

Municipal Waste Management of Kushtia Municipality: Challenges and Opportunities

Md. Abdul Kader^{1*}, Sneha Paul², Md. Sainur Rahman³, Md. Amanullah Parvez⁴ and Ranver Ahmed⁵

¹Student, Department of Urban and Regional Planning, Chittagong University of Engineering and Technology, Email: abdulkader.cuet.14urp@gmail.com

²Student, Department of Urban and Regional Planning, Khulna University of Engineering and Technology, Email: snehapaulputul@gmail.com

³Student, Department of Urban and Regional Planning, Chittagong University of Engineering and Technology, Email: sainurrahman702938@gmail.com

⁴Student, Department of Urban and Regional Planning, Chittagong University of Engineering and Technology, Email: parvezaman1@gmail.com

⁵Town Planner, Kushtia Municipality, Kushtia. Email: ranver.jugia@gmail.com

*Corresponding author

ABSTRACT

Municipal waste management is amongst of those most crucial issues of the world. Nowadays different international organizations i.e. WHO, ISWA etc. are working on introducing waste management system to ensure a better living atmosphere. The waste management system of Bangladesh is not up to the level. Recently, few municipalities have developed their municipal waste management system and Kushtia Municipality is one of them. The municipality owns composting plant where they compost municipal waste and sell into market as organic fertilizers. Though it is a revolutionary work and lot of opportunities are available in comparison with the current scenario of other municipalities in Bangladesh, there are some challenges faced by Kushtia municipal authority. This study aims also to identify the existing weakness and threats on the basis of SWOT analysis. And recommendations based on analysis of the existing scenario will go a long way to solve the problems faced by the authority. More importantly, to satisfy the increasing demand, a new landfill site and two transfer station are proposed. Also the shortest path is found by using GIS.

Keywords: Municipal waste management; composting plant; SWOT analysis; shortest path; GIS;

INTRODUCTION

In a developed country, the average citizen produces about half a ton of waste every year (Jouhara et al., 2017). As a result waste management is a crucial process that needs to be maintained properly. Old waste management systems consist the collection of mixed waste and transporting it a long way to disposal sites. It has a significant negative impact on the environment and humans. An integrated waste management system is one of the major challenges for sustainable development. Integrated Solid Waste Management (ISWM) represents a contemporary and systematic approach to solid waste management. The U.S. Environmental Protection Agency (EPA) defines ISWM as a complete waste reduction, collection, composting, recycling, and disposal system. An efficient ISWM system considers how to reduce, reuse, recycle, and manage waste to protect human health and the natural environment (Rick Leblanc, 2018). In large cities sustainable waste management system is in a complicated situation due to waste materials type and quantity, rapid population growth, less financial resource. In most developing countries solid waste is disposed of in low-lying areas without taking precaution or operation control. As a result, local and regional environment and public health are significantly affected by this unscientific disposal of industrial, bio-medical and municipal solid waste (Essays, 2013). In Kenya, a low income developing country like Bangladesh, the involvement of stakeholders as well as community-based organizations (CBOs), non-governmental organizations (NGOs) and the private sector in offering solutions towards the improvement of MSWM (Henry, Yongsheng, & Jun, 2006). In Nepal, sustainability strategies are developed by the waste collection firm of the municipality of Naples (WCFMN). It is a

public utility firm owned by the municipality of Naples. This organization helps executives and managers of public service organizations to identify and exploit the most effective means of managing the adoption of corporate social responsibility.

This study is done to analyze the opportunities the challenges of solid waste management system in Kushtia Municipality. For fulfilling the goal, certain objectives are fixed to investigate the existing waste disposal system, to do a SWOT analysis of the existing waste disposal system, to find out the suitable location of a new land fill site and transfer stations, to provide some recommendations for the further development of existing situation and finally to find out the shortest route for collecting waste and saving time, money.

This study has multi-dimensional scopes. In this work, a SWOT analysis is made by investigating the existing situation. After that some proposals are made for the further betterment of the existing facilities. A suitability analysis is made by Arc GIS to find out the suitable location of the new landfill site. Finally a route analysis is done by Arc GIS to find out the shortest route for the fastest collection of waste. It will save money as well as time. There are some limitations such as lack of information especially all types of secondary data is not available, geographic database that is provided is not accurate so for better result new geographic database is prepared. It is also time consuming.

