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Challenges Faced in the Collection and Disposal of Municipal Solid Waste: A Case Study of Sanghar City

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Abstract:

The generation of municipal solid waste in many cities has increased as the population is increasing. Mismanagement of MSW collection is creating, health hazards, socio-economic problems, and deteriorating environments. This research aimed to examine the SWM problems and to identify SWM issues through the inhabitant's perspective and propose a sustainable method to control, collect, treat, utilize and disposing of Municipal SW in Sanghar City. Hence, the objective of this study is to achieve through cluster sampling, for the residential questionnaire study, a sample size of 384 was obtained and descriptive statistics and regression and correlation analysis methods have been used to evaluate the data collected. As a result, the collection of MSW is quite inappropriate and constricted to the influential area and solid waste keeps on scattered throughout the remaining areas. In recent years, the mismanagement of MSW has become a major problem in Sanghar city. The key problems of SW in the city are indiscriminate disposal, improper collection, inadequate storage, and insufficient facilities. To address these issues, the management of the disposal of SW must be carried out with the complete participation of the respective communities.

Keywords: *Municipal solid waste; collection; disposal; quality of life; residential satisfaction.*

1. Introduction

In general, MSW is a collection of commercial and household waste created by the living population [1]. Municipal Solid Waste contains recycled paper, cans and bottles, food waste, yard trimmings, and other products [2]. Municipal solid waste comprises any human-derived waste that is usually unwanted as unnecessary or discarded [3]. MSW is a substance that is no longer useful to the individual responsible for it, nor is it meant to be released directly in a pipe. Normally this does not contain human excreta [4]. MSW is produced domestically and commercially in public places and streets. The words "garbage", "trash", "refuse" and "rubbish" were used to refer to some categories of MSW. MSW is therefore any raw material that comes from residential and commercial operations and is deemed to be discarded by those who own it. It takes us to municipal solid waste sources [5].

MSW is one of the big environmental issues facing cities in many underdeveloped countries, including Pakistan. The growth of the economic and urban population is leading to an increased generation of municipal SW. The use of products that cause toxic waste is

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another burden. Unmanaged disposal of city solid waste adds to pollution and general prosperity risks in the districts. Especially in low-income groups, most regions lack a collection of refuse. Locals in low-income societies tend to dump or burn their trash in close empty areas, particularly government sites and rivers [6]. The highest generation of waste of the Kumasi metropolitan area was recorded at 0.75 kg/person/day [7]. Due to the absence of laws and regulations, fundraising, self-awareness, management and knowledge, and the collection of cars, machinery, and recycling technology, it is unable to manage the continually increasing waste products quantity [8].

Therefore, Proper management of MSW is important for minimizing the impacts of environmental conditions and land degradation. Proper management of MSW has become a big issue among many cities in the developing world, and Pakistan is one of them [9]. It is assumed that if MSW is properly handled, it can be a beneficial resource, but if it is not managed efficiently, it can become a cause of environmental and human hazards. More to the point it is also believed by different institutions that is one of the most important components parts of urban sanitation is municipal SW management.
There is a lack of planning and management in Sanghar City. There are no appropriate arrangements for the management of SW. This research concentrates on the present SW management framework especially in the district and its adverse effects on condition and to survey the system, practices, and obligations of different organizations required in strong waste administration inside the premises of the city zone.

2. Literature Review

Improper management of SW creates different environmental and health problems for local people in cities. Mechanisms of municipal SW management in developed and underdeveloped counties are also discussed in this review. This literature may use to accomplish research objectives and give support to suggest a better mechanism of municipal solid waste management to solve overcome problems in the study area. The rapid population growth and urbanization process translate into more waste created [10].

Another research in Kolkata, India, found that a lack of facilities exists, and those improper bin collections are to blame for inadequate municipal solid waste collection and transportation. These studies have shown that this issue must be addressed because it directly affects the climate and culture.

2.1. Municipal Solid Waste

It is a global challenge to manage environmentally sustainable municipal solid waste [11]. However, many municipalities fail to control solid waste management issues, due to a not properly managed system [12]. While some administrated bodies have formed environmental protection plans of action, rules, which are, unfortunately, just take on only in capital cities [6]. Open space areas are used for dumping in most cities [12].
Reducing this problem is the biggest challenge for developing nations such as Pakistan. The public playing a significant part in reducing and managing this problem in general. In Pakistan, it is revealed that there are nearly produced 64,000 tons per day of solid waste [13]. These come out to be an insufficient understanding of the problem of solid waste management (SWM), whereas the first and efficient management of waste is just feasible to a public behavior [14]. Japan is reported to be effective in decreasing solid waste by applying a shared accountability notion where the public separates the waste before dumping it into fuels, non-burnable, and recyclables [15].

