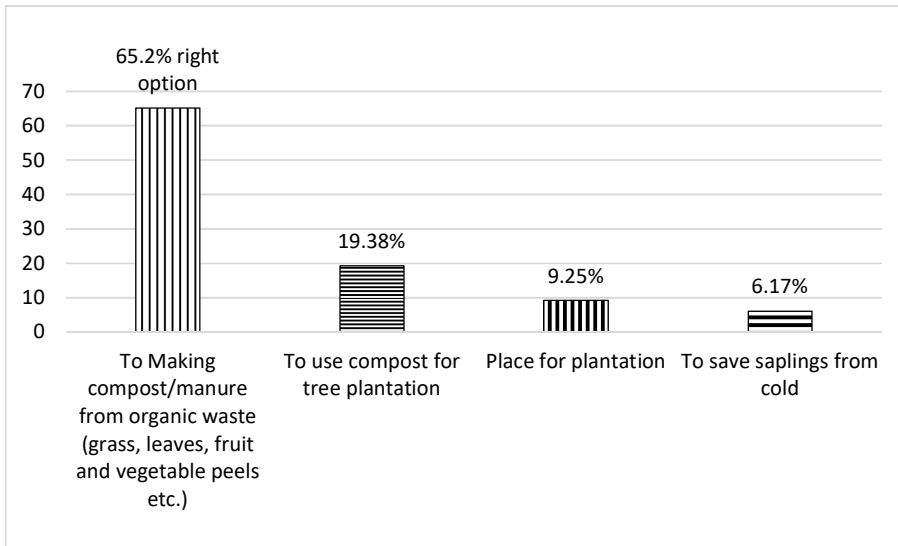
Public ability to recognize Waste Management Symbols

Figure 13: Household respondents' awareness of recycling symbol



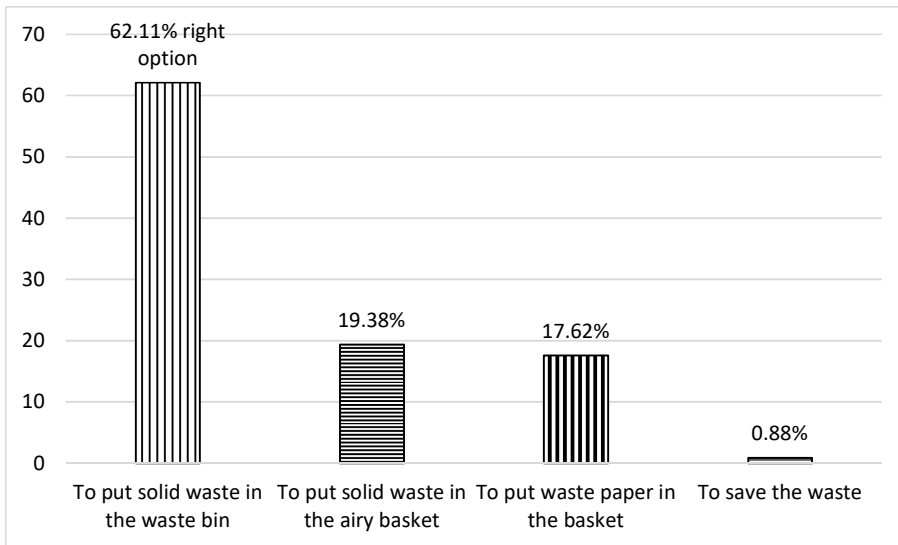
58.59% respondents know the correct meaning of recycling symbol.

Figure 14: Household respondents' awareness of compost symbol



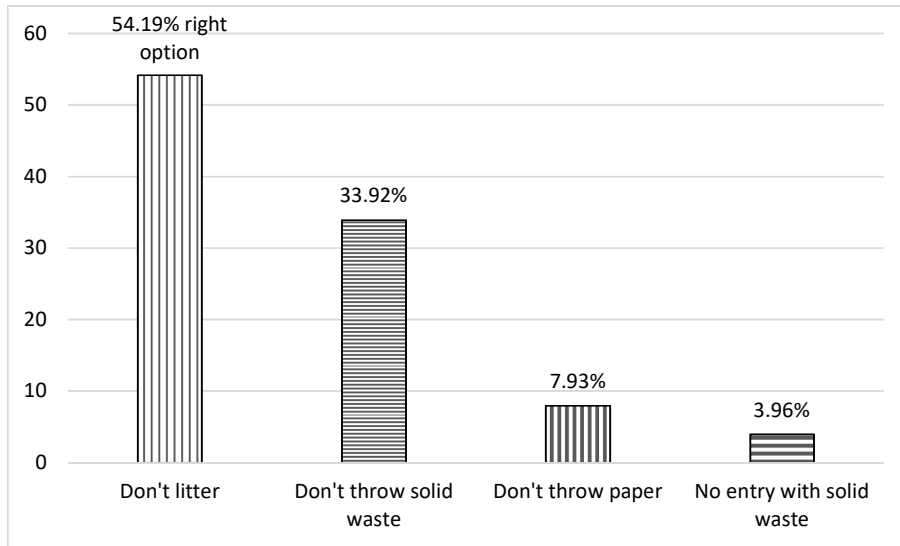
65.20% respondents know the correct meaning of compost symbol.

Figure 15: Household respondents' awareness of dustbin symbol



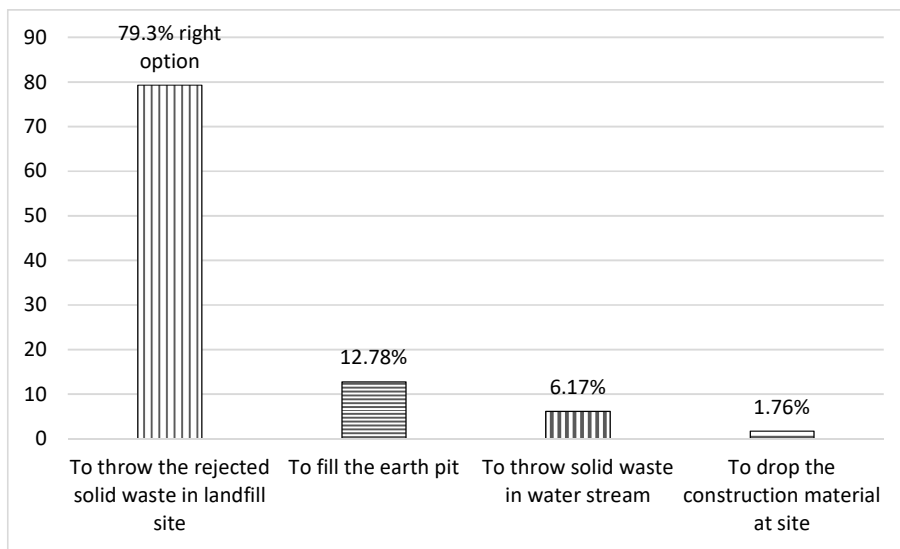
62.11% respondents know the correct meaning of dustbin symbol

Figure 16: Household respondents' awareness of don't litter symbol



54.19% respondents know the correct meaning of littering symbol.

Figure 17: Household respondents' awareness of landfill symbol



79.30% respondents know the correct meaning of landfill symbol.

Summary of the %age of respondents' understanding of waste symbols.






Recycling	Composting	Dustbin	Do not Litter	Landfill
				
58.59	65.20	62.11	54.19	79.30

Table 5.1 Waste's Symbols Awareness

Table above shows that 63.88% respondents have knowledge of the above waste management symbols.

Respondents' recognition of waste symbols is minimum for littering. The overall understanding of waste symbols of respondents is satisfactory. If proper education is provided to people it is expected they would grasp the knowledge of waste issues and stop littering, even prefer to segregate their waste using provided or arranged waste segregating infrastructure.

Figure 18: Are respondents willing to dispose of segregated waste?