Kushtia Municipality Solid Waste Management Process

Kushtia Municipality is the 1st municipality in Bangladesh in which recycling of solid waste and fecal sludge is introduced. Every day around 50 tons solid waste is generated and on an average 20 tons are collected. 12000 liters fecal sludge are collated every day. At present 2 secondary transfer stations are available and only one landfill site is available. The fecal sludge and organic solid waste are processed and turned in fertilizer in the composting plant. The inorganic solid wastes are dumped into the nearby landfill site.

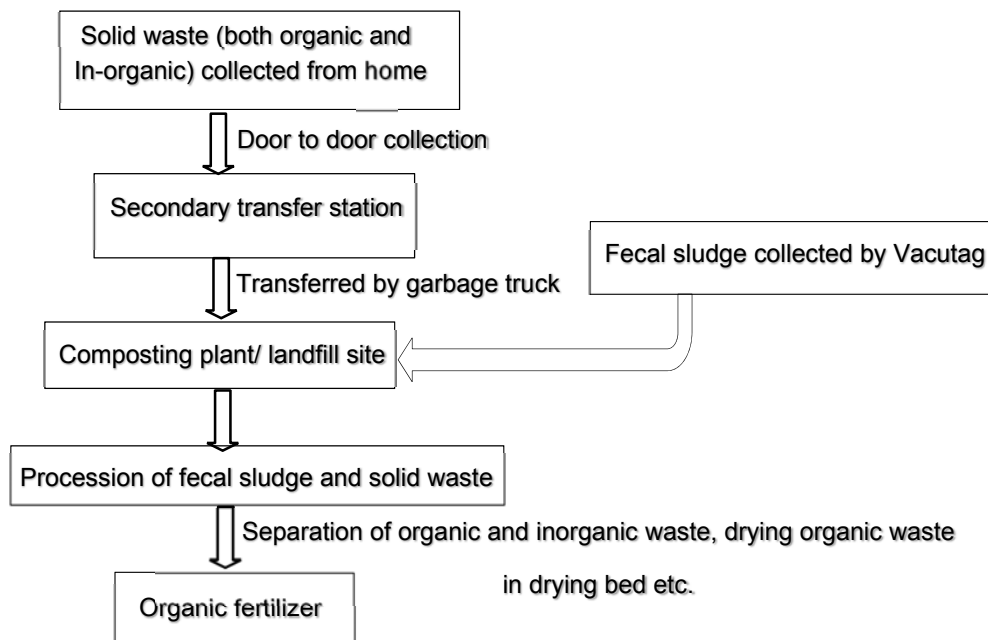


Figure 1 Kushtia Municipality Solid Waste Management Process

METHODOLOGY

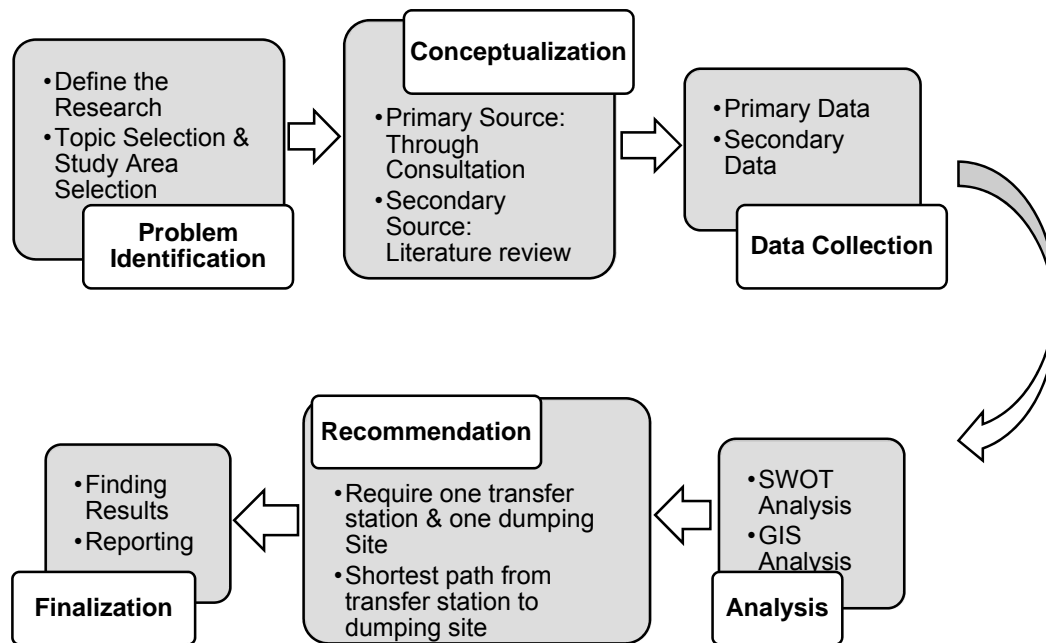


Figure 2 Methodology with a flowchart.