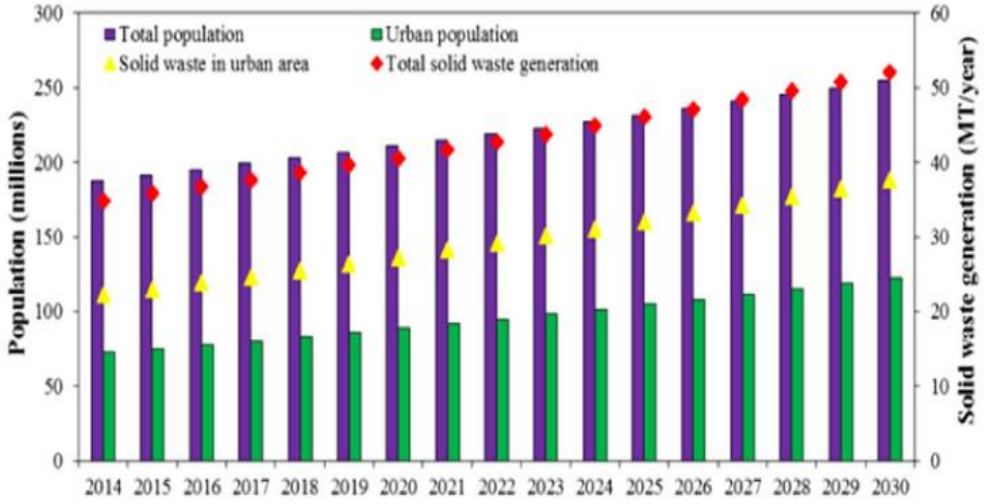

Fig 1: Estimation of Population and generation of MSW in Pakistan (Kawai and Tasaki, 2016)

2.2. Comparison of the activities of MSW management in Pakistan and other countries.

Those countries with a lower GDP produce less SW [16]. By refusing this statement, it explains that SW generation is gathered from information provided by a variety of sources in cities, considering municipalities, NGOs, research centers, higher education institutions, or even the first author. Whereas GDP is a national economic measure. Table 1 displays the generation of MSW coming from various regions and countries.

The amount of MSW produced increases as the population increase, as shown in Figure 1. MSW generation per capita is inversely proportional to national economic growth and varies by country.

3. Material and Methods

The data was gathered from various primary and secondary sources of data. Secondary data were gathered using comprehensive sources, i.e. literature studies in books and journals written. I have selected district Sanghar City and the data have been obtained and analyzed in SPSS 22.0 using descriptive analysis and the technique of regression and correlation analysis. The data identified the main critical causes for the city of Sanghar and discussed their possible solution with the field expert.

The area selected for research purposes is Sanghar city to examine significant issues of MSW management. Sanghar is the headquarters of Sanghar district and Sanghar Taluka. As per the census, 2017 total population of Sanghar city is four, 34,087. The total area of Sanghar city is 2,218 square kilometers. The Coordinates of Sanghar city is 26°2'49" N 68°56'54"E. Generating Solid waste is 350gm per person per day. The total generation is over 250 tons. Sanghar has located approximately 265km from Karachi.

Table I: Generation rate of MSW in different countries

Study year	Region/Country	GR (kg/capita /day)
(2015)	High Income	2.1
	Upper Middle	1.2
	Lower Middle	0.79
	Lower Income	0.6
	African	0.74
	Arabs States	0.77
(2011), (2015)	Asia	0.79
	Latin America	0.82
	Industrial Nations	1.4
	Transition Nations	1.34
	All cities Average	0.96
(2011)	Beijing (China)	1.2
(2010)	Singapore (Singapore)	0.96
(2012)	Dutse (Nigeria)	0.97
	Katsina (Nigeria)	1.12
	Denmark	2.04
	France	1.45
	Netherlands	1.44
(2016)	Kuwait	1.4
	United Kingdom	1.32
	Sweden	1.25
	Romania	0.74
(2012), (2015)	Pakistan	0.57
	Mumbai	0.45
	Kolkata	0.58

