

Assessing the Ecological and Socio-economic Impacts of Waste Disposal and Management in Muthurajawela Wetland: A Case Study

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Abstract—Muthurajawela, a unique coastal wetland in Sri Lanka, faces numerous social and environmental challenges. Uncontrolled land development and environmental pollution in Muthurajawela have disrupted its delicate ecological balance. In preceding inquiries, no relevant data of this particular matter have been discerned. Consequently, this study, conducted within the Bopitiya East Grama Niladari Division of Kerawalapitiya City in the Muthurajawela region, employed a comprehensive approach involving questionnaires, interviews, and on-site observations. The purpose was to methodically scrutinize the ecological and socio-economic ramifications linked to waste disposal and management in the wetland area. A random sample of 50 participants was chosen, and the questionnaires aimed to gather data on waste dumping awareness, environmental impact, health and social consequences, control measures, and restoration efforts in Muthurajawela marsh. A significant 58% of the surveyed population identified soil pollution as a concern, while an overwhelming 94% pointed to water pollution as the primary issue. Additionally, 24% of respondents acknowledged air pollution, 13% cited harm to wildlife, and 12% expressed concerns regarding the degradation of wetland ecosystems. The study investigated smokestack emissions' contribution to environmental contamination. 96% of respondents observed alterations in the quality of their well water. It emphasizes that a significant majority, 90%, expressed concerns about negative health effects. 80% of respondents affirmed the reduction of property values. Waste disposal was confirmed to result in flooding during heavy rainfall by 96% of the respondents. A majority, 78% of the respondents, indicated they had taken

action against the waste dump in their area. To tackle environmental problems in Muthurajawela, it's essential to emphasize responsible waste management, implement pollution control measures, and foster collaborative partnerships among local communities, businesses, and government entities.

Keywords—Socioeconomic, ecological, environmental hazards, waste disposal, Muthurajawela

I. INTRODUCTION

Muthurajawela is a unique and ecologically significant wetland ecosystem located in Sri Lanka, specifically in the western region of the country, which is close to the city of Colombo. Located on Sri Lanka's western coast, close to the Indian Ocean. Muthurajawela has a total size of about 2,400 hectares. Just to the north of the Colombo metropolitan region, it is situated strategically. Due to its historical importance and abundant biodiversity, it is frequently referred to as the "Swamp of Royal Treasure". As one of Sri Lanka's major saltwater wetlands, Muthurajawela has been recognized a Ramsar Wetland of International Importance, emphasizing its global ecological significance. Further, Muthurajawela is well known for having a diverse ecosystem. Numerous types of fish, birds, amphibians, reptiles, and mammals live there, as well as a large variety of other plants and animals. Eco-tourists and lovers of nature go to Muthurajawela because of its distinct

attractiveness. Muthurajawela is an important asset for Sri Lanka because it offers crucial ecosystem functions [1]. Within the Muthurajawela industrial zone, in close proximity to the Bopitiya area, prominent features include the Yugadanavi Power Station and the Kerawalapitiya waste disposal plant. Additionally, some industries like Sobadhanavi Power plant and Pyramid Lanka (Pvt) Ltd can be found. Yugadanavi Power Station is a combined cycle power plant that has a capacity of 300MW and is powered by oil [2]. Furthermore, a 10 MW power plant, which commenced operations in 2021 in Muthurajawela, is equipped to process a daily capacity of up to 700 metric tonnes of municipal solid waste. Kerawalapitiya waste disposal plant has initiated a program to increase the amount of bio-organic compost produced at the Kerawalapitiya solid waste management park from 15 metric tons (MT) per day to 50 MT per day, according to the Ministry of Urban Development and Housing [3].

Rapid industrialization and urbanization in the area have sparked concerns about their sustainability and potential effects on the delicate balance of the marsh. The ecological importance and rich biodiversity of Muthurajawela are under threat from waste disposal and industrial expansion. This survey is rooted in the urgent need to address environmental concerns within the delicate ecosystem of Muthurajawela, Sri Lanka. One concerning aspect of this research is the existence of waste disposal sites within the confines of Muthurajawela. These sites function as facilities for the disposal of different types of waste. Understanding how such dumping affects the ecology is crucial since it might seriously endanger this ecosystem. These locations have the potential to contaminate the soil and water, polluting the ecosystem and releasing poisons. The local flora and animals may be adversely affected by this contamination, which may change their habitats and may cause a reduction in biodiversity. Additionally, the contaminants leaking into water bodies can harm aquatic ecosystems. The presence of smokestacks in industries within Muthurajawela represents a critical aspect of our research focus. These smokestacks serve as a symbol of industrial activity and are essential to understanding the regional environmental dynamics. These enormous towers emit a variety of pollutants into the atmosphere, which could affect the fragile balance of the Muthurajawela ecosystem [4]. This study is a survey investigation into the environmental problems that a part of Muthurajawela wetland ecosystem in Sri Lanka is currently dealing with [5]. It includes two essential elements: the existence of waste disposal sites nearby and emissions from nearby industrial smokestacks.

