Decision-Making in Waste Management: A Data Driven Approach

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Abstract

Data Science is a growing field of interest in the current era where all industries are focusing on using "data" to improve their services. With the establishment of data warehouses and high bandwidth storing "big-data" has become a convenient task for companies. The advancement of technology allows us to exploit and use data in several ways that gives us opportunities to expand the scope of work carried out. In my research I focused on identifying ways in waste management can be improved in the Colombo District using data collected through a questionnaire on "Waste Management" where the main aim of the study was to find the perception of youth towards waste management. A total of 165 (n = 165, males = 69, females = 96) participants were part of this online survey with nearly 82% in between the ages of 18-24. Majority of the respondents indicated that they have limited knowledge on waste management practices followed in the country and nearly 42% of the respondents indicated that they are not satisfied with the waste collection in the region. Based on the observations identified through the baseline survey a theoretical framework was adapted which evaluated all the responses and identified specific areas that needs to be addressed to implement an effective waste management policy in Colombo.

Keywords: Data Science; Data Management; Decision Making; Waste Management; Climate Action; SDG

Introduction

Waste management is a growing problem in several parts of the world with annually over 2 billion tons of solid waste generated on an annual basis and this is expected to grow to 3.40 billion tons by 2050 [1]. On average a person generates 0.11 to 4.54 kilograms of waste on a daily basis and this number varies significantly for people in high income countries as they utilize and use a lot of resources unlike people in low- and middle-income countries. The biggest adverse effect of improper waste management is the impact it has on the environment and the surroundings, most low income countries have a depleted waste management workforce resulting in majority of the waste being deposited into rivers, seas or being burnt in open air increasing the overall carbon footprint and causing harm to species living on the ground and under water [2].

In Sri Lanka the Western Province is the most populated region with over 30% of the population living in this region (5.82 million)

generating over 7000 metric tons of solid waste on a daily basis which is nearly 60% of the total waste generated in Sri Lanka [3]. Colombo is one of the most crowded regions in Sri Lanka with majority of the supply chain of businesses centered around the city and has one of the worst air quality index in Sri Lanka [4]. Although there has been no direct correlation identified between air quality index and waste management in previous studies there are possibilities that improper waste management can result to these changes. As stated by Farzadkia [5] waste management can contribute towards "better environment" which is the ultimate goal of the study to identify the gaps which needs to be addressed for a better environment.

Waste management and it's implications

Waste management is critically important to a country, to achieve environmental economic and societal benefits. Improper waste management can result in spread of contagious diseases

such as parasitic and bacterial infections and can harm life of species living under water and on land. The Sustainable Development Goals (SDGs) were implemented at the United Nations Conference on Sustainable Development in 2012 where the SDG's focuses on building a blueprint that is sustainable for the future where climate change and pollution were two key pillars of the 17 goals [6]. SDG goals 11 - 15 focuses specifically towards climate action and reducing the overall pollution levels at any country, with life on land and water and building sustainable cities being the main priorities at several developing countries. Sri Lanka also currently invests heavily on developing sustainable cities and improving the overall living conditions, however there are major gaps which needs to be addressed in crowded regions as the population density is relatively high. Lebreton and Andrady [7] identified that populated cities have low air quality and difficulties in managing waste, this is currently observed in Colombo as well where there are significant limitations in terms of waste management due to the increasing population.

In low and middle income countries, burning of waste materials using fuel or disposing into waste lines has become a common sight where existing living conditions has several limitations such as limited garbage disposal sites and availability of dustbins for the local communities to dispose their waste. Moreover, majority of these communities dispose all the waste together rather than separating them into different bags making it difficult for the collectors to dispose the waste separately [8]. Although this is a feasible and easy option to be implemented the adverse effects on the environment are significant where carbon monoxide and greenhouse emissions are significantly high which can reduce the overall quality of air and simultaneously affect the environment. Another issue in managing waste in these regions as the waste collected is deposited onto the either an empty land or dumping site which can cause degradation of the soil and act as the perfect catalyst for micro-organizations to colonize [9]. These micro-organisms can become hazardous and cause serious health complications such as skin and lung infections which are chronic long-term illnesses.