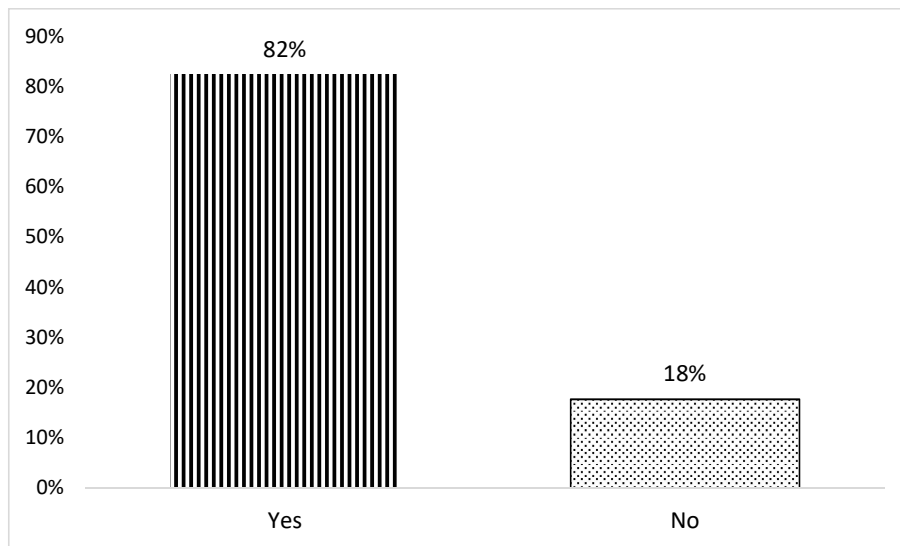


Figure 18 exhibits a very desired but independent response obtained from respondents that 82% of them are agree that waste collector be given segregated waste. 18% opined otherwise. The response shows that if integrated or synchronized environment for waste segregation is provided to the citizen the segregation would sharply increase giving more recyclable and compostable besides lowering the quantities rejected to waste dumps.

Figure 19: Do people complain responsible agencies of mixed waste laying around in their locality?

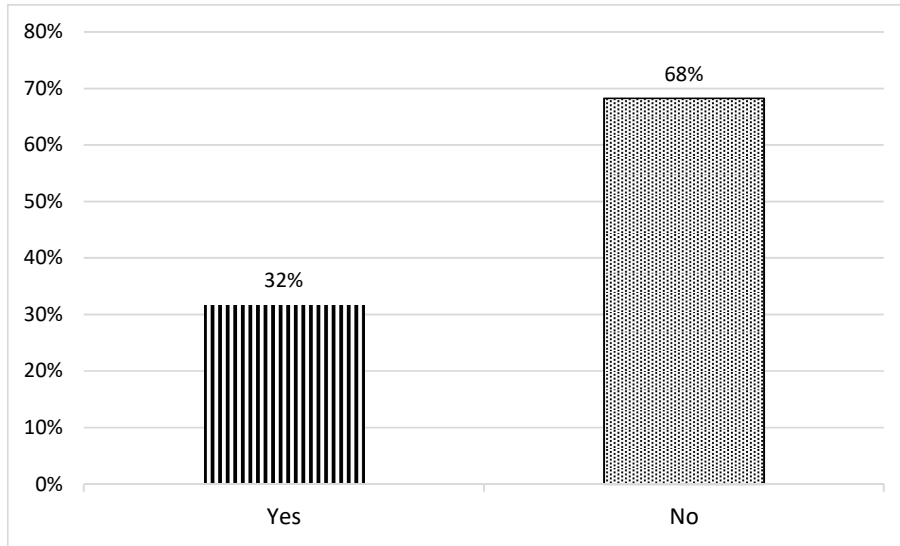


Figure 19 shows that 32% respondents complain to responsible agencies of waste laying around in their localities whereas 68% respondents said that they had not complained the waste problem of their locality. The reason that most of the people do not complain waste problem may be that usually people don't know who to complain, whether their concern would be addressed. One proposition is that there are few solid waste problems so people don't complain which actually is not the case. Conversely, the proposition that problems are many but remain unattended so people have forget complaining about the waste issues of their localities to the responsible agencies.

Figure 20: How people dispose of their solid waste?

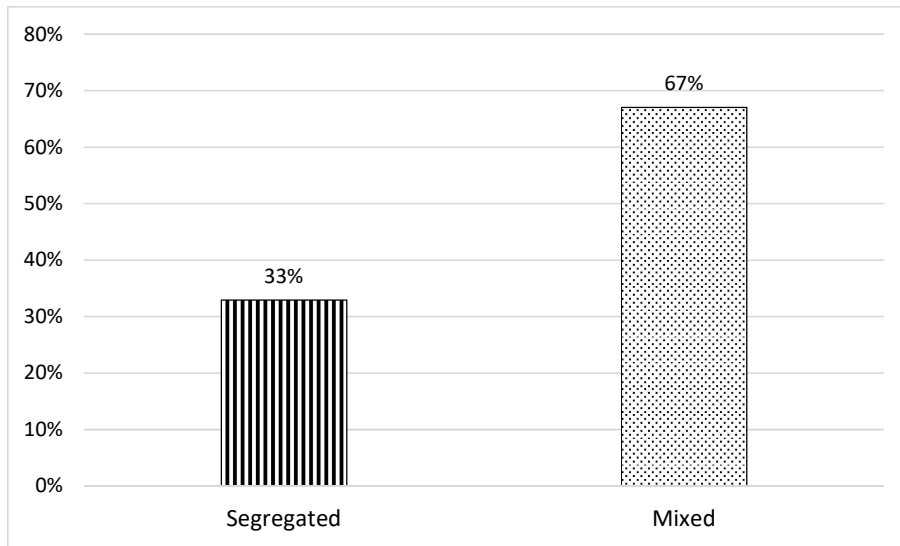


Figure 20 shows that 67% respondents said that they dispose of their waste mixed. Already responsible agency has no formal waste collection system synchronized with segregated primary storage hence it increasingly becomes more difficult to save most of the recyclable that household

throwaway. Therefore, there is a genuine need to educate the people on the matter besides bringing in a synchronized primary storage and collection system.

Figure 21: Main cause of throwing every type of solid waste in one bin

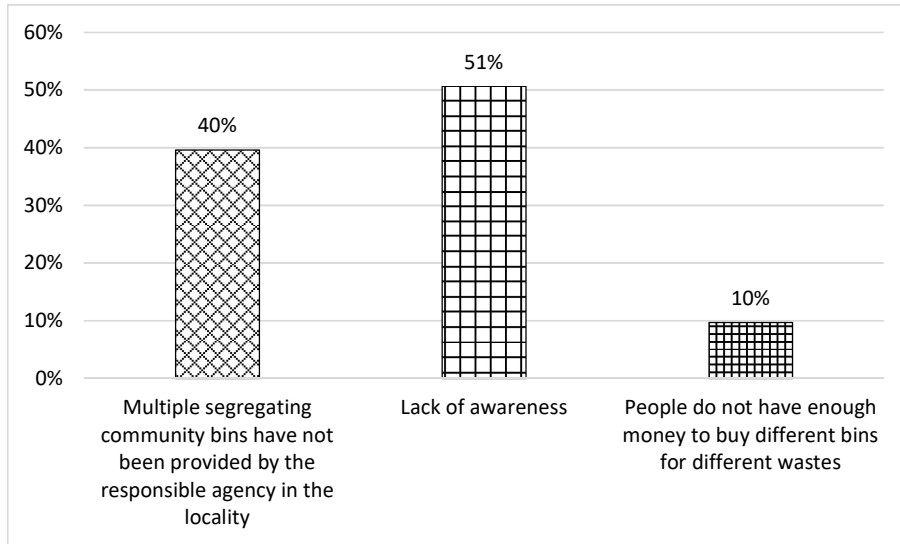


Figure 21 from respondents' response that money is not a big problem for provision of segregating bins. 40% respondents said that they do not segregate waste because community bins to segregate bins are not installed in their localities and 51% said that lack of awareness is the main cause of throwing every type of solid waste in a single bin. It is determined if these two cause are removed the at least 91% of not segregating community will perform solid waste segregation.

Figure 22: Who collects respondents' domestic waste?