II. MATERIALS AND METHOD

A. Study Area

The study was conducted in Muthurajawela-filled land. It is located at Bopitiya East Grama Niladari Division, Kerawalapitiya city, north of the Colombo metropolitan region, western coast of Sri Lanka (79°51'43"E, 7°01'42"N).

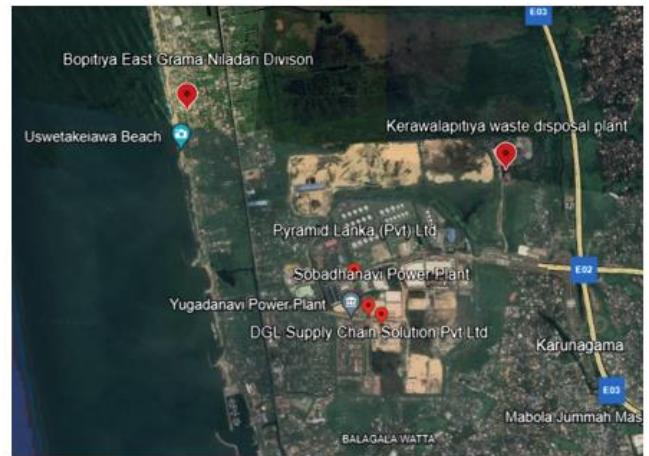


Fig. 1. Aerial view of the study area (Ref: Google Earth)

B. Data Collection

In this study, questionnaires, interviews, and field observations were employed to obtain a comprehensive understanding of the ecological and socio-economic impacts of waste disposal and management in the Muthurajawela Wetland. A dialogue with an authoritative representative was engaged to explore various aspects of the historical and current state of waste disposal and management in the neighborhood of the study area. This research employed a questionnaire survey as the primary method of data collection. The target population for this survey included adults residing in areas near the industrial zone in Muthurajawela, Bopitiya East Grama Niladari Division. A random sampling approach was used to select 50 participants. A wide range of population size, including age, gender, income levels, and geographical areas, were included to ensure diversity in responses. Upon accessing the survey, participants were presented with a brief introduction to the research and provided with informed consent information. Data collection occurred in September 2023 while investigating the Muthurajawela industrial zone. The questionnaires targeted information relating

Section 1—Awareness of waste dumping

Section 2—Awareness of environment impacts

Section 3—Perception of health well-being impact and social impacts

Section 4—control measures

Section 5—perceptions on the restoration of Muthurajawela marsh were included.

Ethical clearance was obtained prior to the research due to the participation of human subjects in the study. Their demographic details and responses to the questions were collected only for the purpose of the study, and the respondents were informed about this at the beginning of the survey. All the respondents participated in the survey as volunteers. The respondents' consent was secured for their voluntary participation in the survey after informing the respondents about the purpose of the study and the potential dissemination of the outcome before the survey.

C. Data Analysis

Data obtained from questionnaires was analyzed using statistical techniques while qualitative data collected by way of discussions, interviews, and field observations were analyzed qualitatively.

III. RESULTS

A. Demographic Characteristics

The range of the test population was between 16 to 79 years. The majority of respondents (65%) were 25-54 years old. Nearly 14 % and 21% of the respondents represented the age groups of 15-24 years and 55-79 years, respectively. Within the surveyed group, the majority held diverse occupations, including bank officers, factory storekeepers, drivers, carpenters, hired workers, self-employed individuals, fishermen, and teachers (58%). Meanwhile, 34% comprised housewives and students from higher educational institutions, with the remaining 8%.

