

Circular Economy Waste Management Approaches to Enhance Local Community Environment: Cameron Highland, Malaysia

Maszura Abdul Ghafar, Mahmoud Bghdadi

Department of Architecture, Faculty of Design & Architecture, Universiti Putra Malaysia, Serdang, Selangor, Malaysia

Abstract—Land development and tourism intensification in Cameron Highlands (CH), Malaysia has led to serious waste management in aiding sustainable local communities' environment. The purpose of this paper is to investigate how Circular Economy (CE) waste approaches could enhance the sustainable environment in CH. This desktop study explores the current waste conditions in CH, identifies CE waste approaches that contribute to the socio-demographics of CH communities in creating a sustainable environment, and recommends the best CE approaches that could enhance the sustainable environment in CH. This study found that sustainable CE waste management using "R" strategies: Reuse, Repair, Repurpose, Recycle, Recover, and Reduce, could help CH local communities and authorities to achieve CE approaches in a sustainable environment in CH. The findings would aid actionable CE policies on waste management strategies tailored to a contextual socio-demographic for CH and achieve CE sustainable development guidelines for Malaysian regions.

Keywords: circular economy, waste management, sustainable environment, Cameron Highlands

I. INTRODUCTION

Waste management has been an issue in tourism areas (Adhikari et al., 2024; Strippoli et al., 2024; Vashishth et al., 2024). In current demand, protecting the environment and preserving natural resources have been the imperial attention of every society worldwide (Sène, 2024). In Cameron Highlands Malaysia, intensification of development and expansions have been seen in the past few years to increase the capacity of housing the tourism and farming demands. Waste production has been increasing rapidly due to population growth, urbanization, and industrialization (Rabbani et al., 2018). This has led to significant challenges in waste management, attributed to the generation of various types of waste, such as yard waste, food waste, municipal solid waste, and construction waste (Aik et al., 2020). With that, many social and environmental issues related to waste management have been seen that reduced

community resiliencies (Saufi et al., 2024); higher land prices (Nasir Ahmad et al., 2023); stricter authority controls (Yusoff & Hashim, 2024); well-being and safety and infra damages concerns (Omar et al., 2024); and limitations of landfill sites (Yong et al., 2019). These undesirable waste management issues in CH are causing pollution and posing health threats to residents and tourists. This phenomenon has led local communities to further contribute to open land dumping or riverside dumping (Ramli, 2014) Sulzakimin, 2021). This study saw that there is a need for a closed-loop system in CH to manage waste among the local communities to create a sustainable environment. Here, this study would like to investigate how Circular Economy (CE) waste approaches could enhance the sustainable environment in CH.

II. METHODOLOGY

This paper systematically organizes and synthesizes the existing research on several key topics: the current waste condition in CH, CH Socio-demographic towards CE waste approaches, and CE Approaches for Enhancing Sustainable Environment in CH. This paper is keen to investigate how Circular Economy (CE) waste approaches could enhance the sustainable environment in CH. Through an extensive literature survey, related keywords are inferences, patterns and trends are identified across literature, and gaps are identified to conjecture gap areas for discussion. Then, thematic analysis was employed, and it would infer towards this paper's main proposition.

III. LITERATURE REVIEW

This section will discuss the Current Waste Conditions in CH the current waste condition in CH, CH Socio demographic towards CE waste approaches, and CE Approaches for Enhancing Sustainable Environment in CH.

Cities in Malaysia are growing a huge demand for domestic tourism, specifically in the highlands. Also, tourism generates income from overseas visitors to the country. The Pre Covid era saw a boost in tourism in the CH district.

One point three million tourists from all over the world have been registered in 2017 (*Malaysia Tourism 2020*, 2020). Also, the district saw a steady rise in local tourists who chose to go to Cameron Highland as their vacation spot. All in all, Cameron Highlands saw intensive development and expansions in

the past few years to increase the capacity of housing the tourism and farming demands, which, therefore, led to and resulted in various impacts on the environmental, social, and economic levels (Figure1) (Aik et al., 2020).