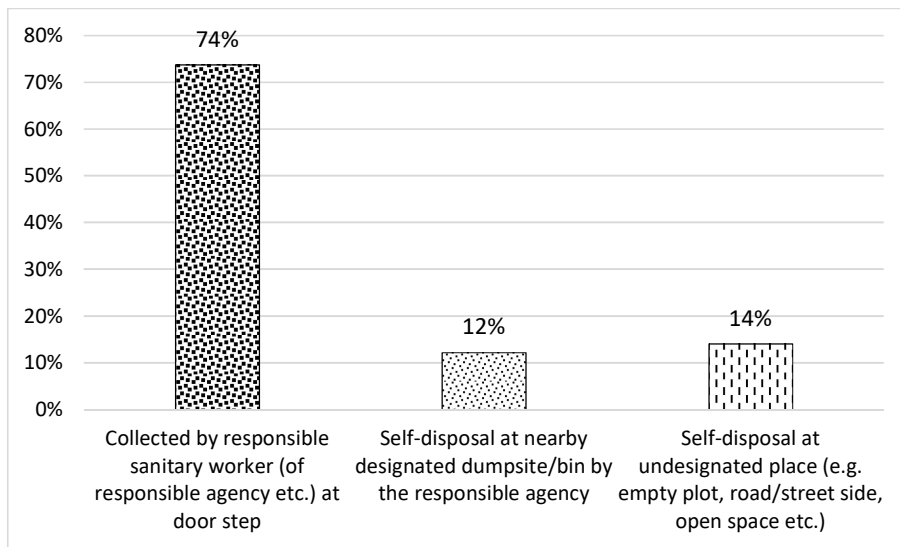


Figure 22 shows that 74% respondents said that responsible agency's sanitary worker collects waste from door step. 12% dispose of at nearby designated waste dump and 14% dispose of their solid waste at undesignated waste dumpsite.

Figure 23: Are community waste bins available near respondents' house/workplace?

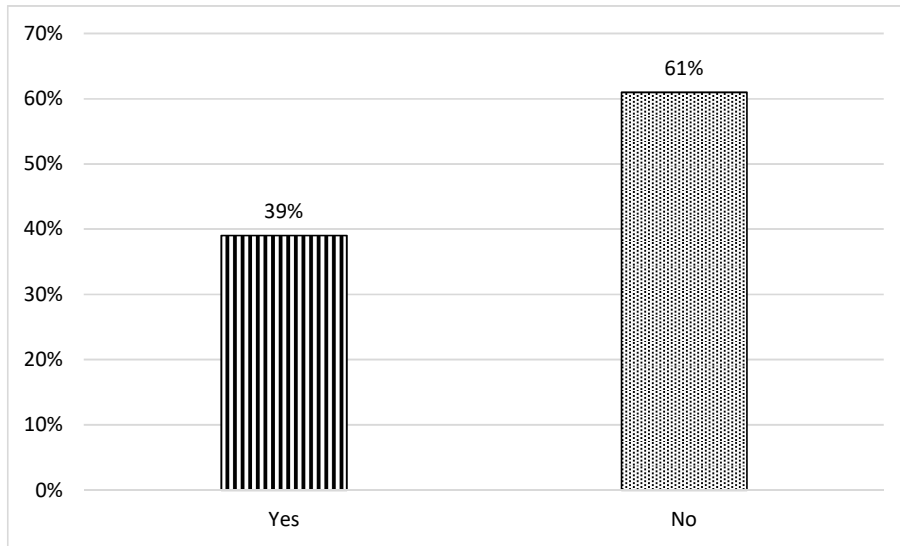


Figure 23 shows that 39% respondents said that community waste bin near their living/workplace are available whereas 61% said that no community waste bins are available. This gap is a reason of littering. It is required that sufficient number of waste bins at appropriate distance are available more over it is also equally important that these waste bins are cleared frequently so that waste disposed of in them may not fall out to create health or environmental problems.

It is also pertinent to say that instead of one bin for every kind of waste the responsible authorities should place 3 set of waste bins (for recyclable, compostable and rejected waste) at appropriate places. This step will create awareness in public to segregate their waste. Also less quantities will go to dumpsites.

Figure 24: Are undesignated dumpsites present near respondents' house/workplace?

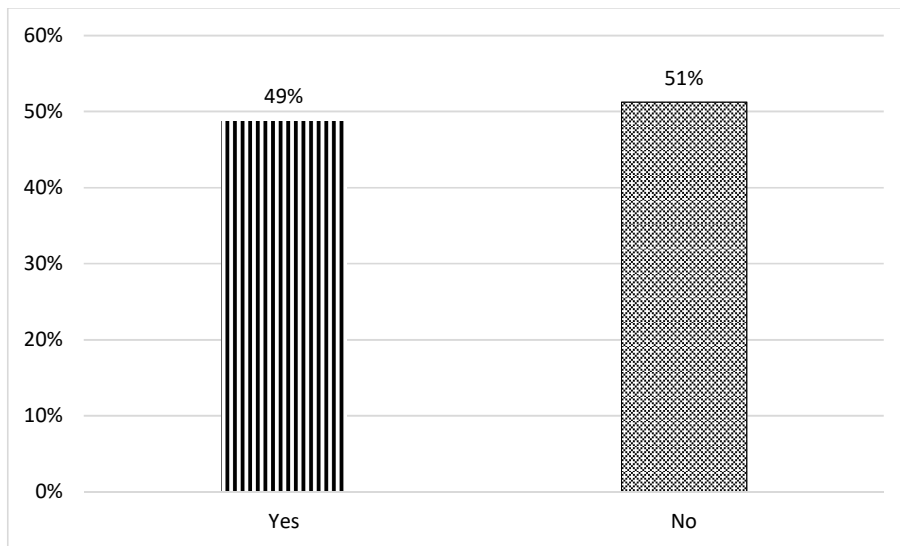


Figure 24 shows that 51% respondents said that in vicinity of their house/workplace undesigned waste dumps are present. This is dangerous to health and environment. From this data we may conclude that 51% population has no integrated waste collection system. The need of this time is not limited to sweep and collect every type of waste and dispose it at some dumpsite but, citizen are required to be involved by making them to segregate their waste at point of generation only residuals left after sorting of recyclables and compostable are allowed to go to landfill. Landfill even sanitary should not be thought of as sustainable place for waste disposal. No one likes to live near sanitary landfill even if it is sanitary.

Figure 25: Do responsible agency supervises respondents' areas for solid waste management services?

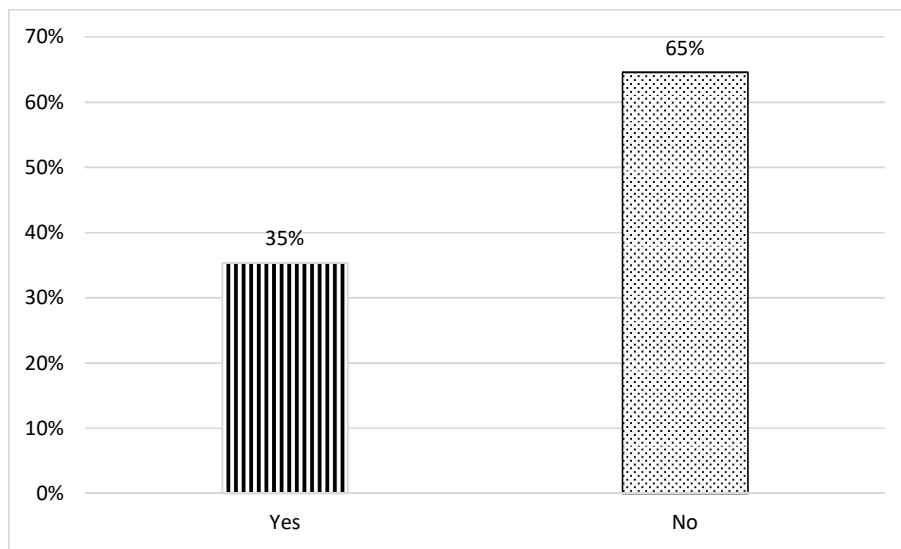


Figure 25 shows that 35% respondents said that their areas are supervised by responsible agencies for quality of solid waste management services. 65% said that no supervision of services is conducted in their areas. Normally if citizen are not involved in solid waste management the responsible agencies are not encouraged to supervise their areas as they couldn't question littering residents. It is required that solid waste management responsible agencies involve citizen in solid waste management of their part and supervise the areas as well as their sanitary workers and their supervisors.

Figure 26: Do respondents agree to have segregating bins at their house/workplace?