B. Opinion of an Authoritative Representative

In this interview, a dialogue with an authoritative representative was engaged. This dialogue proved instrumental in the acquisition of crucial insights about the waste disposal practices at the site. The officer elucidated that the commencement of garbage collection in the vicinity of Kerawalapitiya junction was instigated in 2017, primarily in response to the catastrophic collapse of the Meethotamulla garbage dump. The necessity for an alternative location to accommodate both these degradable and non-degradable waste materials led to the strategic intervention of governmental authorities at that juncture. Degradable materials are those that can be broken down naturally by environmental processes while non-degradable materials are those that do not break down easily in the environment and can persist for a long time. The site is under the management of the Sri Lanka Land Development Corporation (SLDC). In its initial operational phase, the site accommodated a substantial influx of waste, with 250 tons of degradable materials and 350 tons of non-degradable materials being deposited daily, predominantly sourced from the Colombo region. Subsequently, the site has evolved to serve as a central waste collection point, attracting not only municipal contributions but also waste disposal by various government agencies.

A noteworthy transition in the disposal dynamics has transpired, whereby presently, only degradable materials find their way to the site. Furthermore, we were apprised of the meticulous segregation of waste, including the extraction of non-degradable materials such as polythene. In response to our inquiry regarding the utility of the site, the officer disclosed that the disposal process primarily centers on comprehensive composting of the waste materials. Notably, the compost generated is subsequently distributed to the public, with a pricing structure of 18,000 Sri Lankan rupees per ton and 480 rupees for 20 kilograms. Additionally, it was underscored that the administrative authorities have transitioned to a streamlined approach wherein only degradable materials are systematically processed, with a dual focus on environmental and public welfare. The officer's willingness to share these insights proved invaluable

to the research, providing a comprehensive understanding of waste disposal practices at the site in question.

C. Results of the Questionnaire Survey

Section 1—Awareness of Waste Disposal

Based on the provided responses, it is evident that 96% of the population was aware of the waste disposal site, while 4% did not know of it. Among those who were aware, 94% had acquired this knowledge through personal observation, 12% through news reports, 8% through community discussions, and 4% expressed uncertainty about their awareness of the matter. When questioned about the significance of Muthurajawela wetland in their lives, the responses revealed that 6% of people or their family members relied on fisheries based in Muthurajawela marsh, 28% mentioned that it attracted tourists and contributed to the income of villagers, while 76% of the population indicated that the wetland held no importance in their lives.

Section 2—Awareness of Environmental Impacts

When questioned about the most significant environmental issues resulting from waste dumping in Muthurajawela wetland, as indicated in Figure 2, the findings were quite revealing. A significant 58% of the surveyed population identified soil pollution as a concern, while an overwhelming 94% pointed to water pollution as the primary issue. Additionally, 24% of respondents acknowledged air pollution, 13% cited harm to wildlife, and 12% expressed concerns regarding the degradation of wetland ecosystems. It's worth noting that no participants attributed these environmental issues to other factors, and 4% were uncertain.

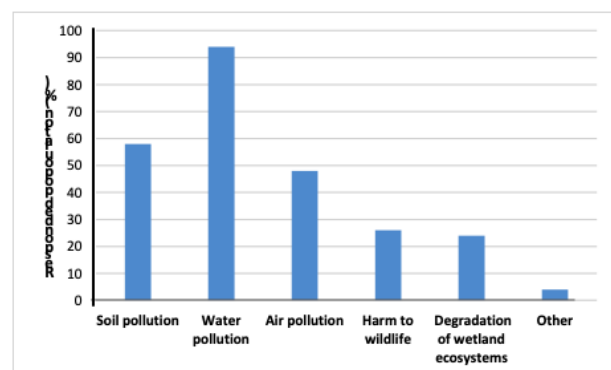


Fig. 2. Significant environmental issues caused by waste disposal in Muthurajawela wetland according to the responded population

Shifting our focus to the primary components of waste, the findings revealed specific statistics: 66% of respondents mentioned food waste, 92% emphasized plastics and polythene, 76% recognized glass materials, 64% acknowledged paper waste, and 28% identified medical waste as notable components. It is important to note that 8% of the population expressed uncertainty regarding waste components. These results are visualized in Fig. 3.