This study is carried out in six stages. *First stage* involves in identifying problems. Urban waste problem is a crucial issue all over the world. So, urban waste management is essential to solve this problem. Ineffective management causes various population e.g. air pollution, water pollution etc. Kushtia Municipality is trying to manage their municipal waste. For this they have developed Kushtia Municipality waste management. There are some strengths in their management system but there are some weaknesses also. This study aims to evaluate the municipality's management system. *Second stage* includes conceptualization. This is done in two ways i.e. through consulting with experts and reviewing previous research related to urban waste management. *Third stage* involves data collection. Both primary and secondary data sources are used to evaluate the waste management system in Kushtia Municipality. Primary data is obtained through field investigation, site visit. Secondary data is collected from BBS, Kushtia Development Plan, website of Kushtia Municipality (www.kushtiamunicipality.org) etc. *Fourth stage* involves analysis. SWOT analysis is done to meet the goal of the study i.e. to find challenges and opportunities as it is a recognized tool. In these study, challenges refer to weakness and threats whereas opportunities include strengths and opportunities. SWOT is a tool for determining external and internal factors which refer to strengths, weaknesses, opportunities and threats of an activity. A detailed SWOT analysis is performed based on the research questions developed. Answers to those questions are extracted through analyzing information obtained from field observations, governmental reports and related literature. Geographic Information System (GIS) is used through suitability analysis to find suitable location for a new transfer station and a new dumping site based on some specific and realistic criteria. GIS is also used to find shortest route from transfer station to dumping site. *Fifth stage* refers to recommendation. After analyzing, some policies are recommended. The municipality requires one transfer station and one dumping site. *Sixth stage* involves finalization. This refers to finding results and formal presentation.

STUDY AREA PROFILE

Kushtia, the cultural capital of Bangladesh, is situated in the south-west part of the country. It's a district in the Khulna administrative division. It is bounded by Rajshahi, Natore and Pabna districts on the north, Chuadanga and Jhenaidah districts on the south, Rajbari district on the east, west Bengal of India and Meherpur district on the west. Kushtia Municipality is the administrative head-quarters and main city of the district (Banglapedia, 2012). It lies between 23°42' and 24°12' north latitude and between 88°42'

and 89°22' east longitudes. Kushtia Municipality was established in April 1, 1869. After about 100 years in 1981, the municipal area once again was extended with the inclusion of north Lahini, Horekrishnapur, Kalisankarpur, Housing Estate and part of Chourhas("History Kushtia Municipality," 2018). Recently, the municipality area is extended. Now, its total area is 42.79 square kilometers and number of ward is 21.

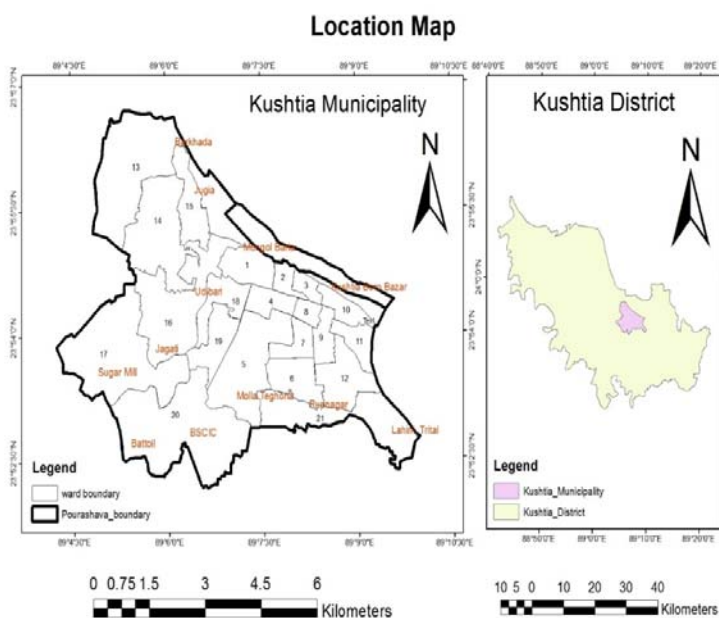


Figure 3 Location map

Table 1. Study area at a glance

Class of the Municipality	:	A
Name of Mayor	:	Anwar Ali
Establishment	:	1 April, 1869
Municipal Area	:	42.79 sq.km
No. of Ward	:	21
No. of Mouza	:	19
Municipal Staff	:	165
Population	:	3,75,149
Total Roads	:	433 km
Total Drains	:	318 km
Number of Street Light	:	5900
Water Supply Pipe Line Coverage	:	33%

