

Review

Life cycle assessment of household food waste in Zimbabwe: a systematic review

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Abstract

Food waste is a significant issue worldwide, with developing countries like Zimbabwe facing unique challenges in managing household food waste. Life Cycle Assessment (LCA) is a tool that can help to understand the environmental impacts of food waste and identify opportunities for reduction. The aim of this review paper is to utilize the LCA approach to examine and analyze the environmental effects of food waste produced at household level in Zimbabwe. The study also attempts to offer insights on feasible methods and interventions that can be used in Zimbabwe to lessen household food waste and the effects it has on the environment. A systematic literature search was conducted using Science Direct, Google Scholar, Springer, African Journal Online, PubMed, Scopus and Sage Publications using key words for example life cycle assessment, food waste, household food waste, sustainability, waste management and environmental impact. The review includes 41 English articles published up to 2024. The references added up to 76 because some of the references were found inside the 41 articles used to compile the review. The review established that household food waste in Zimbabwe is a significant issue. The main causes of food waste include poverty, lack of access to markets and inadequate storage and transportation infrastructure. Life Cycle Assessment has been applied in Zimbabwe to assess the environmental impacts of food waste, with a focus on land, water and greenhouse gas emissions. As a result, relevant stakeholders and the government should give priority to implementing awareness campaigns and education programs to promote food preservation techniques, minimize food loss and encourage the adoption of home composting systems in order to improve Zimbabwe's LCA of household food waste. The review emphasizes the importance of addressing the root causes of household food waste, such as inadequate infrastructure to reduce impacts of household food waste in Zimbabwe.

Keywords Life cycle assessment · Food waste · Household food waste · Solid waste · Waste management · Sustainability and environmental impact

1 Introduction

Food waste is defined as food that is lost or wasted that is meant for human consumption [1]. Food waste includes produce and raw materials that are lost during the growing, harvesting, transportation and storage stages as well as food that diners don't finish at restaurants and throw away at home [2]. Food waste is a significant issue globally, with household food waste being a major contributor [3–5]. Household food waste is food that is discarded at home for example fruits, dairy products, vegetables, meats and grains [6, 7]. Between half and a third of the food produced for human use is wasted worldwide [8]. Romani et al. [9] noted that discarding of food occurs at different stages which consist of

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purchasing, storing, cooking and consumption. However, when household food waste is discarded inappropriately it destroys the environment. According to the Environmental Protection Agency emission of methane is increased by food waste in the United States [10]. This implies that when food waste decomposes in landfills, it produces greenhouse gases such as methane. According to [11] and [12] production of household food waste involves the use of valuable resources for example energy, land and water. This means continuous wastage of household food results in resource depletion for example, water used to irrigate wasted food is regarded as wasted water. Food production activities require land for agriculture; however, clearing land for agriculture results in biodiversity loss [13, 14]. This denotes that if household food waste increases the demand of land for agriculture increases and this exacerbates the destruction of habitats hence, biodiversity loss occurs. Zingale et al. [15] and Hamidinasab et al. [16] opined that the food production lifecycle starts with farming followed by harvesting, processing and storage. However, all stages of the life cycle consumes large amounts of energy. This indicates that energy invested in the production of wasted household food is also wasted.

According to [17] and [18] the LCA assesses the potential environmental impacts related to the entire life cycle of food products involving use of raw materials, processing, transportation, storage and disposal. This entails that LCA is a scientific method that can be used to comprehend the impacts of household food waste to the environment, from its production, consumption as well as to its disposal. However, food waste may have varied negative effects on populations upstream and downstream. Water and land waste are examples of downstream environmental consequences that occur upstream and low water quality may worsen conditions for those downstream [19]. As a result, Life Cycle Assessment is suitable for cradle-to-grave analysis. Cradle-to-grave analysis provides a holistic understanding of impacts of household food waste to the environment and helps to identify areas where improvement is needed [20, 21]. Werf et al. [22] designated that the main goal of Life Cycle Assessment is identifying the hotspots of environmental impacts and to develop measures to manage them. Life Cycle Assessment is important since it provides a comprehensive evaluation of consequences of household food waste to the environment, including land, water and air [23, 24].