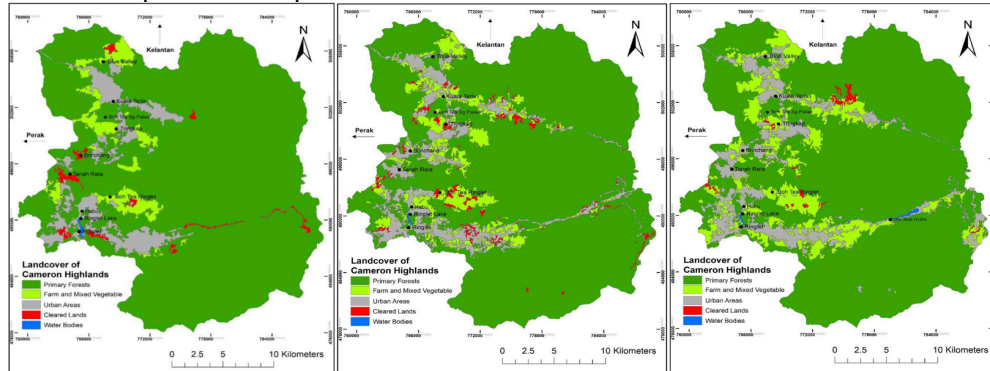


Figure 1: Land use and expansion in Cameron Highlands in 2009, 2014, and 2019 (from left to right). Source: (Aik et al., 2020)

Serious pollution issues have been recorded from the expansion and intensification of lands in Cameron Highlands. Groundwater and streams have been polluted due to inefficient waste management, agrichemicals, and sewage (Barrow et al., 2009). Other issues such as increasing the mean temperature by 2.0°C over the past 25 years in most of the towns in the district. However, the district is expecting an increase in the pollution rate as we keep extracting resources without replenishing them, accumulating waste materials without recycling them, and polluting our air, water, and food crops for the need to maintain competitive profit margins.

CH is experiencing neglected waste management practices due to tourism activities (Omar et al., 2024); unregulated deforestation (Hairazi Rahim et al., 2016), increased agricultural production (Arrow et al., 2005), and urbanization (Saufi et al., 2024) resulting in serious environmental issues (Abidin et al., 2021). CH's extensive agricultural activities generated substantial yard waste exacerbating further waste management challenges in the region (Malakahmad et al., 2017). Because of these issues, landslides, soil erosion, and waste accumulation are now vulnerable to CH (Abidin et al., 2021; Nasir Ahmad et al., 2023; Razali et al., 2018). The study foresaw that CH needs necessary waste management approaches to prevent negative impacts on the local population, environment, and health.

III.1. CH Socio-demographic towards CE waste approaches

Managing waste has a direct relationship with the contextual behaviour and lifestyle of its communities. Municipal solid waste and agriculture waste in CH are considered the primary types of waste produced due to their main agricultural activities and tourism (Hairazi Rahim et al., 2016). The current waste management system in CH is the open-loop system, which directs all collected waste to the landfills where waste is accumulated and treated using the incineration process (Ramli, 2014). An open-loop system such as the 'take-make-dispose' (Kirchherr et al., 2017) did not restore and regenerate waste and upgrade natural resources. Here the study agrees with Djuric Ilic et al. (2018) and Govindan & Hasanagic (2018), that if upturn these waste generation into Circular Economy (CE) approaches, they could grow economic empowerment for communities rather than challenges. The study foresaw CE approaches in waste management particularly in CH could lead to financial benefits for companies and governments.

In-vessel composting has been proposed as a sustainable waste management strategy for Cameron Highlands (Malakahmad, 2017). However, this approach could only aid solid and compost waste management (Michel et al., 2022). Waste recyclable actions from local communities could fill the gap in local waste management (Colon & Fawcett, 2006). Sustainability approaches like waste

management shall be integrated into local CH culture could have a great impact on the community's social levels (Chekima et al., 2016). This study agrees with Hofstede (2011), there is a direct relationship between waste production and social status such as wealth and consumption. Therefore, this study foresees that local CH waste culture could be evaluated by different views of morals, society, and philosophy. The current waste culture is oriented towards an output approach; therefore, waste generation is perceived as only production processes. Here, this study conjectures that redirecting the current culture into an input approach would make CH communities appreciate their waste resources diligently rather than perceive it as a production process issue.

III.2. CE Approaches for Enhancing Sustainable Environment in CH.