RESULTS AND DISCUSSIONS

SWOT Analysis of Municipal Solid Waste Management of Kushtia Municipality

In this study a SWOT analysis is done to investigate the existing situation and find out the gaps between existing waste management condition and ways to improve them.

Table 2 SWOT analysis findings at a glance

<p>Strengths:</p> <ol style="list-style-type: none"> 1. The Municipal Authority is concerned about the necessity of waste management system. 2. The 1st Municipality of Bangladesh who start making compost fertilizer through proper treatment of solid waste and fecal sludge. 3. Providing door to door household waste collection system in old wards. 4. Waste is accumulated at transfer stations rather than dustbins. 5. Providing septic tank and pit latrines emptying services through a fixed service charge. 6. Revenues made by composting the waste and selling them as fertilizer. 7. Extracted water from Faecal Sludge Management (FSM) is being used in farming. 8. Dumping site at Baradi is located at environmentally safe area. 	<p>Weakness:</p> <ol style="list-style-type: none"> 1. Inadequate number of transfer station and dumping site. 2. No shortest route for garbage truck from transfer station to dumping site. 3. Lack of equipment in Municipality to manage the wastes. 4. Shortage of fund to introduce advanced technical system. 5. Lack of technical maintenance farms. 6. Unawareness of general people to dispose and segregation of wastes. 7. Lack of segregation of waste at household. 8. Door to door waste collection system is unavailable in new wards. 9. Inefficient waste sorting system. 10. Less capacity of composting plant & drying bed.
--	---

<p>Opportunities:</p> <ol style="list-style-type: none"> 1. Lands are available for further land filling/dumping site. 2. Door to door waste collection system can be increased. 3. Obtaining external supports from government (such as SHREDA, Ministry of Environment, Forest and Climate Change etc.) and non-government organization (such as IGES, Waste Concern etc.) 4. Getting help regarding FSM services through government and non-government organization. 	<p>Threats:</p> <ol style="list-style-type: none"> 1. Health problems are faced by waste pickers and employees of treatment plant due to chronic exposure to waste. 2. Dumping of waste in open space is more than dumping in sites. 3. Environment surrounding transfer stations is vulnerable
--	---

Strengths

The Municipal Authority is concerned about the necessity of waste management system. Kushtia Municipality introduced IRRC in 2012 with the help from UN-ESCAP and Waste Concern. At present, the IRRC has the capacity of 2 Ton of solid waste and 2-3 m³ of faecal sludge per day (Ahmed, 2018). For proper waste management, the authority started door to door van service for collecting household waste collection. At present, there are 36 vans in the municipality area. It charges only BDT 50/per household per month. This service is still active in twelve old wards and new one word. The Municipality has 6 Garbage Truck to collect solid waste from different transfer station situated within the city. About 35 Tonne of Solid waste is generated every day in Kushtia municipality, whereas municipality can collect about 18-20 ton of waste every day(Ahmed, 2018). The authority maintains an environment friendly system. After collecting wastes from household, van driver accumulates wastes at transfer stations. So, there is very few number of dustbins in the city. Dustbins are provided only some special area e.g. Borobazar. For this, a pedestrian hardly gets bad odor during walking within the municipality area. The Municipality also provides septic tank and pit latrines emptying services through a fixed service charge. The Municipality has 3 Vacutug. There is composting plant in which collected solid waste and fecal sludge are treated and turned into fertilizer. Revenues are made by composting the waste and selling them as fertilizer. The Municipality has outsourced it's IRRC to Aprokashi Ltd, a private firm has the experience and License of producing and marketing of the produced compost(Ahmed, 2018). The extracted water from Faecal Sludge Management (FSM) is being used in farming. The drying bed has a filtering mechanism, after getting filtered the drying bed the liquid waste water is treated again treated at the Coco-pit filter(Ali, 2017). Dumping site at Baradi is located at environmentally safe area. It is an important aspect of Kushtia Municipality waste management. The site is 4 km far away from the heart of the city.



Co-compost plant at Baradi.