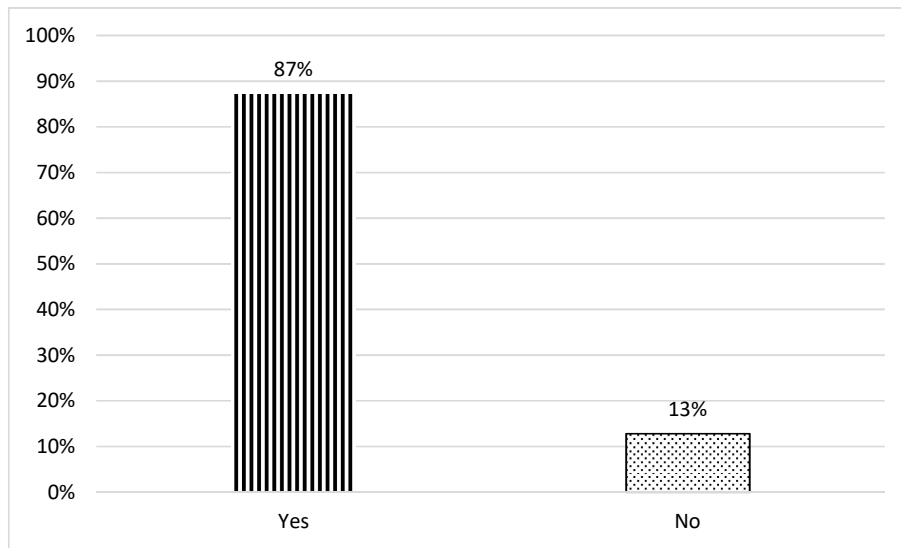


Figure 26 shows a very happy finding from the respondents that 87% agree to place segregating bins at their house workplace in spite of the fact that 67% dispose of mixed waste. This analysis shows that people want to segregate their waste but do not segregate due to absence of synchronized segregated solid waste collection system. It is hoped that if an integrated solid waste collection system is devised people will support and participate.

Figure 27: Are respondents agree to use community segregating bins if provided by responsible agency?

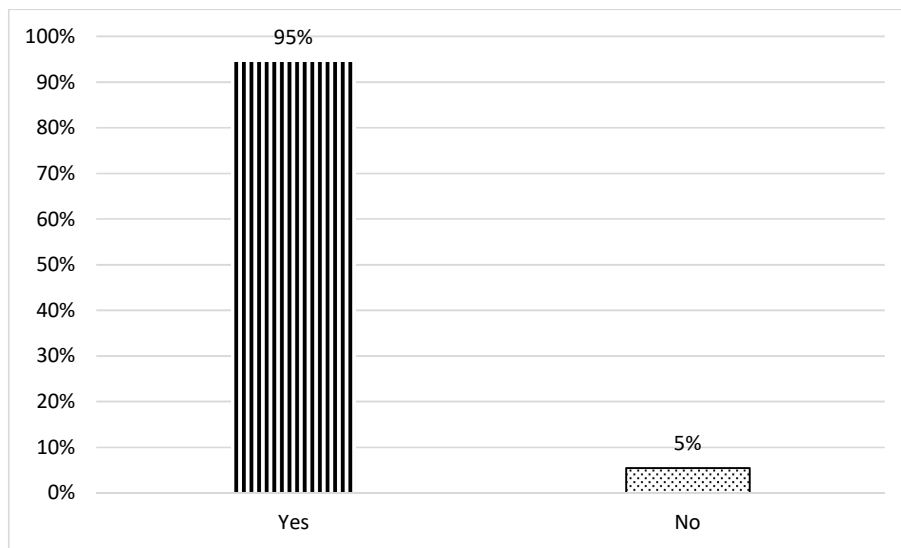


Figure 27 shows that the above chart represents respondents opinion regarding their agreement to use community segregating bins if provided by the responsible agency. 95% have given their consent for using community segregating bins if provided by the responsible agency. Considering overwhelming respondents' agreement to use segregating bins, the government may decide to

bring in solid waste segregation laws. Rest 5% disagree to use community segregating bins who could easily be handled by giving environmental awareness.

Figure 28: Do respondents demand for segregated solid waste collection?

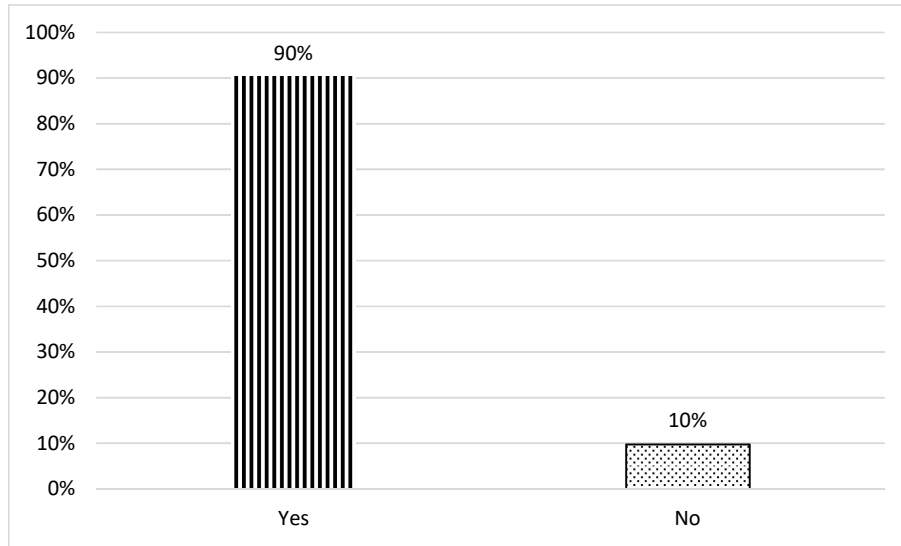


Figure 28 shows that 90% respondents demanded that responsible agency should begin an integrated program for segregated solid waste primary collection. Provision of utility services should be decided democratically, and if we generalize this data to public, government should initiate program for segregated solid waste primary collection. 10% respondents who do not agree to the idea may be persuaded by creating environmental awareness for them.

The respondents on average Rs. 523/month are willing to pay for segregated solid waste primary collection from houses with a sample standard deviation of Rs. 1,945.

Figure 29: Do respondents desire to have a tract of land for categorized self-disposal of the community's construction waste?

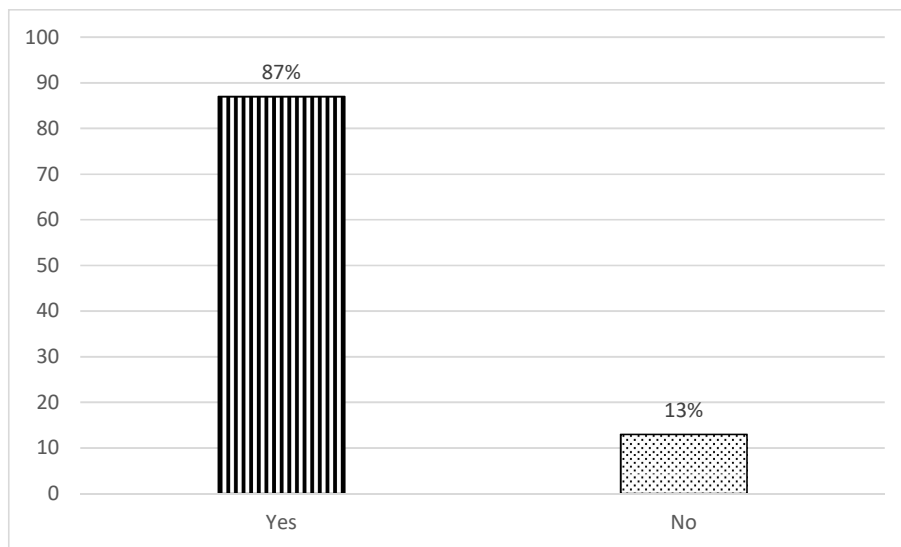
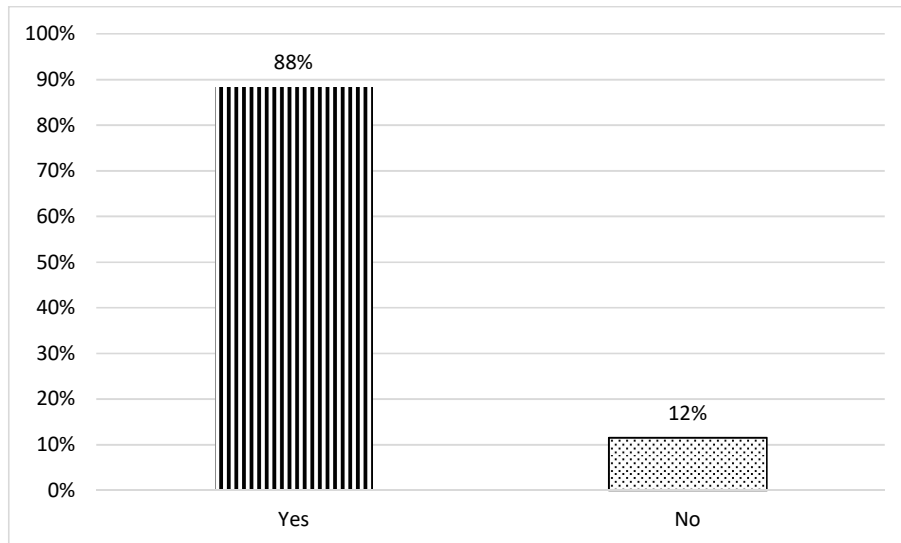