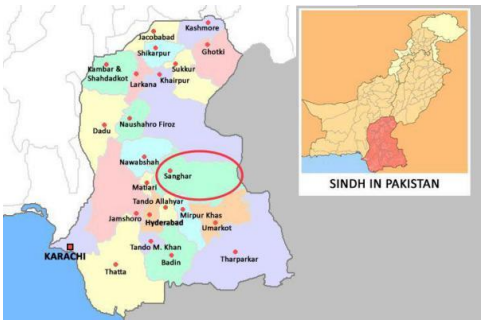

Fig 2: Sanghar district Map (Source: Google Map)

3.1. Method

The data was collected from a field survey through various techniques i.e. quantitative methods, a detailed personal field survey. Besides, the quantitative method was utilized to obtain detailed information about "municipal solid waste management" and its impacts on research area residents. A uniform questionnaire was developed and collected from the selected area residents. Detailed survey for municipal solid waste carried out through per sonal field surveys, personal interviews, questionnaires. The questionnaire may contain open-ended or close-ended questions depending on the nature of the research.

During the day, the survey was conducted for the residents at their homes. The aims of the survey were mentioned to potential residents during the survey [17]. The purpose of this data collection was to find out people's views on the impacts of inadequate SWM on the environment and human health. This strategy has helped test public perceptions of the issue of SWM. It also helped to determine whether their perceptions of the impact that the improper management of SW can have on the environment, likewise on human health is reliable.

Many unnecessary materials are produced in every area of human life, and these materials are discarded simply because they are considered waste. Waste is a core problem in developing countries where waste generation per production unit is far higher than in developed countries due to unsustainable manufacturing practices, poor design, and bad decision-making eventually. The goal of this study was to identify the problems with SWM in Sanghar and its effect on SW management practices. This work is investigative, as well as casual with a total population of 434087 a sample size of 384 is used. The self-administered Questionnaire instrument has been used to collect study data.

The analyzes of the collected data are based on quantitative data analysis techniques (such as mean, percentages, ratios, and standard deviation) and qualitative data analysis techniques (such as content analysis). It was found that not all of the issues facing SWM activities were considered major challenges but the only institutional structure and appropriate laws on SW management. The impact of the problems on waste management practices on the results leads to inefficiency in solid waste management practices. Based on this study's results, it is suggested that

management adopt steps to address the problems facing SWM practices.

3.2. Sample Population

The standard sample population and size of the households must be calculated. The standard level of the total population is (5-10%) which can be used as a sample of the total population [18].

TABLE II. Population Sample (Estimated)

Taluka	Population in 2017	Total Population 2021 (projected)	5% Sample Standard Selecti	Number Of Sampled Households (Questionnaires)
Sanghar	4,34,087	4,39,319	384	384

Sanghar population was 434087 as per Census 2017 with 50% population proportion and the questionnaire sample size is 384 which is taken in (Krejcie and Morgan 1970) table [19]. 5% sample standard selection is taken in the(Israel 1992) table [20]. Clusters from the study area were chosen, which have at least 10 residential units and possessed similar socioeconomic characteristics. As one questionnaire would be able to represent 10 households and approximately 60 inhabitants. Similarly, 384 questionnaires would exemplify 3840 households and 23040 persons in the study area. With the help of quota sampling, this proportion did take into account to satisfy the standard levels of population and sampled households. Thus, the proportions were made and cluster-sampling methodologies were implemented [21-29].
To conduct data about the existing mechanism of municipal solid waste management, machinery, workforce, existing duping points, mod of municipal solid waste collection, Tehsil Municipal Administrations (TMA's) Rules, and Bylaws the interviews were conducted from different officials of concerned authority working on MSW management. To also conduct interviews to know about a previous study on municipal SW management in the city. The following detailed information was received from the authorities concerned about their department [30-34].

4. Results and discussion

Two waste disposal sites have been chosen and visited to observe the problems surrounding municipal solid waste management (SWM) in Sanghar, as well as to understand the sources and forms of waste disposal.

2.3. Sources of Municipal Solid Waste

Municipal SW sources are categorized into two categories of residential and commercial waste. This categorization was based on observations made during visits to the site. Each one source led to various forms of residues. Waste forms found during disposal station visits included cardboard, batteries, paper, wood, plastics, glasses, etc. The details of the waste found at the disposal site concerning its generation source are discussed in Table III.