The concept of Circular Economy is commonly used nowadays among scholars and practitioners; A Circular Economy is an industrial system designed to be restorative or regenerative by nature. It aims to extend product lifecycles through repair, embraces renewable energy sources, avoids harmful chemicals that hinder reuse, and seeks to eliminate waste through better design of materials, products, and processes, including the integration of sustainable business strategies (Geissdoerfer et al., 2017). A Circular Economy approach considers the entire lifecycle of products, encompassing all stages from design, material extraction, and transportation to manufacturing, usage, reuse, recycling, and disposal. (Mohanty, 2011). Here, this study foresaw that there is a need for waste management in CH local communities to create a holistically sustainable environment.

CE approaches could promote sustainable environments and improve waste management through waste prevention, eco-design, re-use, recycling, and establishing a circular market cycle (Stankevičius et al., 2020); and giving affordable waste services, enhancing household health, reducing greenhouse gas emissions, creating job opportunities, and improving agricultural soil fertility through compost application (Terranova et al., 2022). The core of the CE in waste management consists of the basic 3R approaches of reuse, repurpose, and recycle (Ghisellini et al., 2016). Regenerative systems towards input and output waste could be reproduced as a form of energy, furniture, or farming materials like fertilizers (Ghisellini et

al., 2016). Therefore, providing waste management facilities as part of CH's CE waste management approach would be impactful.

Knowledge gaps among community members are crucial to aiding desirable benefits of CE socially, economically, and environmentally. Implementing various recycling processes approaches or cultures such as 'Reduce', could increase the efficiency in product manufacture or use by consuming fewer natural resources. Through 'Repurposing', it could discard products in a new product with a different function, and 'Recycle' could aid processed materials to obtain the same or lower quality next-generation product. 'Recover' could turn materials into energy recovery. The mentioned processes will not succeed unless the waste culture is redirected into an input approach that focuses on the appreciation of resources to tackle the waste issue. Here, this study anticipates that when CE approaches are incorporated into the local culture waste management, it could regenerate CH waste management processes through reduction, repurposing, recycling, and recovery. In this instance, this study posits that the enhancement of contextual community awareness culture towards waste management approaches can only happen when contextual communities are aware of the input and output of their waste resources. This could impact how local authorities aid waste treatment facilities in the CH environment.

IV. DISCUSSION

In the discussion, this paper will discuss how to transform the local community's awareness of CE waste management approaches. Then, it would discuss how local authorities could provide CE intervention for waste management; and finally, create a wholistic contextual waste management system.

IV.1. Transforming local communities' awareness towards CE waste management approaches

Fostering sustainable environmental practices in Cameron Highlands requires raising community understanding of circular economy (CE) waste management techniques. The Separated Waste Approach, which improves community involvement in waste management by classifying garbage at the source into recyclables, organic waste, and non-recyclables, is essential to this. Awareness campaigns should educate residents on the benefits of this approach, including reduced landfill use, resource conservation, and mitigation of environmental pollution. A

culture shift that sees waste as a resource is necessary to achieve effective CE waste management. Communities can be encouraged to embrace CE principles through educational campaigns that highlight the financial and environmental advantages of resource recovery, recycling, and reuse. Waste may be converted into useful products, including premium compost for farming, as shown by useful, approachable initiatives like integrated solid waste management systems and in-vessel co-composting. Success relies on collaboration between local authorities, businesses, and residents, with platforms for community dialogue, promotion of waste segregation at household and community levels, and accessible collection and recycling infrastructure playing pivotal roles. Showcasing success stories and incentivizing participation further motivates communities to adopt sustainable behaviours. Cameron Highlands may establish itself as a leader in sustainable waste management by incorporating CE practices into daily living and emphasizing their value for environmental health and local resilience. This strategy promotes a cleaner and more sustainable future for the community by preserving the area's distinctive natural balance while also yielding long-term economic and environmental advantages.

IV.2. Local authority's CE intervention for CH waste management

Through the implementation of sustainable waste management regulations, enforcement, public awareness campaigns, and the use of sustainable technologies, government officials and policymakers must actively participate in Cameron Highlands, Malaysia, in order to mitigate trash generation and alleviate environmental concerns. Promoting a circular economy in waste management can be achieved by drawing on successful global strategies, such as the European Circular Economy Action Plan (H & Ismail, 2023), which prioritize waste reduction, recycling, and resource recovery. The government revision directives such as the Waste Framework and Packaging Directives, and mandatory source separation could make local individuals to monitor surrounding areas prone to illegal dumping to deter offenders. Public engagement is equally vital, and authorities or non-governmental organizations can instil recycling knowledge through training sessions, and events on regenerative solutions. Educational campaigns could also help residents appreciate the ecological value of their surroundings and their role in conserving natural resources. Consistently engaging recycling programs can pique public interest

and foster widespread participation, supporting the transition toward a circular waste management system. Strategies like waste bank mechanisms, scheduled collections, and technical guidance could be strong foundational infrastructure, with regular maintenance. The community involvement is crucial to improvement the waste management practices in CH. Together, they could establish a sustainable model that demonstrates the local's dedication to environmental stewardship while simultaneously improving the quality of life for its citizens whilst safeguarding the environment.