Household food waste is now a challenge in developing countries [25–27]. Zimbabwe, like other developing countries, encounter problems associated with household food waste [28, 29]. It is asserted that Zimbabwe generates 2.5 million tonnes of solid waste yearly, the most of which comes from industries and household waste [30]. A study carried by [75] at secondary schools in Zimbabwe indicated that the school kitchen produces around 61% of food waste. However, food waste is regarded as a portion of solid waste and it comes mostly from homes, businesses, restaurants and lodging facilities. Currently, the issue of household food waste in Zimbabwe is multifaceted due to different aspects such as infrastructure, socio-economic conditions, consumer behaviour and cultural practices [31, 32]. As a result, understanding the current state of household food waste involves examining factors contributing to food waste, its impacts to the environment and measures used to manage issues related to household food waste. Motsi et al. [29] and Edson et al. [33] indicated that inadequate storage facilities, limited access to markets, poor transportation infrastructure and post-harvest losses contribute to household food waste in Zimbabwe. In rural areas of Zimbabwe, where the majority of the population resides there are problems with proper storage facilities, for example, refrigerators and this leads to extensive food losses [34, 35]. However, in urban areas limited access to markets due shortage of funds to pay to the city council and inadequate transportation infrastructure increase the accumulation of food waste in Zimbabwe. Continuous accumulation of food waste in Zimbabwe affects the individual, society as a whole and the environment to a larger extent [26, 36]. At an individual level, household food waste results in economic strain since households throw away edible food items [37, 38]. Around the world, 1.3 billion tons of consumable food is lost every year [39]. In the United States, every year, over 31% of the post-harvest food that is fit for human consumption is lost [40]. According to [41] 63% of the population are living below the poverty datum line in Zimbabwe as a result, reducing household food waste is essential for addressing food insecurity in Zimbabwe.

In Zimbabwe food waste is disposed of in the landfills, where it decomposes anaerobically and produces greenhouse gases such as methane [42, 43]. However, this not only contributes to climate change but also represents a lost opportunity for utilizing organic waste through composting or other sustainable methods. In the twenty-first century, there have been serious efforts by non-governmental and governmental organizations in Zimbabwe to manage the issues related to household food waste [36, 44]. Reynolds et al. [45] and Zamri et al. [46] opined that efforts used to address household food waste include educational campaigns which raise awareness among the consumers on the impact of food waste to the environment and promote responsible consumption. In addition, initiatives which focus on improving handling and storage techniques of farm produce after harvest have been employed to reduce post-harvest losses at household levels. However, household waste continues to increase in Zimbabwe. Therefore, this review paper ought to evaluate the environmental impacts associated with household food waste throughout its life cycle assessment in Zimbabwe.

This means the review is going to assess various stages of food production, consumption and disposal. The review also aims to identify opportunities for improvement in waste management practices.

The findings of the study help Zimbabwe to meet the demands of Sustainable Development Goals. Sustainable Development Goal 2: Zero Hunger is closely related to Zimbabwe's household food waste reduction efforts. Reduced home food waste means that more food may be stored for consumption, supporting sustainable agriculture, achieving food security, reducing hunger and improving nutrition. In order to prevent food waste, policymakers may incorporate the review's findings into their current national food security plans. Reducing food waste can increase the amount of food available for consumption, which will help in the fight against hunger and the achievement of food security.

1.1 Study area

Zimbabwe is a landlocked country located in Southern Africa [43]. The nation occupies an area of about 390.757 square kilometres in Africa. According to the Zimbabwe National Statistics Agency (ZIMSTAT), the estimated population of Zimbabwe is 15.1 million [47]. Zimbabwe is well known for its diverse human and physical geography as well as its economic situation. The economic geography of Zimbabwe is marked by a mix of traditional agriculture and modern industries. Agriculture remains a crucial sector, employing a large portion of the population in Zimbabwe. However, economic challenges have led to fluctuations in agricultural productivity and food accessibility. Zimbabwe has experienced periods of hyperinflation and currency instability, impacting purchasing power and access to food. Zimbabwe's single town/city has the capacity to produce 467,303 tonnes of solid waste including food waste each year [74].