TABLE III. Sources and Types of Municipal Solid Waste

Source	Typical Location	Types of Solid Waste
Residential	House/ Apartments	Food waste, cardboard, chemicals, bottles, metals, textiles, dust, paper, special waste (bulk foods, consumer electronics

		, batteries, oil, and tires), and household hazardous waste.
Commercial/Municipal	Offices, restaurants, hotels, markets, and stores	Paper, cardboard, iron, wood, plastics, food waste, glass, Special waste, toxic waste

Structured questionnaires and unstructured interviews were conducted at the disposal sites during the visit with the staff and the individual responsible for managing the waste. By analyzing 384 questionnaire forms obtained during these visits, the respondents were statistically analyzed to reach a consensus. The objective of the questionnaire and the interviews were conducted to find explanations for the production of waste that was disposed of at the selected sites. The results obtained from the Likert questionnaire scale are discussed in Table IV.

The mean of the first factor has 0.972 SD (Standard Deviation). Most of the respondents i.e. 281 out of 384marked this factor strongly agree. The major reason is, an increase in population is a common cause of waste generation in Sanghar city and most people agree with it that is why it has the highest value of RII too. For poor management, the factor has 0.945 SD (Standard Deviation). Most of the respondents i.e. 103 out of 384 marked this factor strongly agree. For factors second and fourth, SD is within an almost equal range, here, the majority of the respondents are lying in SA (strongly agree). The major reason being the difference of opinion on this factor. As some people, observe a high level of awareness. However, others take in a different way i.e. generating a high level of waste.

TABLE IV. Causes of Waste Generation

No.	Cause of Waste Generation	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	Standard Deviation	Relative Important index	Ranking
1	Increase Population	281	47	34	11	11	1.5	0.972	0.9	1
2	Lack of awareness among the public	103	126	55	56	44	2.51	1.33	0.6979	4
3	Poor Management	279	50	33	14	8	1.49	0.945	0.901	2
4	Restrict Open Dumping Yards	227	12	66	35	44	2.11	1.467	0.7786	3

Therefore, these products should not be discarded at open dumpsites, appropriate disposal methods such as incineration, etc. should be implemented. Fig.3 and Fig.4 demonstrate the open dumping of solid waste on the road.

The second significant factor, as found by this study, is public awareness. The most common problem of the day now is a lack of knowledge about waste. It has been found that the public is not interested in reducing the production of waste but is increasing it by any means. The people do not accept it as their responsibility to reduce waste and dump it on roads that would make the world unpleasant and unsafe, and then start criticizing the government. The main role the public itself plays in this regard is to make them aware of the need of the hour through various social activities.

Fig 1: Open dumping by the community of solid waste on the road.

Poor or bad management of higher authorities has also been stated to be a major cause and ranked second. Management is the key to success for any organization in any situation but mismanagement, whether residential or commercial, can fail. Likewise, inadequate management of restaurants, commercial areas, and construction work contributes to a rise in the solid waste that can be avoided by creating an accurate management plan for each organization.

Fig 3: Dumping sites on the road

Furthermore, insufficient awareness of how to store materials may cause pre-use material harm, i.e. proper use of containers and materials to minimize waste (e.g., creatively storing and using leftovers). It will help householders reduce household waste; especially it is necessary for Sanghar city because most of the city is a residential area.

Table V represents a Pearson Correlation Matrix showing the association of dependent and independent variables. The Asterisk (*) in the table shows that the 2- tailed correlation is significant at the 0.01 level, having a confidence level of 99%. In each cell represents its strength or relationship, whose detail is given in the legend of Table 4. The value of ±1 shows a perfect correlation, the value of ±0.9 to ±0.7 shows strong correlation, the value of ±0.6 to 0.4 shows moderate correlation, the value of ±0.3 to ±0.1 shows weak correlation, and unfilled cells shows no correlation. Most of the correlation values are negative; it shows how the relationship negatively affected the other variables.