IV.3. Proposing Contextual Waste Management System for CH

The findings highlight the necessity of a variety of Circular Economy in trash Management (CEWM) strategies in order to successfully handle regional trash issues. Enabling strategies such as prolonging product lifespans through repair and maintenance, repurposing components of discarded items into new products with alternative uses, and encouraging innovative designs that minimize waste, advanced technical methods such as the use of sophisticated devices and machinery could play crucial roles in optimizing waste processing. Cost-effective and practical techniques can be highly effective, particularly in resource-limited settings. Conversion of organic waste into fertilizers, transforming solid waste into functional tools or appliances, and repurposing broken items could aid the fundamental ideas of energy recovery. Good programs and events that aimed at encouraging community involvement in sustainable practices could raise awareness, promote recycling, and foster public participation, offering significant potential to advance CEWM principles and transition toward a more sustainable and resilient waste management system in Cameron Highlands. Even change is frequently slow, fostering a culture of resource appreciation and moving toward sustainable waste management techniques requires constant education, community involvement, and institutional support.

V. CONCLUSION

In the Cameron Highlands of Malaysia, where extensive tourism, farming, and urbanization have resulted in serious environmental problems, this study focuses on the pressing need for sustainable waste management techniques. It highlights important problems like rising trash production, agricultural pollution, deforestation, and poor waste management techniques that have led to

landslides, soil erosion, water source contamination, and health hazards for locals and visitors. The current open-loop waste management system, heavily reliant on landfills and incineration, exacerbates these issues by failing to restore or regenerate waste resources. The paper proposes transitioning to a circular economy (CE) approach, which emphasizes sustainability and resource efficiency.

Central to the study's framework is the adoption of the "R" strategies—Reuse, Repair, Repurpose, Recycle, Recover, and Reduce. These principles aim to minimize waste generation, prolong material lifecycles, and transform waste into valuable resources. Composting organic waste, for example, might manage waste accumulation and lessen the need for artificial fertilizers. The importance of waste separation at the source, which permits efficient recycling and lowers contamination, is also emphasized in the research. Community involvement is emphasized as a critical component, with education and awareness campaigns proposed to shift cultural attitudes toward perceiving waste as a resource rather than a byproduct.

Local authorities are positioned as central to this transformation, tasked with establishing supportive policies, providing infrastructure for waste collection and recycling, and enforcing regulations to curb illegal dumping. The paper emphasizes the potential for job development and economic empowerment in addition to environmental advantages by fostering economic opportunities in recycling and resource recovery. A holistic, localized waste management system is recommended to cater to the region's socio-demographic and environmental needs, ensuring long-term sustainability and resilience.

The study comes to the conclusion that a waste management system based on the circular economy provides a workable answer to Cameron Highlands' escalating environmental and socioeconomic problems. In addition to addressing current waste problems, the framework promotes a cultural shift toward sustainability by fusing CE ideals with regional tactics like resource recovery and trash separation. In order to create a closed-loop system that minimizes waste and maximizes resource efficiency, communities, businesses, and authorities must be involved. The study offers a replicable model for other regions facing similar challenges, demonstrating the transformative potential of CE in enhancing

environmental sustainability, public health, and economic vitality.