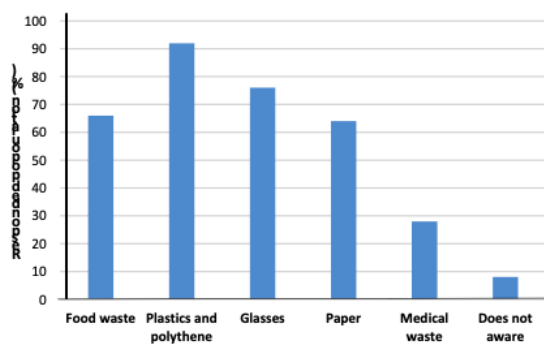


Fig. 3. Main components of waste according to the responded population

Regarding the inquiry about spontaneous combustion, there were no affirmative responses; 100% of respondents denied such occurrences. Additionally, when asked if they had experienced any odors near the waste dumping site, 96% of respondents confirmed the presence of odors.

Based on the questionnaire survey, all members of the population responded that they do not utilize water from Muthurajawela wetland, and there are no reported users of water from that area. Among them, 76% of the respondents stated that the water quality is very poor, while others indicated a lack of awareness regarding water quality. When questioned about the impact of the waste dump on the water quality of the wetland, there were no denials; all respondents acknowledged water pollution. Furthermore, 4% of respondents expressed uncertainty, leaving a substantial 96% with affirmative responses. The questionnaire also probed whether respondents had noticed any changes in the water quality of the Muthurajawela marsh since the commencement of garbage disposal. Shifting our focus to the changes in water quality, a significant 96% of respondents reported alterations in the water's color, while 80% noted the shift from flowing to stagnant water. In addition, 42% observed an excessive growth of algae, 12% noted the overgrowth of invasive plants like common water hyacinth, and 4% were uncertain. These results are visualized in Fig. 4.

According to the questionnaire, a substantial 86% of respondents observed birds and other animals in the marsh feeding on waste. Another question focused on fish mortality in the Muthurajawela marsh due to waste dumping, with 80% of respondents confirming the occurrence of fish mortality. In terms of vegetation death within the marsh, 76% of respondents affirmed the presence of vegetation demise. Additionally, when asked about the presence of animals, including birds and flies, in the marsh, a significant 88% of respondents affirmed their presence. Subsequently, another question explored the respondents' perceptions of a decrease in the number of migratory birds compared to previous years. The results revealed that 34% of respondents noticed a decrease, 10% did not observe a decrease, while others expressed uncertainty and lacked knowledge regarding the matter.

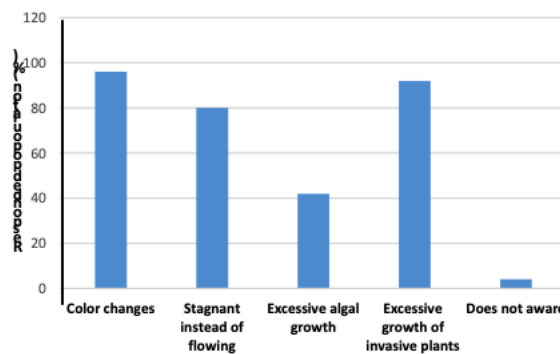


Fig. 4. Observed changes in water quality

Section 3—Perceptions on Health and Well-Being Impacts

The questionnaire survey dedicated a section to examine the health, well-being, and social consequences of waste dumping in the Muthurajawela wetland. Respondents were queried about their perceptions regarding whether garbage dumping had negative health effects on workers or the local population in the area. An overwhelming 90% of the population, with no dissenting views, while 6% expressed uncertainty, and 4% claimed ignorance, confirmed the existence of such impacts. Respondents also reported an increased prevalence of health issues, including dengue and respiratory problems, attributed to garbage dumping based on their experiences. The questionnaire survey additionally unveiled that 96% of respondents observed alterations in the quality of their well water. The next questionnaire aimed to determine whether individuals had assessed the quality of their well water after waste disposal commenced in the marsh. The results indicated that 64% of the population had conducted tests, while the remaining 36% had not. Next respondents were asked if they had observed stray animals feeding on waste, to which 90% responded affirmatively, while 10% reported not having observed such behavior. Furthermore, question probed whether there had been an increase in stray animals, yielding responses from 94% in the affirmative, and 6% in the negative. In next question, which sought observations regarding an increase in rabies incidents, only 2% of respondents reported affirmatively, with the overwhelming majority, 98%, responding in the negative.