2 Methodology

Literature review for the review paper includes a systematic search approach to identify, evaluate and synthesize existing secondary sources on the LCA of household food waste in Zimbabwe. Through using the systematic approach, the research question was defined first. In this case the research question focuses mainly on LCA of household food waste in Zimbabwe. A preliminary literature search was conducted from various databases such as Google Scholar, PubMed, Science Direct, African Journal Online, Web of Science and Sage and Scopus. Keywords such as life cycle assessment, food waste, household food waste, sustainability, waste management and environmental impact were used during searching of documents from the databases. Boolean operators namely "and", "or", quotation marks" were utilised to combine search terms, refine searches and narrow down the results. English articles published up to 2024 were included to understand previous and current aspects related to the topic. During literature search 92 papers were retrieved from the databases. Nevertheless, 31 duplicates documents were removed after screening, leaving appropriate documents at 61. Appropriateness of documents was determined by abstract content and key words, therefore after screening 61 documents considering abstract content and key words 22 documents failed to meet demands of the criteria. As a result, 39 documents remain relevant and were used to write the review paper. The extracted data was synthesized to identify common trends, themes, research gaps and areas for further analysis. Through in-text and end-text referencing, validity and reliability of the research was ensured. The research methodology flow chart is shown in Fig. 1. Table 1 was used to present the articles which mention the aspect of life cycle assessment of household food waste in Zimbabwe.

3 Results and discussion

3.1 Food waste generation and characterization

In Zimbabwe different types of household food waste are produced every day [36, 48]. In Zimbabwe's suburbs for example Chitungwiza 13.4% of food waste is produced per week and in Epworth 8.0% of food waste is produced per week [77]. Types of household food waste usually produced in Zimbabwe include leftovers, vegetable scraps and fruits and expired or spoiled food [49, 50]. This means that household food waste produced in Zimbabwe varies, however, a significant proportion consists of avoidable food waste such as edible items that are discarded due to improper storage and over-purchasing. As a result of this, these waste items increase the problem of food waste which is already straining the country. According to [51] unavoidable household food waste items such as, inedible parts of food, peels and bones increase the volume of household food waste. Numerous aspects, for example, food