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REFERENCES

- Abidin, R. Z., Mahamud, M. A., Yusof, M. F., Zakaria, N. A., & Arumugam, M. A. R. M. A. (2021). Determination of cover management and soil loss risk mapping by sub-districts and river catchments of cameron highlands malaysia. *Land*, *10*(11).
<https://doi.org/10.3390/land10111181>
- Adhikari, S., Dangi, M. B., Cohen, R. R. H., Dangi, S. J., Rijal, S., Neupane, M., & Ashooh, S. (2024). Solid waste management in rural touristic areas in the Himalaya – A case of Ghandruk, Nepal. *Habitat International*, *143*(December), 102994.
<https://doi.org/10.1016/j.habitatint.2023.102994>
- Aik, J., Ismail, M. H., & Muharam, F. M. (2020). Land Use / Land Cover Changes and the Relationship. *Land*, *9*(372), 1–23.
- Arrow, B., Lifton, C., Han, C., & An, T. (2005). Sustainable Development in the Cameron Highlands, Malaysia of streams is vulnerable to eroded silt, agricultural pollution and sewage. Damage to forests in the Cameron Highlands has been caused by selective logging, plantations (there are around 2800). *Journal of Environmental Management*, *6*, 41–57.
- Barrow, C., Chan, N. W., & Masron, T. (2009). *Issues and Challenges of Sustainable Agriculture in the Cameron Highlands*. *10*, 89–114.
- Chekima, B., Chekima, S., Syed Khalid Wafa, S. A. W., Igaua, O. A., & Sondoh, S. L. (2016). Sustainable consumption: The effects of knowledge, cultural values, environmental advertising, and

- demographics. *International Journal of Sustainable Development and World Ecology*, 23(2), 210–220.
<https://doi.org/10.1080/13504509.2015.1114043>
- Colon, M., & Fawcett, B. (2006). Community-based household waste management: Lessons learnt from EXNORA's 'zero waste management' scheme in two South Indian cities. *Habitat International*, 30, 916–931.
<https://doi.org/10.1016/j.habitatint.2005.04.006>
- Djuric Ilic, D., Eriksson, O., Trygg, L., & Åberg, M. (2018). No zero burden assumption in a circular economy. *Journal of Cleaner Production*, 182. <https://doi.org/10.1016/j.jclepro.2018.02.031>
- Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy – A new sustainability paradigm? *Journal of Cleaner Production*, 143, 757–768.
<https://doi.org/https://doi.org/10.1016/j.jclepro.2016.12.048>
- Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner Production*, 114, 11–32.
<https://doi.org/10.1016/j.jclepro.2015.09.007>
- Govindan, K., & Hasanagic, M. (2018). A systematic review on drivers, barriers, and practices towards circular economy: a supply chain perspective. *International Journal of Production Research*, 56(1–2), 278–311.
<https://doi.org/10.1080/00207543.2017.1402141>
- H, C., & Ismail, M. F. A. (2023). An Overview of the Circular Economy Activity for Small Island Wastes and Marine Debris. In *Iop Conference Series Earth and Environmental Science*.
<https://doi.org/10.1088/1755-1315/1201/1/012013>
- Hairazi Rahim, Mohd Amirul Mukmin Abdul Wahab, Mohd Zaffrie Mat Amin, Azahar Harun, & Mohd Tarmizi Haimid. (2016). Economic values of conservation attribute options in Cameron Highlands. *Economic and Technology Management Review*, 11, 123–133.
- Hofstede, G. (2011). Dimensionalizing Cultures. *Online Readings in Psychology and Culture*, 2(1), 1–26.
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the Circular Economy: An Analysis of 114 Definitions. *SSRN Electronic Journal*.
<https://doi.org/10.2139/SSRN.3037579>
- Malakahmad, A., Idrus, N. B., Abualqumboz, M. S., Yavari, S., & Kutty, S. R. M. (2017). In-vessel co-composting of yard waste and food waste: an approach for sustainable waste management in Cameron Highlands, Malaysia. *International Journal of Recycling of Organic Waste in Agriculture*, 6(2), 149–157. <https://doi.org/10.1007/s40093-017-0163-9>
- Malaysia tourism 2020*. (2020).
- Michel, F., O'Neill, T., Rynk, R., Bryant-Brown, M., Calvez, V., Li, J., & Paul, J. (2022). Chapter 7 - Contained and in-vessel composting methods and methods summary. In R. Rynk (Ed.), *The Composting Handbook* (pp. 271–305). Academic Press.
<https://doi.org/https://doi.org/10.1016/B978-0-323-85602-7.00009-1>
- Mohanty, C. R. C. (2011). Reduce, reuse and recycle (the 3Rs) and resource efficiency as the basis for sustainable waste management. *Proceedings of the Synergizing Resource Efficiency with Informal Sector towards Sustainable Waste Management, New York, NY, USA*, 9.
- Nasir Ahmad, N. S. B., Mustafa, F. B., & Muhammad Yusoff, S. Y. (2023). Spatial prediction of soil erosion risk using knowledge-driven method in Malaysia's Steepland Agriculture Forested Valley. *Environment, Development and Sustainability*, 26(6), 15333–15359.
<https://doi.org/10.1007/s10668-023-03251-8>
- Omar, N., Safeei, R., Jali, F., & Mohammed, S. (2024). Tourism Under Pressure: Analyzing the Impacts of Climate Change and Over-Tourism on Destinations. *International Journal of Research and Innovation in Social Science*, VIII, 1688–1697.
<https://doi.org/10.47772/IJRIS.2024.8090138>
- Rabbani, M., Heidari, R., Farrokhi-Asl, H., & Rahimi, N. (2018). Using metaheuristic algorithms to solve a multi-objective industrial hazardous waste location-routing problem considering incompatible waste types. *Journal of Cleaner Production*, 170, 227–241.
<https://doi.org/10.1016/j.jclepro.2017.09.029>
- Ramli, A. (2014). *Illegal Dumping in Cameron*