Door to door Van service for household organic inorganic waste collection



Waste is accumulated at transfer stations rather than dustbins.



Garbage Truck.



Vacutag provides septic tank and pit latrines emptying.



Organic Fertilizer: Production of Co-Compost Plant.



Extracted water from Faecal Sludge Management (FSM)



Dumping site at Baradi is located at environmentally safe area

Figure 4 Strengths of the Municipal waste management

Weaknesses

Existing two transfer cover those areas of the municipality where door to door household waste collection system is available. If the authority start their services at newer words where door to door household waste collection system is not available, these two stations are insufficient. Besides, dumping site and co-compost plant is located at Baradi (Ali & Ahmed, 2015) has not capability for increased wastes. Shortest path is used for reducing cost, saving time and efficiency. But there is no shortest route for garbage truck from transfer station to dumping site. So, shortest route can be proposed. It will save cost and time. Number of garbage trucks and vacutags is not sufficient. Moreover, if one transfer station and one dumping site are established, the municipality will need more equipment. But, the municipality alone has not the ability to establish more composting plant, more drying bed due to shortage of fund. The municipality is facing lack of technical maintenance farms. For example, if the pump of vacutag is crippled during operation, the authority has to go Dhaka for repairing. It is quite impossible to go Dhaka in every cases as distance is about 300 km. For solving this problem, the authority is using Shallow machine instead of pump (Ali, 2017). The maximum inhabitants of the municipality have less awareness about disposal and segregation of wastes. Many people dispose their solid wastes into drain, waterbodies, road etc. in lieu of giving waste collecting van. Even they connect pit latrines with drains. Further, the Municipality has no policy for increasing consciousness about segregation of wastes during waste collection at household. Waste sorting system of the authority is inefficient. It is done manually. It is also time consuming and is not cost effective. Advanced technology is not used. The municipality is emptying about 14-15 m³ faecal sludge per day through Vacutug operation, whereas the IRRC can treat only about 3-4m³ faecal sludge per day. So, the municipality is also facing challenges of managing that faecal sludge.



No segregation of wastes



Inefficient sorting system at compost plant.



This compost plant has not capacity to manage whole wastes of the city.

Figure 5 Weaknesses of the Municipal waste management

Opportunities

Recently, area of Kushtia Municipality is extended and enough lands are available for further land filling/dumping site. There are much agricultural land, open spaces, barren land at northern-western, western, western-southern part of the municipality. Door to door waste collection system is available in the old wards. There is opportunity to introduce it in the new wards. It will develop the whole waste management system of Kushtia Municipality. There is also opportunity to get external supports from government (such as SHREDA, Ministry of Environment, Forest and Climate Change etc.) and non-government organization (such as IGES, Waste Concern etc.). Recently, SHREDA (a govt. organization) has proposed that they will establish a power plant based on solid wastes. Moreover, the municipality is getting help FSM services through SNV Netherlands Development Organization with fund from Bill and Melinda Gates Foundation. This system would be more efficient and the quality of the service can be improved if any help can be taken by govt. organization. At present, Kushtia Development Plan (under PDP project) draft final is ready and waiting for final approval. These will solve various present and future problems regarding waste management system of Kushtia Municipality.

Threats

Health problems are faced by waste pickers and employees of treatment plant due to chronic exposure to waste. As labors are not aware about health issues. Dumping of waste in open space is more than dumping in sites. People are not careful about this. So, drainage condition is becoming worse day by day. As people dispose wastes in drains, waterbodies, open spaces etc. Environment surrounding transfer stations is vulnerable. Fig. 5.13 shows this situation more clearly. Though there is better condition in the transfer station located at housing estate, condition of transfer station located beside Kushtia Govt. Women College is vulnerable.



Environment surrounding transfer stations is vulnerable



Labors are not aware of health issues.

Figure 6 Threats part of the Municipal waste management

RECOMMENDATIONS

Proposed Land Fill Site and Transfer Stations

For a new landfill site, Rupnagar is selected which is situated in ward number 21. Udibari, Jugia, Mongol Baria, Boro Bazar, Molla teghoria and Barkhada are rejected as these sites are populated and landfill site will harm the people around it. Though Sugar Mill, Battoil, and Lahini areas are less populated they are far from the transfer stations. So transportation cost will be increased. As for being industrial area BSCIC area are rejected to be taken as a landfill site. Also, Udipara and jagati are showing growth trend. So for developing a sustainable town, these sites shouldn't be used as landfill sites. Here, Rupnagar situates not too far from the central area and most of its land is open land. This site is also not too far from the road so transportation of garbage will be easy. So Rupnagar will be the suitable site for landfilling.