Focused on the observation of an increase in mosquito abundance, all respondents indicated the presence of an increase. Similarity, respondents were asked about the observation of an increase in mosquito-borne diseases like dengue, with 64% acknowledging such observations and 36% negating them. Next participants were queried about an increase in flies within their household due to waste disposal, to which 100% responded in the affirmative. Subsequently, inquired about any perceived increase in food-borne diseases, with 6% responding positively, 88% in the negative, and 6% expressing uncertainty. For next question, which focused on the presence of individuals with skin disorders resulting from contact with the dumping site, 96% answered negatively, while 4% expressed uncertainty. Regarding the administration of medicines for these diseases, received responses wherein no one answered affirmatively, 16% in the negative, 18% expressed

uncertainty, and 66% lacked information. Respondents were asked about the observation of dust emissions on the roads due to waste transportation by tractors, with 96% confirming such observations, none of them negating them, and 4% expressing uncertainty. Subsequently, focused on whether the waste dumping site had a detrimental impact on property values in the area. An overwhelming 80% of respondents affirmed the reduction of property values, while 18% expressed uncertainty, and 2% lacked information. Next respondents were asked if waste transport vehicles had damaged the roads, with 96% confirming such damage, no one denying it, and 4% expressing uncertainty. Next Question inquired whether waste dumping led to flooding during heavy rain, to which 96% answered in the affirmative, no one denied it, and 4% expressed uncertainty. Following this, the inquiry was directed towards whether the disposal of waste had impacted the occupations of the respondents. In response, 58% affirmed an affirmative effect, while 42% indicated a negative impact. Next focus was on the observation of a decrease in tourist attractions following waste disposal, with 84% acknowledging such a decrease, 4% negating it, 4% expressing uncertainty, and 6% lacking knowledge on the matter.

Section 4—Control Measures

This section of the questionnaire survey is focused on the inquiry into control measures. Respondents were queried about their engagement in any actions against the waste dump in their vicinity, with 78% responding affirmatively and 22% indicating otherwise. Similarly, in the next question, which investigated whether the authorities had been informed of the issues faced by resident due to garbage dumping, 78% affirmed that they had indeed apprised the authorities, while 22% reported a lack of communication with the relevant authorities. According to their information, the relevant authorities, including the Grama Niladari, Municipal council, Local council members, and Public Health Inspectors, have taken several actions. These actions included organizing a shramadana campaign and cleaning the village canal, as well as addressing the issue of solid waste in the swamp. Additionally, community participation efforts to reduce solid waste disposal in the Muthurajawela Swamp included shramadana campaigns and protests.

Section 5—Restoration of Muthurajawala Marsh

The prevalent public sentiment revolves around waste disposal being a significant threat to the village. This concern is largely attributed to the substantial garbage-laden lorries causing road damage. Additionally, there are pressing issues related to leachate emissions, soil contamination, and the proliferation of mosquitoes. As per their shared experiences, it is apparent that before the establishment of the industrial zone, the area was pristine and free from unpleasant odors. However, with the advent of factories and the creation of the garbage dump, the quality of water, air, and sound deteriorated. Moreover, the ability to breathe clean air freely was severely compromised.

According to the respondents, there is no involvement in water quality monitoring activities in the Muthurajawela. Inquiries regarding the perspective on the foremost

challenges associated with the management and alleviation of pollution in wetlands yielded prevalent viewpoints. These viewpoints underscore the distinctive botanical and aquatic diversity inherent in wetland ecosystems. Consequently, it is posited that the stewardship of these ecosystems should be undertaken in a manner that safeguards their unique biodiversity. Additionally, a notable challenge articulated involves the complexity of wetland management during the rainy season, exacerbated by the substantial influx of waste disposal, which poses a considerable impediment to effective environmental conservation efforts. Next inquired about the awareness of ongoing conservation or restoration efforts in the Muthurajawela wetland, results indicated that none of the respondents were aware of such efforts, with 34% asserting a lack of awareness, 60% expressing uncertainty, and 4% professing a lack of knowledge on the subject. The opinions were taken about improving the water quality and overall health of Muthurajawela wetland. The most common opinion was waste from the industries and smokestacks should not be released into the environment in this area.

IV. DISCUSSION

This study has illuminated several critical aspects of these environmental issues and their potential impact on the region of Muthurajawela. It is critical to emphasize that the responses obtained from the questionnaire survey reveal a significant range of viewpoints and experiences. This variation is attributed to a mixture of causes, including differences in knowledge levels, human interactions, and demographic distinctions. The variety of perspectives revealed by the survey data emphasizes the complexity of the issue under investigation and highlights the need for a thorough and complex strategy to address the ecological and socioeconomic aspects of waste disposal and management in the Muthurajawela wetlands.