Administrative and staff management is another concern for most countries as only the daily wage workers who are fairly uneducated undertake these jobs. The occupational hazard is significantly high and chances of being infected with contagious diseases is high if protected equipment's are not administered. As stated by

Thakur, Ganguly and Dhulia [10] majority of the workers involved in waste collection only have primary or secondary education with a daily wage of less than $2.00 on average. Due to this a lot of garbage collectors are assigned only in areas where the waste generation and disposal is high whilst other areas have minimum number of people collecting waste resulting in overcrowding of waste disposal bins, waste being thrown on roadsides, water lines and sometimes burnt on empty lands by the public themselves. Public also tend to refrain from meeting the garbage collectors as they feel uneasy and have a "mixed-opinion" about them as they are not hygienic and prefer greeting them at the entrance or leave the garbage at the gate which is a common practice followed by majority of the population. Only a few families who can afford garbage bags use them for waste collection whilst the others use random plastic bags which are harmful for the environment [11].

The final major implication is the costs involved managing these waste materials, the cost of waste is significantly rising post the COVID-19 era as more safety measures needs to be implemented in terms of waste collection and disposal adhering to the rules and regulations imposed by WHO. The intensification of single-use products and panic buying has led to increased consumption of products as consumers continuously purchase these items are reserves in case of lockdowns [12]. Due to this the cost of waste management from collection to treatment has changed considerably resulting in requirements of more funds. During these times of uncertainties governments of various countries prioritizes overall health and well-being of individuals in the country making it significantly difficult to invest more on waste management [13,14].

To address all the above issues and find a synergy between the workers and public to streamline and understand the importance of waste management, a survey was developed which focused on looking at the different aspects of waste management and understand the current generation's perspective towards this.

Data-based approach using questionnaires

The main aim of the subject being broad focusing on different dimensions on understanding the youth perceptions, to specifically target the selected audience a questionnaire was developed that collected both quantitative as well as qualitative data. Based on studies conducted by Kolbe [15] and Fernando [16] the questionnaire model was replicated specifically focusing on questions re-

lated to waste management and demographics data. A total of 165 responses were gathered through an online survey generated using Survey Monkey where 110 responses were from Sri Lanka and the rest from India and Bangladesh specifically focusing on the South Asian countries to understand the different dimensions of waste management. The questionnaire focuses on obtaining individual responses analyze them and understand the gaps and problems faced by individuals to transform the data gathered into responses.
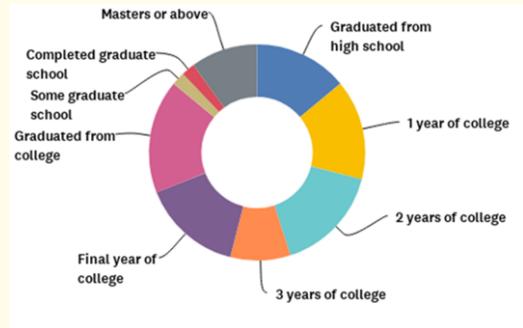
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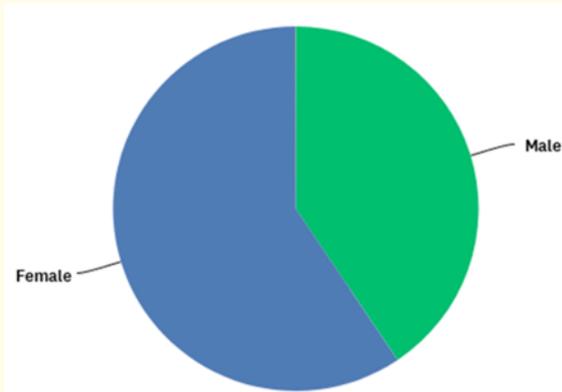
Figure 1: The gender representation was higher from the females indicating a strong interest the subject of waste management.
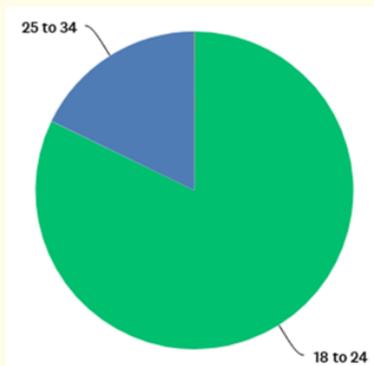
Figure 2: Nearly 82% of the respondents were in between the ages of 18 - 24.
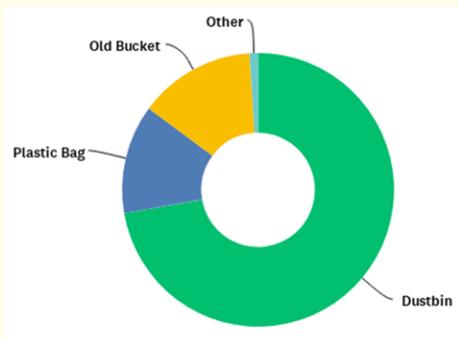