Figure 29 shows respondents desire to have a tract of land for categorized self-disposal of the community's construction waste. If responsible agencies provide such tract of land its administration could be self-sustainable as some salable debris like concrete, wood etc. will come to the amenity site for disposal. Such an arrangement will encourage households/citizen not to contaminate the water streams, woods open plots etc. and dispose of their construction way in a disciplined manner. Consequently, the environment will be improved. In developing countries construction debris/rubble is also recycled for construction industry. The same practice could be adopted in Pakistani cities. The arrangement will help to mine fewer natural resources e.g., lime, stone, soil, etc.

Figure 30: Do respondents desire to have a separate program for collection of construction waste?



Construction waste is actually an inert waste. It may be recycled for construction purposes. Studies have confirmed use of recycled material in construction projects. In Australia construction waste after recycling is used in various construction projects e.g. house construction, bridges etc. thereby, valuable virgin natural resources e.g. sand, mud, limestone is save. However in Pakistan, presently, no responsible agency collects construction demolition waste. It seems as if respondents' intuition guided them, and the *figure 30* shows that 88% agree that separate program for collection of construction waste should be started. 12% said that no such program should be started who may be convinced through giving them awareness of construction waste hazards.

Figure 31: Are respondents willingness to pay separately for collection of construction waste?

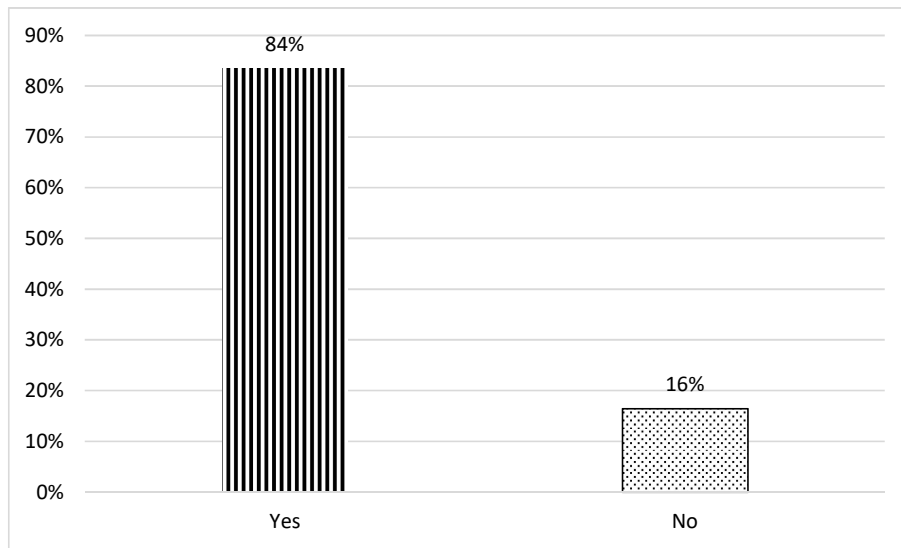


Figure 31 shows that 84% willing to pay separately for collection of construction waste. We know that construction waste which is salable or usable people make use of it accordingly. Rest is laying unattended for years neither people get it lifted nor do responsible agencies make effort to lift it as requisite machinery is also not available with the agencies. So respondents are willing to pay if their construction waste is get lifted. No one should be allowed to refuse the services to lift construction/demolition/renovation waste.

The respondents on average are willing to pay Rs. 562/wheelbarrow for primary lifting of construction demolition waste from their houses with a sample standard deviation of Rs. 2,277.

Figure 32: Do respondents opine to contract out segregated solid waste collection services?

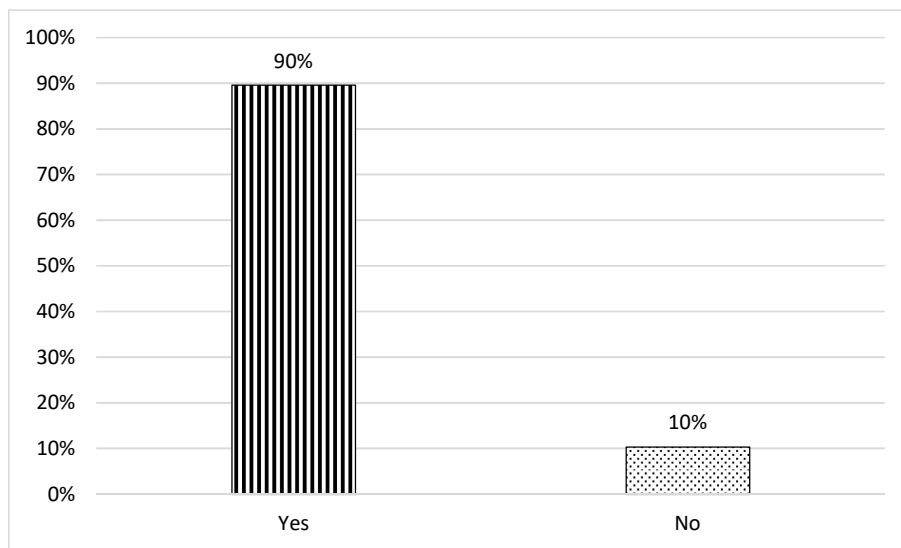


Figure 32 shows that 90% respondents agree that segregated solid waste collection services should be contracted out as government could not afford to employ thousands of staff including sanitary workers, supervisors etc. due to financial burden. Moreover, even spending billions of rupees on

the regular staff the objective of integrated solid waste management is not achieved. One reason of this lag in actual performance is that because of job security these workers take their responsibility for granted. Many cleaners/supervisors are engaged with working on their seniors residences etc.

In view of all this bureaucratic hurdles it is imperative that segregated solid waste collection services are contracted out. To increase competition for each 50,000 population government should decide floating separate service tender.

Improving Municipal Solid Waste Management in India, (Zhu., D et al., n.d.) Likewise tender for secondary collection, recycling, composting, and landfill site management should be floated. After detailed deliberation the government may decide the appropriate contract type from the following:

1. Service Contract
2. Management Contract
3. Design, Build and Operate (DBO)
4. Lease
5. Build, Own and Operate (BOO)
6. Build, Own, Operate and Transfer (BOOT)
7. Build, Operate and Transfer (BOT)
8. Concession (including fee collection)

Figure 33: Should people be fined on littering?

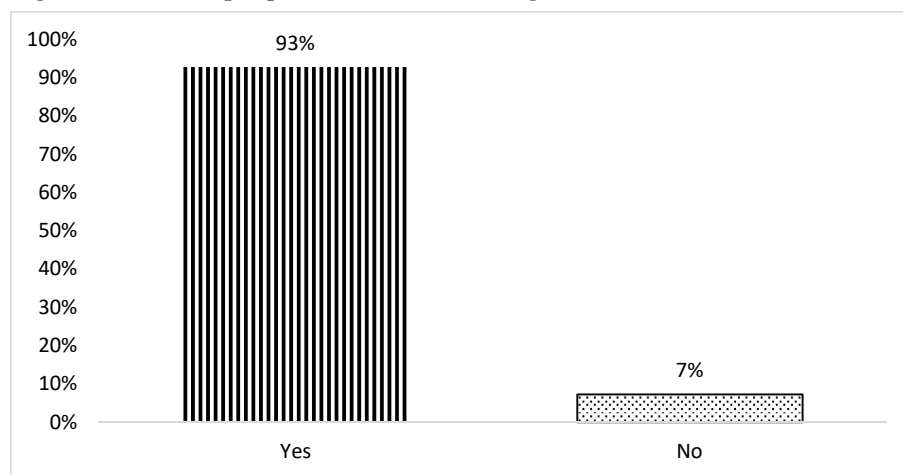


Figure 33 shows response of the respondents where 93% are willing to fine those whom area of responsibility is dirty whereas, 7% think that littered areas responsible shouldn't be fine. This analysis shows that respondents' rage towards littering. It is expected if a just fine mechanism is implemented areas will be cleaner and mainly educated public is expected to abide by.