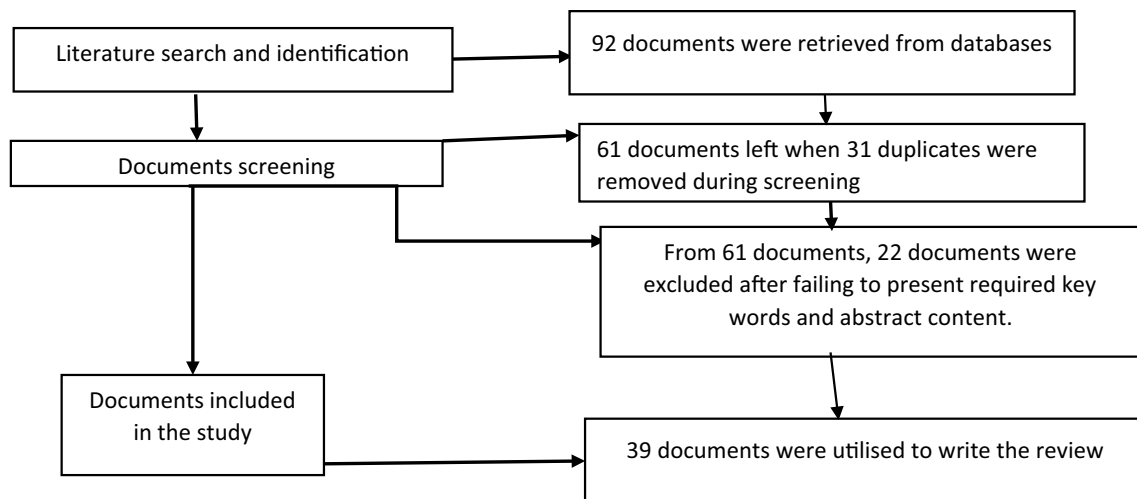


Fig. 1 Research Methodology Flow Chart. Source: Authors

purchasing habits, cooking methods, storage practices and misinterpretation of expiry dates result in the generation of household food waste [52–54]. According to [4] and [55] consumers often buy more food than they consume, leading to excess food that eventually goes to waste. This entails that factors which influence over purchasing for example lack of meal planning and bulk-buying result in an increase of food waste. Sehnm et al. [56] and Ahmed and Alzahrani [57] indicated that inefficient meal planning leads to an accumulation of food that goes unused and eventually spoils and becomes waste. Most consumers prioritize the purchase of fresh food items and this causes consumers to discard food items which are approaching their expiry dates [2, 58]. Misinterpretation of date labels on food products can lead to premature disposal of items that are still safe for consumption [59, 60]. This suggests that until foods are no longer fit for eating, people could overlook household goods that lack clear labels. Nyoni and Bonga [61] and Motsi [29] indicated that poor storage practices often result in the disposal of spoilage food items in Zimbabwe. This means that failure to use preservation techniques notably canning, freezing and pickling result in the deterioration of food items in Zimbabwe.

According to [62] and [63] household food waste in urban areas of Zimbabwe is characterized according to composition, nutrient content and physical properties. However, the composition of household food waste varies depending on the source and the type of household food discarded [1, 64, 65]. This anticipates that the type of household also affects the composition of household waste. Fruits and vegetables are the most common type of household food waste, followed by bread and grains, meat, fish and poultry, dairy products, eggs, beverages and leftovers [5, 66]. The composition of household food waste differs in developing and developed countries [60]. In less developed nations, a higher percentage of household food waste comprises roots, tubers and grains, whereas in developed nations, higher proportion of household food waste comprises fish, meat and poultry [5, 57]. However, different compositions of household food waste contain nutrient content.

Carbohydrates are a major component of household food waste, including starches and sugars from vegetables, fruits and grains [7, 11]. Nevertheless, household food such as plant sources, dairy products and meat contains proteins which increase the nitrogen content in household food waste. According to [63] household food waste contains essential minerals and vitamins such as vitamin A and C. Despite being discarded nutrients in household food still retain their nutritional value [17]. According to [7] household food waste exhibits diverse physical properties due to its heterogeneous nature. This infers that physical properties of household food waste can range from solid to semi-solid or liquid form depending on the type of food items discarded. Household food waste contains non-digestible components such as peels, seeds and fibrous materials that affect the physical properties [20, 25]. As a result, the texture of household food waste can be different, for example, cereals and bread add to the dry solid fraction whereas vegetables and fruits increase the wet solid fraction. The moisture content of household food waste is relatively high due to the presence of water-rich vegetables and fruits [23, 56]. Food waste type and characterization in Zimbabwe is shown in Table 2.

Table 1 Articles which mention the aspect of life cycle assessment of household food waste in Zimbabwe