Also, the new transfer station will be required as the municipality territory has increased, a lot of garbage are produced and transportation of garbage from ward number 13-20 is becoming tough. If we select a landfill site in Rupnagar then transfer station is not required for ward number 20 and 21. 13-19 number wards are situated a bit far from the landfill sites so two new transfer station will be required as the need assessment and as the distance from the new landfill site. Also, new 2 transfer stations will be so close to the existing landfill site.

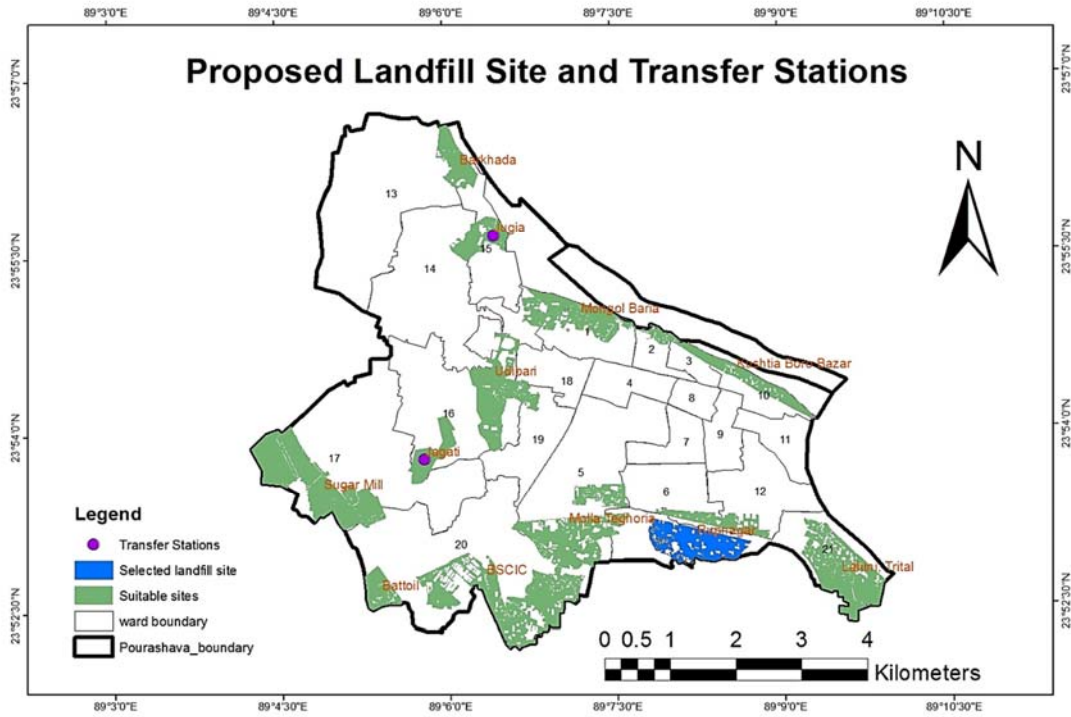


Figure 7 Proposed land fill site and transfer stations

Proposed Shortest Path from Existing Transfer Station to Dumping Site

There are 6 trucks which are used for transfer the collected waste to the dumping site. But there is no selected route for the trucks. For find out the shortest route first of all the routes including primary, secondary and access road are digitized and created network dataset from geographic information system (GIS). Finally, the two transfer stations (housing d block and beside mahila government college) and dumping site are marked and analyzed the shortest route which will save time and transportation cost. There is only one dumping site situated at Baradi in Kushtia. About 12-ton solid waste and fecal sludge is produced in kushtia municipality but only 2-ton waste is used for creating organic fertilizer. One dumping site is not enough for 4 lacs people. In this case another dumping site and two new transfer stations are proposed. The new dumping site is situated in rupnagar, behind the kushtia medical college. The existing two transfer stations if use the proposed dumping site the route will be short and cost efficient. And the two proposed transfer station if use the existing transfer station it also would be the same. So the eastern part of the municipality is proposed to use the new dumping site and the western part is used the existing dumping site it would be very cost effective and time saving transportation system because shortest route is available in this condition.