The number of males was 57.3%, and the number of females was 42.7%. Overall, 34.6% of respondents were aged 18 to 35, whereas 13.5% were above 60 years. Regarding household size, 33.9% responded that they were 2 to 4 family members live in the house, 25.5% were 5 to 7 family members, 22.7% were 8 to 10 family members, while 18.0% replied that they were more than 10 family

members in their house. Concerning education and income, about 32.3% had a post-graduation level of education, and 33.9% belonged to the category receiving a monthly income of RS 10,000 to 20,000 PKR, while 20.1% received RS 2000 to 10,000. About the profession, 33.6% were unemployed, and 2.6% was pensioner (see Table VI).

TABLE V. Correlations among variables

		1	2	3	4	5	6	7	8	9
1	Gender									
2	Age	.42**								
3	Education	-.64**	-.50**							
4	Employment	-.31**	-.42**	.27**						
5	Household size	.36**	.71**	-.47**	-.30**					
6	Income	-.59**	-.72**	.61**	.37**	-.63**				
7	Empty Dustbin	.52**	.81**	-.55**	-.39**	.60**	-.66**			
8	Generate waste	.51**	.75**	-.62**	-.34**	.69**	-.76**	.72**		
9	Disposal waste	-.44**	-.49**	.64**	.06	-.56**	.55**	-.51**	-.53**	
10	Waste collection	-.66**	-.51**	.78**	.20**	-.48**	.48**	-.50**	-.50**	.64**
	**. The correlation at level 0.01 (2-tailed) is significant. Note. N= 384, * ρ < .05, ** ρ < .01									

The description of the model and parameters for environmental factors are shown in Table VII. A value of 0.755 for 'R' shows that the environmental factors on municipal solid waste have a significant impact on people's quality of life. A value of 0.571 for 'R^2' shows that the predictors lie close to the line of regression, i.e., a strong prediction point. A value of 0.565 for 'Adjusted R^2' shows that 56.5% of residents realize that environmental factors have a significant impact on municipal solid waste generation. Whereas waste disposal was found to harm the environment and health quality with values of -0.155, respectively.

TABLE VI. Demographic characteristic.

Characteristics	**Frequency**	**%**
Gender		
Male	220	57.3
Female	164	42.7
Age		
18 to 35 Years	133	34.6
36 to 45 Years	120	31.3
46 to 60 Years	79	20.6
Above 60 Years	52	13.5
Occupation		
Employed	90	23.4
Unemployed	129	33.6
Self- Employed	56	14.6
Pensioner	10	2.6
Student	99	25.8
Education		
Uneducated	5	1.3
Primary	77	20.1
Matriculation	58	15.1
Intermediate	12	3.1
Graduation	108	28.1
Post-Graduation	124	32.3
Household-Size		
2 to 4	98	25.5
5 to 7	130	33.9
8 to 10	87	22.7
Above 10	69	18.0
Monthly Income		
RS 2000- RS 5000	77	20.1

RS 5001- RS 10,000	77	20.1
RS 10,000- RS 20,000	130	33.9
> 20,000	100	26.0

TABLE VII. Coefficient of regression for environment variables

R= 0.755, R^2= 0.571, Adjusted R^2= 0.565, Std. Error of Estimate= 0.683					
S. no	**Factor**	**Beta**	**Std Error**	**t-test**	**Sig.**
	Constant	1.587	0.198	8.036	0.000
X1	Empty Dustbin	0.418	0.029	14.662	0.000
X2	Disposal waste	-0.155	0.044	-3.490	0.001
X3	Waste collection	-0.076	0.042	-1.809	0.071
X4	Need for health education to create awareness regarding solid waste management	0.078	0.030	2.563	0.011
X5	Environmental impacts of solid waste around dumpsites	-0.00	0.027	-0.210	0.834

The overview model and parameter estimates for economic factors are shown in Table VIII. A value of 0.696 for 'R' shows that the economic factors influence all household sizes in a residential area significantly. A value of 0.484 for 'R^2' indicates the predictors lying on the regression line. A value of 0.479 for 'Adjusted R^2' indicates that 47.9 percent of residents think economic factors greatly influence the quality of life and the physical environment. Whereas income was found to be the negative impact factor with a coefficient value of -0.477. This can be explained as Sanghar City has gained a significant increase in residential density as a result of which the drainage and street conditions are getting worse and no one wants to pay for the cleaning of such waste that comes from the high-income family. They create more garbage as compare to the low-income group. Thus, people complain about the disposal system and the condition of the street.