Figure 3: Majority of the respondents had completed high school education and were into college with over 70% of the respondents completing high school or in college.
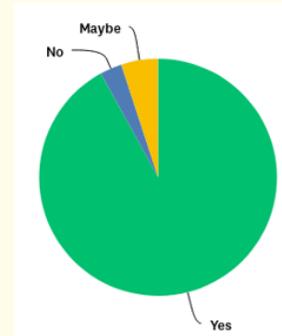
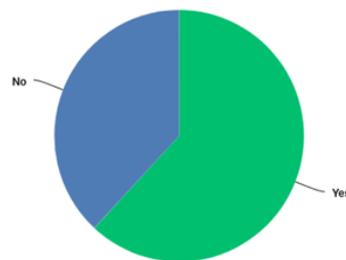**Figure 4:** Nearly 90% of the respondents had an idea of waste management practices.

Figure 5: The main type of waste generated at household was centered towards paper, plastic, and food waste.
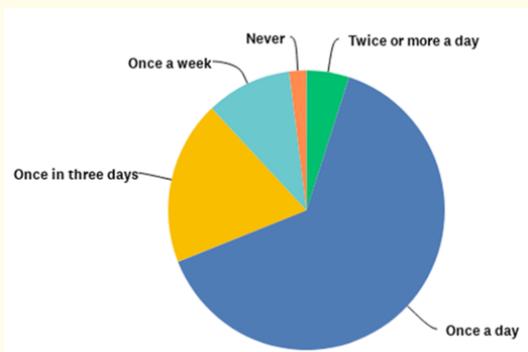
Figure 6: The main mode of waste collection was dustbin, however not many households used that the primay item for waste collection.
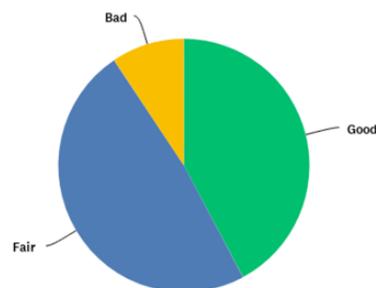

Figure 9: The main mode of waste collection was dustbin, however not many households used that the primay item for waste collection.
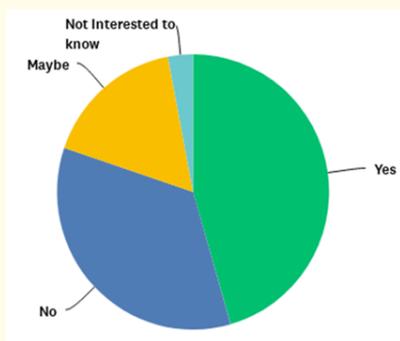

Figure 7: One of the major observations in this study was that nearly 40% of the households do not have waste collected on a daily basis whilst only nearly 50% had waste collected once a day.
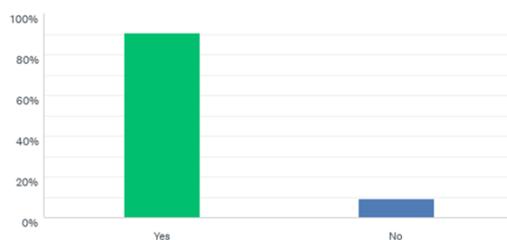

Figure 10: There was an underwhelming response for the overall waste collection evaluation with only 42% saying it was good.
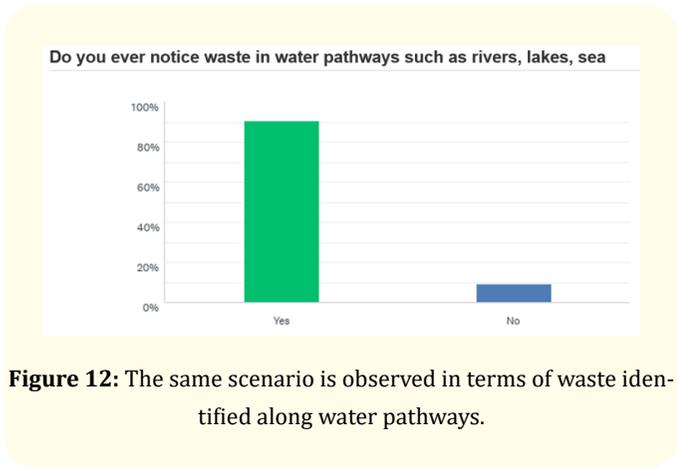

Figure 8: The question on "Do you know where your waste gets deposited" had a mixed bag of response where percentage was equally split between yes and no.