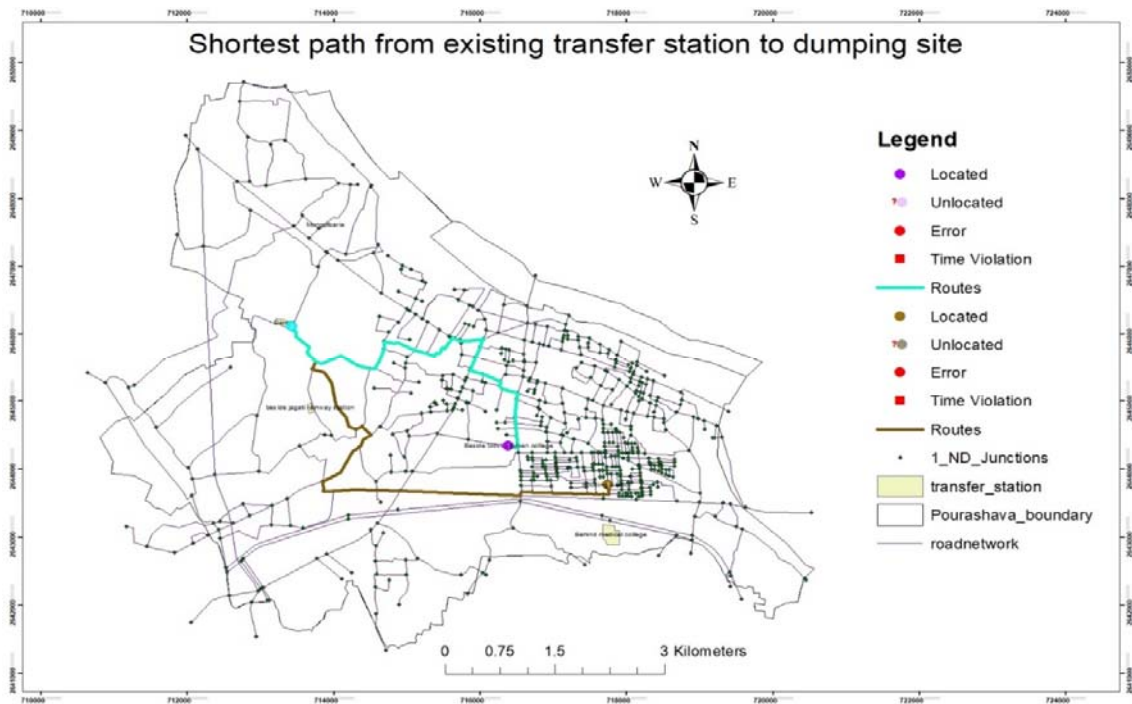


Figure 8 Proposed shortest path from proposed and existing transfer stations to existing dumping sites.