TABLE VIII. Coefficient of regression for Economic variables

R= 0.696, R^2= 0.484, Adjusted R^2= 0.479, Std. Error of Estimate= 0.755					
S. no	**Factor**	**Beta**	**Std Error**	**t-test**	**Sig.**
	Constant	3.095	0.247	12.529	0.000
X6	Education	0.135	0.046	2.968	0.003
X7	Income	-0.477	0.047	-10.143	0.000
X8	How much will you pay?	0.212	0.040	5.298	0.000

Table IX displays the overview model and estimation of parameters for the rules and regulation factors. A value of 0.494 for 'R' shows that the rules and regulation factors are contributing less among effective and efficient

solid waste management of restricted open_dumping_yards in Sanghar city. A value of 0.164 for 'R^2' indicates that the predictors are not outliers, but are far from the line of regression, i.e., not a good prediction point. A value of 0.156 for 'Adjusted R^2' shows that only 15.6% of improper waste management is caused due to the rules and regulation factors of solid waste. According to the estimation of the differences between actual and estimated variables by 'standard error of the estimate,' value of 1.058 indicates that the difference between actual and estimated variables is very high.

Whereas, increase penalties who violate the rules and regulations were found to be the element having a negative effect with a coefficient value of -0.100. And what the model predicts will not be as specific as the actual situation.

TABLE IX. Coefficient of regression for Rules and Regulation variables

R= 0.405, R^2= 0.164, Adjusted R^2= 0.156, Std. Error of Estimate= 1.058					
S. no	**Factor**	**Beta**	**Std Error**	**t**	**Sig**
	Constant	1.635	0.432	3.785	0.000
X9	Restrict_open_dumping_yards	0.304	0.037	8.131	0.000
X10	The management of SW is going to be solved.	0.304	0.171	1.773	0.077
X11	Increase penalties who violate the rules and regulations	-0.100	.041	-2.44	.015

In Sanghar city, there is a Lack of Planning and Management. There is no appropriate arrangement for the administration of SW. Therefore, the municipality accumulation of family waste is very irregular and constrained to powerful ranges. Therefore, strong waste stays scattered all through the rest of the areas. To distinguish the issues in MSW in Sanghar. To highlight the strong waste issues of the neighborhood individuals.

The current system of MSW administration at Sanghar city might be included with no appropriate principles and directions. Besides, this review can propose new and Improve instruments for the administration of civil strong waste administration. This exploration likewise can direct to receive a successful component of municipal solid waste administration to maintain a strategic distance from natural and well-being clashes in Sanghar city. Management and workers are not taking that waste the 86% of people are not satisfied with the actual situation of SW. The regression model used in this analysis to determine the environmental and public health effects is based on the variables selected. The main variables used in this work are descriptive statistics given in Table 6. The values depicted are based on the regular data points for all forms of MSW considered obtained from each source.

Taking into view the significance of a policy in solving urban issues, recommending policy implications was based on the results of the analysis. Economic, environmental, and rules and regulations factors were found as the cause of improper management. This results in achieving the study's objectives. To identify SWM issues through the inhabitant's perspective.

Fig.5 shows that the proposed plan for the municipal solid waste of Sanghar city and dumping site is also mentioned in this map. Green points show the skip containers and each container should be placed in every corner of the street, and the black arrow shows the dumping site, which is 50 acres of land, and this land is used for landfilling purposes.