Figure 34: Should the people be fined if they do not dispose of their solid waste segregated in at least three categories—recycle, compostable and rejected?

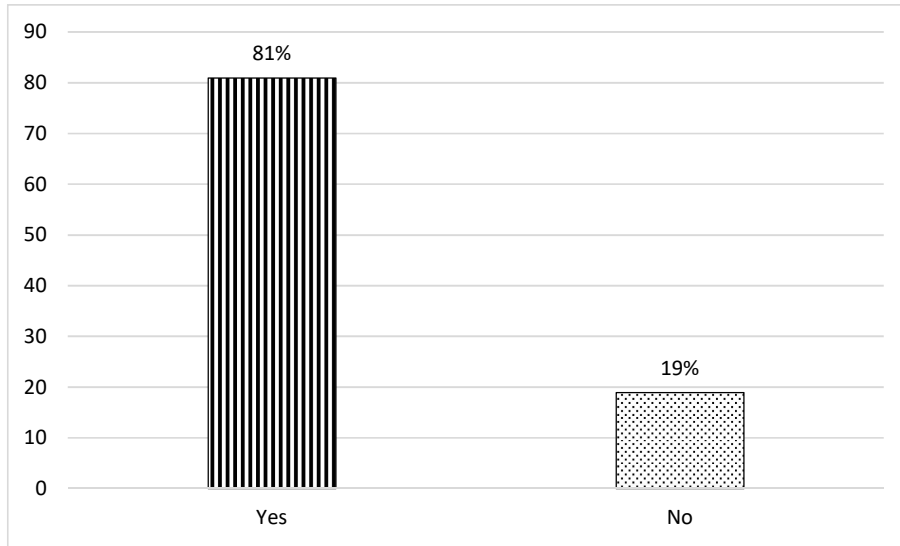


Figure 34 shows that 81% respondents are agreed that mixed disposal of municipal solid waste should be fined. Although 67% respondents said that they dispose of mixed waste but it is a point of satisfaction that they realize the advantages of segregated solid waste disposal. They might be performing otherwise due to non-availability of necessary infrastructure. It is expected that if segregated solid waste primary collection is started the majority of the people would appreciate it and behave in favor of it.

Figure 35: Should government bring in an Act on the promotion of sorted collection and recycling of containers and packaging?

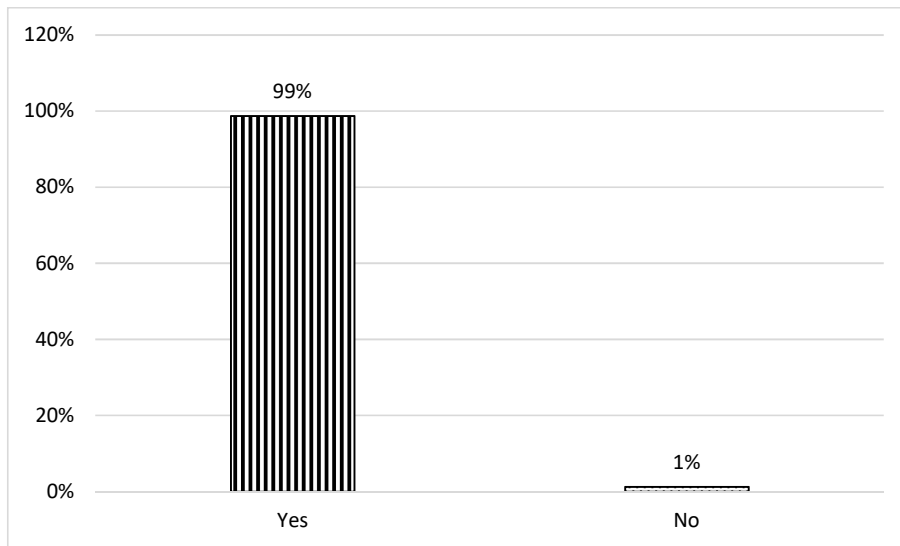


Figure 35 shows that 99% respondents opined that the government should bring in an Act on promotion of sorted collection and recycling of containers and packaging. 1% opined against who may be persuaded through creating awareness. The world has to go for zero solid waste policy

otherwise consumerism and increasing population will destroy our only man dwelling the planet Earth.

Data analysis shows that 17.62% household respondents do not want to pay for segregated waste collection program. And 11.45 % respondents willing to pay higher amounts from 1000 to 1500 for the program. 70.93 % household respondents willing to pay from Rs. 50 to Rs. 500 per month for the program.

Most of the people are willing to pay for sorted collection of solid waste. Their payment may be increased if effective and efficient services are provided.

5.2 Summary of the Questions which Responses are Critical to Start Solid Waste Segregation Drive

Infectious diseases spread due littering (Yes)	Mixed throwing of waste dangerous to health and environment (Yes)	If all type of waste be thrown in the locality (No)	Respondents willingness to dispose of segregated waste (Yes)	Fine on littering (Yes)	Fine of mixed disposal (Yes)
95%	87%	35%	82%	93%	81%
Segregated waste disposal provides more recyclable, compostable etc. (Yes)	Public awareness about solid waste management (poor)	Govt. educates public about waste segregation (No)	Should Govt. use media to educate people about waste segregation (Yes)	People complain about mixed solid waste (No)	People solid waste disposal behavior (mixed)
72%	92%	87%	99%	68%	67%
Main cause of dumping every type of waste in one bin (lack of awareness and community bins)	Presence of undesignated dumpsite in in neighborhood (Yes)	Respondents willing to have segregating waste bins at their house/ workplace	Respondents desire to use community segregation bins (3 categories if provided)	Respondents willingness for initiation segregated solid waste collection program (Yes)	Respondents desire to have tract of land for segregated disposal of construction waste (Yes)
91%	49%	87%	95%	90%	87%
Respondents' desire to have separate program for collection of construction waste (Yes)	Respondents in favor of and Act regarding segregated collection and recycling (Yes)				
88%	99%				

Average of critical %ages= 81% therefore, from respondents' responses, public is expected to support segregated solid waste collection system if implemented with integrated necessary prerequisites.

5.3 Environmental Awareness and Segregated Solid Waste Collection

Discussion:

5.3.1 Awareness

We analyzed the impact of impact of solid waste awareness on household willingness to participate in solid waste segregation. It is expected that greater the awareness the more households will be willing to do solid waste segregation.

5.3.2 Infrastructure at house

On the basis of the primary data collected we say that if households are provided segregating bins by the authorities, respondents are willing to use them for waste segregation at home.

5.3.3 Infrastructure in community

Community infrastructure for waste segregation is key to encourage public for waste segregation. This require that waste segregation bins set is equally spread (75 meters apart) in the community.

5.3.4 Provision of law

We have analyzed if people agree that households who do not do waste segregation should be fined and, are agree that in this regard government should bring in law it will show that if laws are made for solid waste segregation public will be obligated to do it as respondents have showed their agreement for law making and fines in this connection.

Here, it is to be noted that segregation of household waste becomes more and more cumbersome if waste is not segregated at source. It is equally important not to mix the waste while collecting by the sanitary worker. MCI would also need material recovery facility (MRF) to further segregate the waste streams in order to recover materials for recycling and composting.

The idea of amenity site is not new as it is being implemented in UK where, citizen could drop their material wastes e.g., building material, used furniture, electronics so that these waste do not create visual pollution and spoil the environment. The concerned authorities need to look into this opportunity as well.

If segregation at source is not started to reduce the quantities rejected to dumpsites and recovery of recyclable and compostable this huge amount of waste at maximum could not only be swept from one community area to a far flung country site. As the population is increasing exponentially the city dwellings are approaching near to waste dumps or vice versa.

A policy to strictly follow the 3Rs of waste management is need of the hour which is not practicable unless a policy on waste segregation at source is introduced through an Act of Parliament.