- Highlands*.
- Razali, A., Syed Ismail, S. N., Awang, S., Praveena, S. M., & Zainal Abidin, E. (2018). Land use change in highland area and its impact on river water quality: a review of case studies in Malaysia. *Ecological Processes*, 7(1).
<https://doi.org/10.1186/s13717-018-0126-8>
- Saufi, S., Azinuddin, M., Mat Som, A. P., & Hanafiah, M. (2024). Overtourism Impacts on Cameron Highlands Community's Quality of Life: The Intervening Effect of Community Resilience. *Tourism Planning & Development*, 1–8.
<https://doi.org/10.1080/21568316.2024.2319155>
- Sène, A. L. (2024). Justice in nature conservation: limits and possibilities under global capitalism. *Climate and Development*, 16(9), 838–847.
<https://doi.org/10.1080/17565529.2023.2274901>
- Stankevičius, A., Novikovas, A., Bakaveckas, A., & Petryshyn, O. V. (2020). EU Waste Regulation in the Context of the Circular Economy: Peculiarities of Interaction. In *Journal of Entrepreneurship and Sustainability Issues*.
[https://doi.org/10.9770/jesi.2020.8.2\(32\)](https://doi.org/10.9770/jesi.2020.8.2(32))
- Strippoli, R., Gallucci, T., & Ingrao, C. (2024). Circular economy and sustainable development in the tourism sector – An overview of the truly-effective strategies and related benefits. *Heliyon*, 10(17), e36801.
<https://doi.org/https://doi.org/10.1016/j.heliyon.2024.e36801>
- Sulzakimin, M., O, S. F., & Sulzarina, M. (2021). Issues on a Solid Waste Management System in Cameron Highlands, Malaysia. *Advance in Environmental Waste Management & Recycling*, 4(3), 229–231.
<https://doi.org/10.33140/aewmr.04.03.09>
- Terranova, C., Rodrigo-Ilarri, J., Rodrigo-Clavero, M.-E., & Rozo-Arango, M.-A. (2022). M-Grct: A Dynamic Circular Economy Model for the Optimal Design of Waste Management Systems in Low-Income Municipalities. *International Journal of Environmental Research and Public Health*.
<https://doi.org/10.3390/ijerph19052681>
- Vashishth, T., Sharma, M. V., Agarwal, S., Gupta, N., Singh, S., & Sharma, R. (2024). *Embracing the Current Challenges in Sustainable Waste Management in Tourism and Hospitality* (pp. 219–256).
<https://doi.org/10.4018/979-8-3693-7898-4.ch011>
- Vergara, S. E., & Tchobanoglous, G. (2012). Municipal solid waste and the environment: A global perspective. In *Annual Review of Environment and Resources* (Vol. 37).
<https://doi.org/10.1146/annurev-environ-050511-122532>
- Yong, Z. J., Bashir, M. J. K., Ng, C. A., Sethupathi, S. A., Lim, J.-W., & Show, P. L. (2019). Sustainable Waste-to-Energy Development in Malaysia: Appraisal of Environmental, Financial, and Public Issues Related with Energy Recovery from Municipal Solid Waste. *Processes*.
<https://api.semanticscholar.org/CorpusID:210307636>