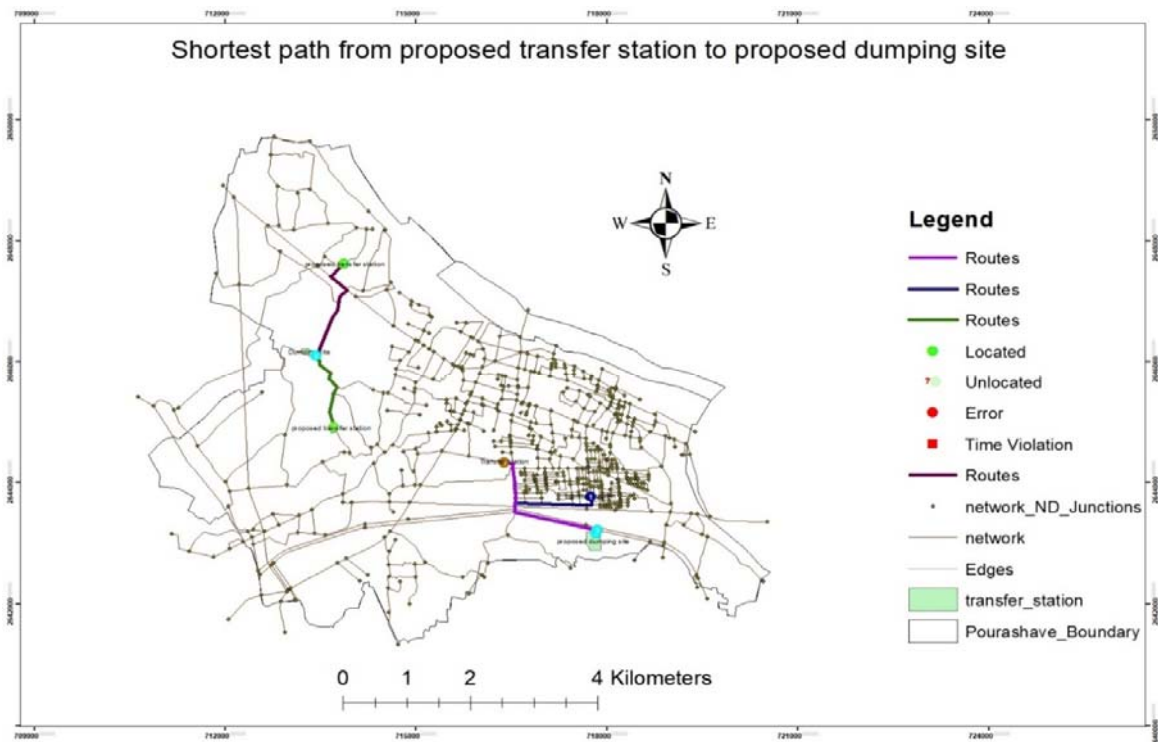


Figure 9 Proposed shortest path from proposed transfer station to existing dumping site and proposed dumping site

Important Recommendations Based on SWOT analysis

- Number of equipment related to waste management should be increased
- The Government should allocate more fund towards the municipal waste management.
- Technical farms should be more developed and advanced with the help of government and non-government organizations.
- Policy should be developed and campaigns, workshops can be organized at route level for increasing awareness about the necessity of segregation of wastes.
- Door to door van services can be started in newer wards.
- Waste sorting system should be developed.
- Capacity of compost plant and drying bed should be increased

CONCLUSIONS

Above study reveals clearly that Kushtia Municipality has a successful history of waste management system and doing better day by day. At present, the municipality is working in this sector in full swing. But there are some challenges and opportunities. If the government, non-government organizations provide assistance and the municipal authority is careful about this, the inhabitants of the Kushtia city will get a better, environmentally safe and pollution free Kushtia.

ACKNOWLEDGEMENTS

First of all, we would like to express gratitude to Almighty, Allah for his kindness and to give us strength for completing this research work. There is no word to express profound gratitude to Anwar Ali, Honorable Mayor, Kushtia Municipality. Last but not the least, we are thankful and indebted to all who helped us directly or indirectly in completion of this study.

REFERENCES

- Ahmed, R. (2018). Write-up Regarding Kushtia IRR. Kushtia.
- Ali, A. (2017). Waste Management in Kushtia Municipality_Final. Kushtia: Kushtia Municipality.
- Ali, A., & Ahmed, R. (2015). Fecal Sludge Management in Kushtia Municipality A Co-Compost Fertilizer Approach List of Raw Materials Used in Co-Compost. In and M. H. H. M. Alamgir, K.A.B.M. Mohiuddin, S.M.T. Islam (Ed.), *Waste Safe 2015–4th International Conference on Solid Waste Management in the Developing Countries* (Vol. 148, pp. 978–984). Khulna.
- Banglapedia. (2012). Kushtia District - Banglapedia. Retrieved June 9, 2018, from http://en.banglapedia.org/index.php?title=Kushtia_District
- Essays. (2013). Solid waste management the most important element constituting the environmental health. Retrieved June 8, 2018, from <https://www.ukessays.com/essays/engineering/solid-waste-management-the-most-important-element-constituting-the-environmental-health-engineering-essay.php>
- History Kushtia Municipality. (2018). Retrieved June 9, 2018, from <https://www.kushtiamunicipality.org/History.html>
- Henry, R. K., Yongsheng, Z., & Jun, D. (2006). Municipal solid waste management challenges in developing countries – Kenyan case study, 26, 92–100. <https://doi.org/10.1016/j.wasman.2005.03.007>
- Jouhara, H., Czajczyńska, D., Ghazal, H., Krzyżyńska, R., Anguilano, L., Reynolds, A. J., & Spencer, N. (2017). Municipal waste management systems for domestic use. *Energy*. <https://doi.org/10.1016/j.energy.2017.07.162>
- Rick Leblanc. (2018). Integrated Solid Waste Management (ISWM) - An Overview. Retrieved June 8, 2018, from <https://www.thebalancesmb.com/integrated-solid-waste-management-iswm-an-overview-2878106>
- US EPA, O. (2017). Criteria for the Definition of Solid Waste and Solid and Hazardous Waste Exclusions. Retrieved from <https://www.epa.gov/hw/criteria-definition-solid-waste-and-solid-and-hazardous-waste-exclusions#solidwaste>