Figure 11: Almost 100% of the participants agreed that they have noticed waste along empty roads and lands.

Figure 12: The same scenario is observed in terms of waste identified along water pathways.

Figure 13: Only 75% have seen waste being burnt around their premises.

Discussion

The problem of waste management in Colombo is evident from the overall responses gathered from all the participants. Unlike previously conducted studies [17,18] the overall responses generated from this survey are from the youth representatives at the community level allowing us to understand the perspective and opinions of youth towards waste management. The gender segregation between the two populations indicated that females have an overall higher participation as they show more interest towards these topics unlike the males. This is also proven in a study conducted by Xiao [19] where the overall participation of females was above 50%, one of the main reasons for this increased participation is that females lead the household responsibilities in most parts of the world and understand the importance of waste management. In terms of youth participation, nearly 82% of the respondents were in between 18 - 24 years showing a high proportion of young adults willing to contribute towards building a sustainable framework. Social media is one of the driving factors that pushes youth towards being part of these interventions as they firmly believe in the concepts and theories behind global warming and climate change which influences their mindsets to protect the planet. As illustrated by Halder and Singh [20] the influence of social media is such that it creates opportunities for youth to explore and learn more about various factors that influence the overall environment of which waste management is an integral part of the process. This statement is proven in analyzing the overall educational levels of students where nearly 70% of the students have completed high school or are undergraduate students studying at various universities.

Although food waste was the highest type of waste thrown from different households, plastic and paper waste were significantly high compared to other developing countries. Previous studies indicated this is a common trend observed in low income countries where the plastic waste released moves from "land to water" due to improper waste management [21]. As indicated above in figure 6 only 40% of households use dustbin while the other use various other ways to collect household waste, where plastic bags are commonly used. Frequency of waste collection influences this decision as in most developed countries waste gets collected at a set time and schedule whilst in South Asian countries we rely heavily on door-to-door service and this changes based on different areas [22]. Another concern which the public constantly is worried about is the fact that garbage robbery is a common phenomenon in these parts of the world where stealing garbage bins, transferring waste to private companies for extra money and even selling plastic and cardboard waste are common daily scenarios [23]. Due to this there is a lack of trust developed among people resulting in shifting from bins to bags to collect waste effectively and with minimum loss.

Majority of the respondents had a mixed opinion on identifying where the waste gets deposited, males had an overall better understanding as to where the waste gets deposited while only 42% of the females knew about it. This is one of the main reasons where nearly 60% agreed that there is a problem with waste management practices followed in Colombo as they had limited idea to how the process works. To bridge this gap, proper education on

waste management needs to be provided to ensure that both genders understand the importance and workflow of processes. The education and awareness strategy has proven to be effective in the past in countries such as Malaysia, Singapore and China and can be implemented in Sri Lanka as well [24]. As indicated in previous studies and current ongoing studies, burning waste, throwing them on empty lands and water lines has become a trend in these parts of the world due to the lack of support available collecting and transferring the waste to a safe site. In the survey responses gathered nearly 70% on average has witnessed these scenarios and no action has been taken by any of them.

Recommendations

1. Awareness campaigns on segregation of wastes need to be strengthened by providing clear communication, training, and guidance to the public and community workers.

2. Establish guidelines for consumers on how to reduce single-use products consumption and educate on sustainable approaches and best disposal alternatives.

3. Design policies addressing the need for proper waste management practices to be implemented at divisional secretariat levels.

4. Encouraging local investments in the development of circular products designed for both hygiene and recycling.

5. Develop a separate waste management tax policy on plastic packaging, this way we can reduce harmful products being consumed.

6. Identify an alternative emergency safe disposal method.

Conclusion

Based on the data gathered, we were able to identify that there are significant gaps in terms of waste management in the Colombo District with majority of the respondents identifying waste collection as the main issue or concern that needs to be addressed. However, the sample size obtained is significantly small and a larger sample size is required to understand the problem in-depth, for this approach to be successful more stakeholders, government representatives and policy makers needs to be involved in discussions with community workers and youth networks to build and implement the proposed framework. Our strategies and action should reflect our preparation levels in case of future crisis situations.

Declaration of Competing Interest

The author declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix

Questionnaire 1 - https://www.surveymonkey.com/r/R82WKGF.