In this connection government should be seen working to provide necessary infrastructure as without infrastructure waste segregation is not a viable initiative. If waste segregation infrastructure is provided people for environment and health would be willing to participate by contributing amount or by physical efforts as the purpose to reduce waste and make our cities free from ugly littering. However, added economic benefit i.e., material recovery, environment up gradation or health benefit are luckily could be considered as gifts of noble practice i.e. waste segregation at source.

Chapter 6: Conclusion and Policy Recommendations

6.1 Conclusion

The problem of every growing waste is obvious in our country. The other countries are also facing this problem but some e.g., Sweden, Switzerland and Japan etc. have managed it by adopting scientific measures. We in Pakistan should manage this problem scientifically and on the basis of relevant statistics. The research unbiasedly and to our pleasure as well proved that most of our public wants to segregate waste subject to necessary infrastructure is provided. Some important findings are as under:

88 % respondents said that infectious diseases are spread due to littering.

96 % respondents said that littering deteriorate environment.

98 % respondent bother littering

98 % respondent are of the view that public should be fine if waste found in their area of responsibility.

94 % respondents said that public awareness about waste management is either very poor or poor.

46 % respondents said that people should be given awareness about waste segregation through social media e.g. Facebook, WhatsApp, twitter, Tik Tok etc.

People rightly recognized waste management symbols; their %ages are given as under:

Recycling	Composting	Dust Bin	Littering	Landfill
60	70	70	74	82

The percentages of public sense of waste symbols shows that public is sufficiently aware of waste disposal knowledge beside that

74 % respondents said that they dispose of waste mixed.

4 % respondents said that they do not segregate due to low financial status.

It is determined from the respondents data that people are aware of the need of waste segregation and if necessary infrastructure i.e., segregating bins, timely clearing are performed 68 % of people will rightly be doing waste segregation at source.

68 % respondents said that their waste is collected by responsible worker from door step.

38 % people have employed domestic workers for household chores.

96 % respondents are agree to have separate bins for separate categories of waste at home whereas, 90 % agree that community segregating bins if provided will be utilized.

80 % of the respondents are willing to use waste segregation program in case responsible agency provide them waste segregation bins.

84 % of the respondents are ready to use the community piece of land provided by the responsible agency for categorized disposal of their construction waste.

92 % respondents said that to obtained better efficiency solid waste management be privatized.

100% respondents said that government should bring in an Act for on the Promotion of Sorted Collection and Recycling of Containers and Packaging.

Generally it is thought that public is not aware of the waste segregation and doesn't want to segregate solid waste at source and it is presumed that people be given more awareness about solid waste management. However, the findings of survey showed that actually people are aware of solid waste segregation and intend to segregate waste but appropriate integrated infrastructure is not available therefore their efforts to segregate waste are futile resultantly they do not segregate at source and responsible agencies are dumping mixed waste in crude dumpsites. Overall the negligence on the part of responsible agencies is making our country less and less ecofriendly.

- About 20 thousand ton of solid waste is produced in Islamabad per month.
- About 25 million ton of solid waste is produced per year in Pakistan. By 2030 this amount of waste will reach more than 30 million ton (mathematical estimates). About 60 % of waste is dumped in dumpsites whereas about 40 % is thrown in open plots, depressions, water streams etc.
- The nation does not afford to dump these huge quantities of waste as nobody likes to live near waste dumps. Due to increase in population the dwellings come closer to the waste dumps which complicate waste problem further. The solution is zero waste policy.
- In order to reduce the waste/trash whether goes to ordinary dumpsites or remain unpicked on the roadside, free land, or thrown in low laying areas e.g. valleys, water streams etc. the local authorities should promote waste segregation at source.
- Our research clearly shows that public is willing to segregate their waste in 3 categories of recyclable, compostable and rejected waste subject to domestic and community waste segregating infrastructure is provided the by the responsible agency.

6.2 Way forward:

As all the responses of respondents are in favor of solid waste segregation at source why till now no such policy have been devised by the government in this connection. This could be an area of research for the students who are interested to reduce the waste to zero or 100% usage of waste in any of the productive uses i.e., recycling or composting or energy production etc.

6.3 Policy recommendations:

It is hoped that if following points are implemented in letter and spirit our overall environment will shift from mess to order. It will bring aesthetic, health and environmental quality:

- People should be encouraged to perform waste segregation at source. Public awareness of waste segregation should be promoted using Newspaper, TV, radio, educational institutions and social media e.g. Facebook, WhatsApp, twitter, Tik Tok etc.
- The government through a responsible agency should provide and administer the appropriate number of community bins sets for solid waste segregation. The sets will comprise of 3 bins each for recyclable, compostable and definite or ejected waste. Only the definite waste will go to landfills.
- The government through a responsible agency should provide and administer amenity centers for each 50,000 population to dispose of their construction waste and other waste which could/should not be collected in the bins.
- To begin with segregation at source—government could adopt the following measures to promote solid waste segregation at source without spending any additional budget.
 - (a) All corporate offices, commercial centers, government offices, hotels, factories will be required to conduct waste segregation at source in three bins designated for recyclable, compostable and definite waste. The responsible agency will be responsible to collect segregated waste.
 - (b) All waste will be stored at source in properly covered containers.
 - (c) Dedicate one or two day/week for collection of dry waste (mostly recyclable) using the existing workforce.
 - (d) Wet waste (organic waste) should be collected on daily basis.
 - (e) Trash i.e., washroom floor waste hairs etc., tissue wastes, hospital waste, body wastes such as hairs etc., infectious waste etc. should be collected on daily basis

Violators should be charged with fines.

- Government through responsible agencies should facilitate use of recycled raw material, compost without which the practice of waste segregation will be futile and we will not be able to manage ever growing quantities of waste.

It is hoped if the recommendations are followed in letter and spirit waste in the cities will be reduced consequently, quality of health, environment and rural and urban aesthetic will be enhanced. The recommendations will also promote economy of our country.

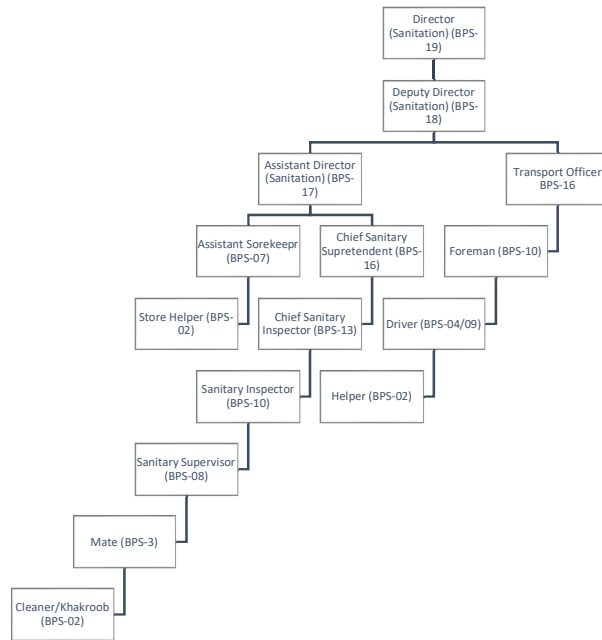
References:

- WasteDive. (n.d.). *World Bank: Global waste generation could increase 70% by 2050*, 17.04.2020, <https://bit.ly/3bkN55o>
- Department of Commerce, United States of America. (2019). *Waste Management*. 17.04.2020, <https://bit.ly/3euvtpG>
- Website: The Balance Small Business Source: <https://bit.ly/2CCGuHi>
- Lew, R., (2018). Solid Waste Management in Pakistan. BioEnergy Consult. Retrieved from <http://www.easybib.com/apa-format/website-citation>
- Nisar, H., Ejaz, N. & Naushad, Z. (2008). Impacts of solid waste management in Pakistan: a case study of Rawalpindi city, WIT Transactions on Ecology and the Environment, *Vol 109*. 685-691. doi: 10.2495/WM080701
- Árnadóttir, Á.D., Gerjo Kok , Gils S and Hoor G.A. (2018). Waste Separation in Cafeterias: A Study among University Students in the Netherlands. *International Journal of Environmental Research and Public Health*, doi:10.3390/ijerph16010093
- Yee, T.S., Ting, L.S. (2016). Attributes in Fostering Waste Segregation Behaviour. *International Journal of Environmental Science and Development*, doi: 10.18178/ijesd.2016.7.9.860
- A. Malakahmad, M. Za, and M. Nasir, —Solid waste characterization and recycling potential for University Technology PETRONAS Academic Buildings, American Journal of Environmental Sciences, vol. 6, no. 5, pp. 422-427, 2010.
- Amjad (2015). Household Awareness and Willingness for Better Solid Waste Management: A Case Study of Quetta.
- Asian Development Bank. (2013). *Material Recovery Facility Tool Kit*. Philippines: Asian Development Bank.
- Kansal, A., (2002). Solid Waste Management Strategies for India. *Indian J. Environment Protection*, 22(4).444-448. Kalpana Corporation
- Asian Productivity Organization. (2007). *Solid Waste Management: Issues and Challenges in Asia*. Tokyo, Japan: Asian Productivity Organization
- Agarwal, R., Chaudhry, M. & Singh, J. (2015). Waste Management Initiatives in India for Human Wellbeing, *European Scientific Journal*, June 2015, 105-127.
- Singhirunnusorn, W., Donlakorn, K. & Kaewhanin, W. (2012). Household Recycling Behaviours and Attitudes toward Waste Bank Project: Maha Sarakham Municipality. Maha Sarakham University, Thailand
- Khattak, N., Khan, J. Ahmad, I. (2009). An Analysis of Willingness to Pay for Better Solid Waste Management Services in Urban Areas of District Peshawar. *Sarhad J. Agric.*, *Vol.25* (3). 259-535. Pakistan Institute of Development Economics, Islamabad
- Rafiq, N. & Dr. Zeeshan (2016). Economic and Environmental Benefits of Conversion of Municipal Solid Waste into Renewable energy: A Case Study of Islamabad. Pakistan Institute of Development Economics, Islamabad.

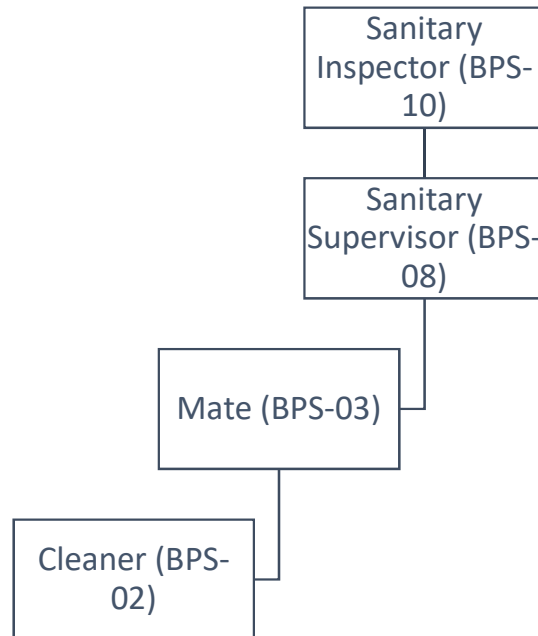
- Masood, M., Barlow, C. Y. & Wilson, D. C. (2014). An assessment of the current municipal solid waste management system in Lahore, Pakistan. *Waste Management & Research*, Vol. 32(9). 834–847. doi: 10.1177/0734242X14545373
- Parajuli, A (2016). Application of Contingent Valuation Method in Natural Resource Management in Nepal, Kathmandu Forestry College: Nepal.
- Mahar, A., Malik, R. N., Qadir, A., Ahmad, T., Khan, Z. & K, M. A. (2007). Review and Analysis of Current Solid Waste Management Situation in Urban Areas of Pakistan. *Proceedings of the International Conference on Sustainable Solid Waste Management, September 2007*. 34-41. Chennai, India
- Ministry of *Environment*, Japan. Solid Waste Management and Recycling Technology of Japan-Towards Sustainable Society-
- Qasim, M. Capital Development Authority, Islamabad, Allama Iqbal Open University, Islamabad, NED University, Karachi, (2010). Characterization of Household Waste in Islamabad and Exploring Possible Reuse and Recycling Options.
- Ahsan, A. et al., (2014). Assessment of Municipal Solid Waste Management System in a Developing Country. *Chinese Journal of Engineering*.
- Malik, S (2019). *Pakistan's waste problem is a recycling industry waiting to be found*. Dawn News. <https://bit.ly/2GkxwAr>
- Bahria Town; Paving Way towards Sustainable Community (2017). <https://bit.ly/3liBKXS>
- World Bank Institute, Improving Municipal Solid Waste Management in India
- Pakistan Bureau of Statistics. Population Census. District and Tehsil Level Population Summary with Region Breakup, Islamabad. Retrieved from <https://bit.ly/33DmQFO> on 10.08.2020
- Kissan Engineering (2018), Pakistan Waste Management. <https://bit.ly/30EUXLz> (<https://kissanengg.com.pk>)
- Batool, S.A. et al., (2008). *Economic potential of recycling business in Lahore, Pakistan. February 2008. Waste Management 28(2):294-8. DOI: 10.1016/j.wasman.2006.12.007. Source: PubMed*
- Dawn, Nov. 30, 2018. Water Charges to Go up in the Capital. <https://bit.ly/30zU4UI> (dawn.com)
- Junaidi I. (2019). CDA to devise garbage collection, sorting system. Dawn Newspaper <https://bit.ly/3d12ZmQ> (dawn.com)
- Dawn. (Jan 29, 2020). *MCI calls off bidding for garbage collection contract at the eleventh hour*. 19.04.2020 From <https://bit.ly/2KsxYLr>
- Urdupoint (Feb 16, 2020). *Lack Of Garbage Collecting Vehicles Hampers MCI Waste Management*. 19.04.2020, From <https://bit.ly/2XNhvck>
- CDA Changes Site for Proposed Landfill Site. Waste-to-Energy Plant (2018). <https://bit.ly/3d292Yt>
- Grey, A. (n.d.). *Germany recycles more than any other country*. World Economic Forum. Retrieved from <https://bit.ly/34Dz7sS> on 08.10.2020

- Solid waste disposal and collection system in Pakistan*. Retrieved from <https://bit.ly/2Fa8h2Y> on 08.10.2020
- Waste Management*. Retrieved from <https://bit.ly/3euvtpG> on 08.10.2020
- Thornton, A. (n.d.). These 11 companies are leading the way to a circular economy. World Economic Forum. Retrieved from <https://bit.ly/3d76U1H> on 08.10.2020
- Tchobanoglous, G., Kreith, F. (2002). Handbook of Solid Waste Management
- Kansal, A. (2002). Solid Waste Management Strategies for India. *Indian J. Environmental Protection*, 22(4).
- Teaching and Training Module for Higher Education in the Waste Management Sector published by the Institute of Waste Resource Management, Germany
- Javied, et al., (2014) *Management of municipal solid waste generated in eight cities of Pakistan*. International Journal of Scientific & Engineering Research, 5(12), 1786-1192. Retrieved from <https://bit.ly/36F4Nkx> on 08.10.2020
- Kumar, et al., (2010) *Healthcare Waste Management (HCWM) in Pakistan: Current Situation and Training Options*. J Ayub Med Coll Abbottabad 2010; 22(4)
- Singhirunnusorn, W. et al., (2012) *Household Recycling Behaviours and Attitudes toward Waste Bank Project: Mahasarakham Municipality*. Journal of Asian Behavioural Studies, 2(6). Retrieved from <https://bit.ly/3nvOqwo> on 08.10.2020
- Lew, R. (2019). *Solid Waste Management in Pakistan*. *Bioenergy Consult*, (2019). Source: BioEnergy Consult. <https://bit.ly/2VheMX2> Retrieved on 08.10.2020
- I. G. Masson, A. Oberender, and A. K. Brooking, —Source separation and potential re-use of resource residuals at a University Campus, *Resour. Conserv. Recycl.*, vol. 40, pp. 155-172, 2004.
- (2011) *CDA launched Sanitation Helpline*. The News. Retrieved from <https://bit.ly/2GQnFm0> on 20 June 2011
- Abbasi, K. (2018) *CDA changes site for proposed landfill site, waste-to-energy plant*. Retrieved from <https://bit.ly/3d292Yt> on 13.10.2020
- Nawaz, S. (2018). *Dysfunctional, archaic solid waste management system in capital ruining environment*. Pakistan Today. Retrieved from <https://bit.ly/3lCx8fq> on 13.10.2020

Appendix-I Hierarchy of CDA Sanitation Department



Sanitation Department Hierarchy for Door to Door Solid Waste Collection



Source: Capital Development Authority Website