This research has illuminated a series of profound ecological impacts. Through the identification of waste dumping sites, quantification of pollutant concentrations, and scrutiny of their ecological repercussions, we have underscored the gravity of the ecological challenges confronting Muthurajawela. The contamination of soil and water, the degradation of habitats, and the potential loss of biodiversity have all been established as tangible outcomes of irresponsible waste management. These findings underscore the fragility of Muthurajawela's ecosystem and the urgent necessity for conservation endeavors and the adoption of responsible waste disposal practices to safeguard its intricate equilibrium. This study constitutes a pivotal call to action in this context. To address the myriad issues that afflict Muthurajawela, it underscores the significance of adopting responsible waste management practices, implementing pollution control measures, and fostering collaborative partnerships involving local communities, businesses, and governmental bodies. Our findings advocate for a holistic strategy that not only acknowledges the biological and socioeconomic interdependencies but also strives to preserve and conserve these invaluable ecosystems, aligning with broader global imperatives concerning wetland preservation and sustainable development. Based on the findings of this

survey, it is imperative for the government to address this issue, as the current level of their contribution is deemed wholly inadequate.

V. CONCLUSION

The research investigation entitled "Assessment of the Ecological and Socioeconomic Impacts of Waste Disposal and Management in Muthurajawela Wetland" has yielded profound insights into the multifaceted challenges confronting this distinctive and delicate ecosystem. The findings from this study underscore the exigency of addressing these challenges to safeguard the ecological integrity of Muthurajawela Wetland and ensure the well-being of the local communities reliant on this natural resource. Of note, our survey revealed that 96% of the surveyed population demonstrated awareness of waste dumping activities in the vicinity of Muthurajawela Wetland. This awareness significantly facilitated the acquisition of pertinent information for our study.

It was observed that a substantial portion of the population had a long-standing association with Muthurajawela Wetland, either from birth or after residing in the area for a minimum of 10 years. Remarkably, none of the respondents relied on water from Muthurajawela Wetland or groundwater for their domestic needs. The majority of respondents rated the overall water quality of Muthurajawela Wetland as "very poor." In response to inquiries about observable changes possibly linked to waste dumping, diverse and concerning accounts were provided. Respondents noted the proliferation of dogs, accompanied by changes in the color and flow of water in the wetland, stagnant water bodies, and the presence of animals like dogs and crows in proximity to the waste dump and the village. These changes were paralleled by increased instances of dengue patients and respiratory problems, particularly among young children, suggesting significant health impacts. The ramifications extended to transportation, with garbage-clogged channels causing flooding, road damage due to heavy garbage-loaded lorries, and frequent flooding during heavy rain, posing transportation challenges for villagers. Furthermore, the study highlighted the increase of mosquito and housefly populations in the area, with reports of dengue cases and unpleasant odors emanating from the garbage dump. Despite complaints submitted to local councils and government agencies, there was a notable absence of effective action. The results underscore the urgency of sustainable waste management practices, pollution control measures, and collaborative endeavors involving government entities, businesses, and local communities to address the myriad challenges faced by Muthurajawela. The rehabilitation of waste disposal site is essential, necessitating the complete removal and restoration of the marsh. In light of the research survey results, it is paramount for the government to significantly enhance its current level of contribution to address this issue, as the existing efforts are considered wholly inadequate.

REFERENCES

- [1]. J. Dewasurendra, "Muthurajawela Wetlands and Environmental Issues," no. November 2020, pp. 0–8, 2021.
- [2]. Nadeera and Dilshan, "Acquisition of Yugadanavi power plant and right to build new LNG terminal: US firm says agreement finalised",

The island.

- [3]. N. Jayathilake, I. U. Kumara, and S. Fernando, "Solid and Liquid Waste Management and Resource Recovery in Sri Lanka: A 20 City Analysis," CGIAR Res. Progr. Water, L. Ecosyst. Int. Water Manag. Inst., pp. 1–83, 2020.
- [4]. S. A. Oke, "On the environmental pollution problem: A review," *J. Environ. Eng. Landsc. Manag.*, vol. 12, no. 3, pp. 108–113, 2004, doi: 10.1080/16486897.2004.9636828.
- [5]. P. Yadav, J. Singh, D. K. Srivastava, and V. Mishra, "Environmental pollution and sustainability," *Environ. Sustain. Econ.*, vol. 4, no. 1, pp. 111–120, 2021, doi: 10.1016/B978-0-12-822188-4.00015-4.