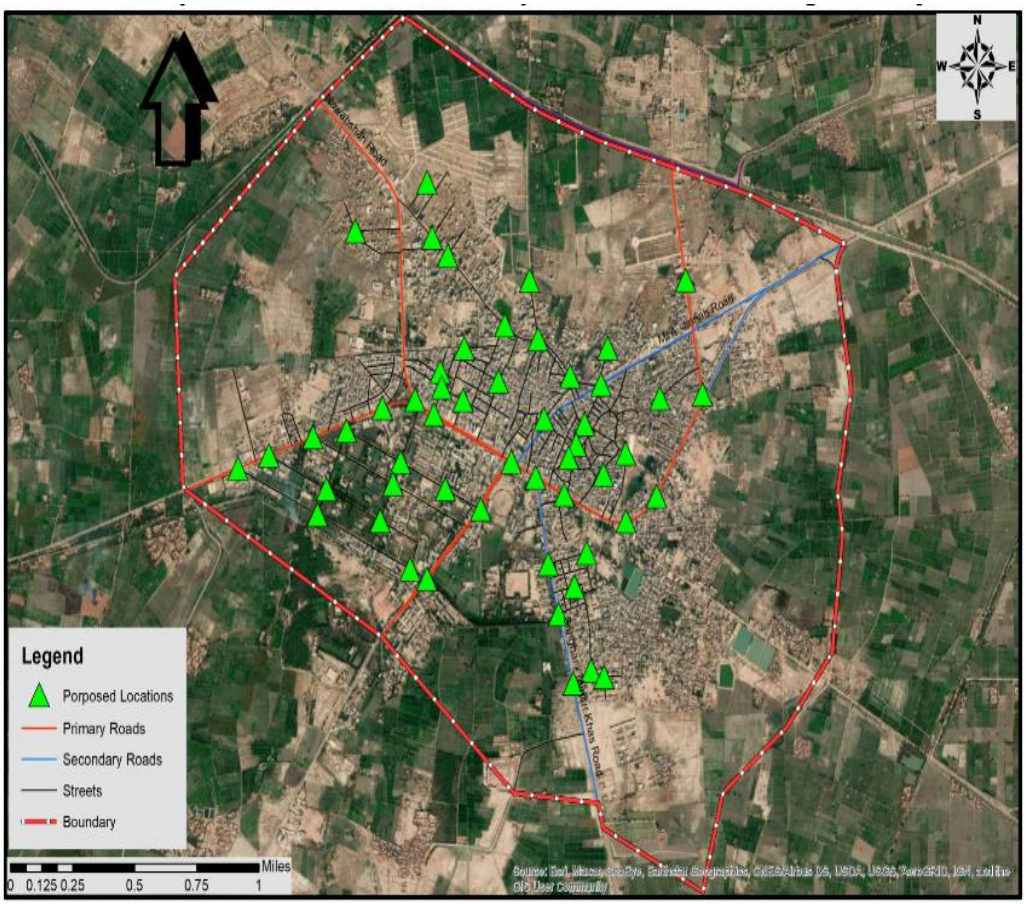

Fig 5: Image showing the proposed plan for skip containers and dumping site in Sanghar city.

5. Conclusion

My thesis aims to suggest a proposal for proper MSW dumping sites in Sanghar to enhance the city's quality of life and physical climate. The following goals are set to achieve this goal, and they are focused on data collected from primary and secondary sources.

Municipal solid waste management is essential for a city's growth and physical condition because improper solid waste disposal degrades human health and causes diseases in the environment. This problem, however, can be resolved through proper waste management and collection, which is a critical need in every region, including Sanghar, which has been chosen as the research area. The research examines several causes of SW generation in Sanghar through visits and a simple questionnaire survey. The level of significance of the causes was observed by collecting data between the different respondents to the survey questionnaire. The study concludes that, with population increases, a lack of public awareness, poor management are a few of the critical causes of waste generation in the city. Discussions with experts have revealed that controlling the population, including controlling urban growth in the city, can bring down major issues. Increasing public

awareness, effective management of the various organizations can lead to a decrease in waste generation in the city. The study through the results suggests that there is an utter need for an efficient SW management system in Sanghar. In this regard, the Local Government needs to put their efforts. The overall system from collection to its safer disposal requires special attention. Moreover, public awareness can help the system more. The Local Government should not only utilize the public funds on the maintenance of the entire system properly but also requires focusing on arranging a few programs like public meetings, seminars, workshops, etc. on monthly basis. These programs would be aware of the public, which is an important stakeholder in the reduction and proper management of SW. The results show that the residents of Sanghar city have not facilitated to dispose of their waste properly daily. 60% of the Cumulative Percent of ashes was produced because of the open burning of MSW. 28% of SW is disposed into the open space and 31%on the dump side where openly burn the solid waste. 33%of solid waste disposes of residents by self and due to lack of management and workers are not taking that waste the 86% of people are not satisfied with the current situation of solid waste. The regression model used in this study to identify effects on the environment and public health is based on the variables selected. The main descriptive statistics variables used in this work are shown in Table 6. The values shown are based on the daily data points collected from each source for all MSW types considered. The study can be expanded further to equate related work with other major cities in Pakistan and abroad. In this way, thorough literature in different countries can be checked and potential approaches can be further refined.

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