Questionnaire 2 - https://www.surveymonkey.com/r/QHNDJJV.

Bibliography

1. Vertakova YV. "The integrated approach to sustainable development: the case of energy efficiency and solid waste management (2019): 670216917.

2. Fuldauer LI., *et al*. "Participatory planning of the future of waste management in small island developing states to deliver on the Sustainable Development Goals". *Journal of Cleaner Production* 223 (2019): 147-162.

3. Dharmasiri LM. "Waste Management in Sri Lanka: Challenges and Opportunities". *Sri Lanka Journal of Social Sciences* 9.1 (2020): 72-85.

4. Ileperuma OA. "Review of air pollution studies in Sri Lanka". *Ceylon Journal of Science, Faculty of Science, University of Peradeniya, Sri Lanka* 49.3 (2020): 225-238.

5. Farzadkia M., *et al*. "Municipal solid waste recycling: Impacts on energy savings and air pollution". *Journal of the Air and Waste Management Association Taylor and Francis* (2021): 1-17.

6. Lemaire A and Limbourg S. "How can food loss and waste management achieve sustainable development goals?" *Journal of Cleaner Production* 234 (2019): 1221-1234.

7. Lebreton L and Andrady A. "Future scenarios of global plastic waste generation and disposal". *Palgrave Communications, Palgrave* 5.1 (2019): 1-11.

8. Jha AK., *et al*. "Sustainable municipal solid waste management in low income group of cities: a review". *Tropical Ecology* 52.1 (2011): 123-131.

9. Ali SM., *et al*. "Open dumping of municipal solid waste and its hazardous impacts on soil and vegetation diversity at waste dumping sites of Islamabad city". *Journal of King Saud University-Science* 26.1 (2014): 59-65.

10. Thakur P., *et al*. "Occupational health hazard exposure among municipal solid waste workers in Himachal Pradesh, India". *Waste Management* 78 (2018): 483-489.

11. Miller R. "Plastic shopping bags: An analysis of policy instruments for plastic bag reduction (2012).

12. Islam T., *et al*. "Panic buying in the COVID-19 pandemic: A multi-country examination". *Journal of Retailing and Consumer Services* 59 (2021): 102357.

13. Parthan SR., *et al*. "Cost estimation for solid waste management in industrialising regions-Precedents, problems and prospects". *Waste Management* 32.3 (2012): 584-594.

14. Klemeš JJ., *et al*. "Minimising the present and future plastic waste, energy and environmental footprints related to COVID-19". *Renewable and Sustainable Energy Reviews* 127 (2020): 109883.

15. Kolbe KD. "Knowledge, Attitudes and Behaviour Regarding Waste Management in a Grammar and a Comprehensive School in England--Results from a School Questionnaire". *Journal of Teacher Education for Sustainability* 17.1 (2015): 58-71.

16. Fernando RLS. "Solid waste management of local governments in the Western Province of Sri Lanka: An implementation analysis". *Waste Management* 84 (2019): 194-203.

17. Lekammudiyanse L and Gunatilake SK. "Efficiency of the household compost bin as a waste management technique in sri lanka (A Case study in gampaha municipal council area)". *International Journal of Basic and Applied Sciences* 10.1 (2009): 54-59.

18. Vidanaarachchi CK., *et al*. "Municipal solid waste management in the Southern Province of Sri Lanka: Problems, issues and challenges". *Waste Management* 26.8 (2006): 920-930.

19. Xiao L., *et al*. "Promoting public participation in household waste management: A survey based method and case study in Xiamen city, China". *Journal of Cleaner Production* 144 (2017): 313-322.

20. Halder P and Singh H. "Predictors of recycling intentions among the youth: a developing country perspective, Recycling". *Multidisciplinary Digital Publishing Institute* 3.3 (2018): 38.

21. Jambeck JR., *et al*. "Plastic waste inputs from land into the ocean, Science". *American Association for the Advancement of Science* 347.6223 (2015): 768-771.

22. Trivedi V. "Door-to-Door Garbage Collection Program in Surat city (2009).

23. Babazadeh T., *et al*. "Challenges in household solid waste separation plan (HSWSP) at source: A qualitative study in Iran". *Environment Development and Sustainability* 22.2 (2020): 915-930.

24. Desa A., *et al*. "Waste education and awareness strategy: towards solid waste management (SWM) program at UKM". *Procedia-Social and Behavioral Sciences* 59 (2012): 47-50.

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