Authors	Year	Title
Kanonhuwa and Chirisa	2021	Food waste in urban Zimbabwe: Options for food recycling
Kwenda et al.	2022	A mini-review on household solid waste management systems in low-income developing countries: A case study of urban Harare City, Zimbabwe
Sinthumule and Mkumbuzi	2019	Participation in community-based solid waste management in Nkulumane suburb, Bulawayo, Zimbabwe
Motsi	2021	Food Processing and Handling in Zimbabwe
Mandlenkosi	2022	A Critical Analysis of the Urban Food System, Urban Governance and Household Food Security in Bulawayo, Zimbabwe
Edson et al	2022	The Warehousing Strategies Adopted to Contain Maize Post-Harvest Storage Losses in Zimbabwe
Chapungu et al.	2015	Assessment of domestic solid waste management systems in rural district service centres: the case of Ngangu residential area in Chimanimani District, Zimbabwe
Mandisvika et al.	2015	Post-harvest issues: Rethinking technology for value-addition in food security and food sovereignty in Zimbabwe
Kanonhuwa et al.	2021	The future of food, the city and environment: Case for resilience in Zimbabwe
Nhubu et al.	2022	Biogas Potential from the Biomethanization of Biodegradable Municipal Solid Waste Generated in Harare
Shabani et al.	2023	Applicability of the Life Cycle Assessment Model in Solid Waste Management in Zimbabwe
Toriro and Banhire	2021	Urban Food Markets and the Resilience Factor in Zimbabwe
Nhubu et al.	2020	Comparative assessment of composting and anaerobic digestion of municipal biodegradable waste in Harare, Zimbabwe
Nyoni and Bong	2019	Hygienic practices of street food vendors in Zimbabwe: A case of Harare
Tawodzera	2013	Urban household vulnerability to food security and climate change: experiences from urban areas of Zimbabwe
Mutambisi and Chirisa	2021	City Food in Zimbabwe: The Origins and Evolution
Mandevere	2015	An investigation into the effectiveness of household solid waste management strategies in Harare, Zimbabwe
Mudzengerere and Chagwenya	2012	Waste management in Bulawayo city council in Zimbabwe: in search of sustainable waste management in the city
Mashoko	2022	Indigenous Knowledge and Food Preservation: A Case of 'Collective Responsibility' for the Murambwi Locality in Chivi, Zimbabwe
Nhubu and Muzenda	2019	Determination of the least impactful municipal solid waste management option in Harare, Zimbabwe
Chatira-Muchopa et al.	2019	Solid waste management practices in Zimbabwe: A case study of one secondary school

Table 2 Food Waste Type and Characterization in Zimbabwe

Food Waste Type	Characterization	References
Fruits	Prone to quick decay High in moisture content	[36, 51, 62, 63]
Grains	Slow to decompose Dry	
Vegetables	Varied in decomposition rates based on type	
Meat	Attracts pests if not disposed of properly High protein content	
Dairy	High in protein and fat content	

3.2 Life cycle assessment of household food waste

Life Cycle Assessment helps to understand the environmental impacts related to the production, consumption and disposal of household food [17, 20]. This implies that the life cycle of household food is divided in various stages and each stage has its own impacts to the environment. Motsi [29] and Zingale et al. [15] opined that production is regarded as a significant part of the food waste life cycle. This indicates that food waste begins at the production phase where it is influenced by other agricultural activities, for instance, harvesting. Factors such as diseases, pests and weather conditions cause food losses in the production stage [35; 24]. Additionally, food waste can occur during transportation as a result of poor temperature control methods due to delays in transit. This points out that factors which affect quick transit of food lead to the damage and spoilage of perishable foods hence, food losses occur before the food reaches the appropriate destination. In the storage stage food waste results from improper storage conditions [4, 50]. As a result, conditions in the storage facilities such as level of humidity and temperatures spoil food in storage and this increases food waste.

According to [7] poor management of the inventory and overstocking of food in storage facilities result in the expiring of food products before they are used. Supermarkets participate in food waste reduction, reuse and recycle activities, but little is known about department managers' and frontline employees' perceptions on strategies on minimizing food waste [58]. Food loss at supermarkets and other retail food establishments accounts for almost 43 billion pounds [40]. Romani et al. [9] and Massow et al. [6] opined that household food waste occurs as a result of trimming off edible portions of vegetables and fruits and improper portioning that result in left overs that are eventually discarded. At the consumption phase household food waste is attributed to the behaviour of the consumer [2, 52]. This means over-purchasing of household perishable foods practiced by consumers results in an increase of household food waste. In the final phase of the LCA household food waste is sent to landfills where its decomposition occurs [67, 68]. However, decomposition of household food waste produces methane gas which increases greenhouse gas in the atmosphere. According to [69], in addition to creating problems during disposal, waste contributes significantly to greenhouse gas emissions, making up around 5% of all emissions worldwide. Alternatively, some household food waste can be incinerated or disposed of through composting [23]. According to [15, 17] every stage of the household food waste life cycle causes various challenges to the environment such as water and land pollution which put the health of citizens at risk of diseases. The illegal dumping of waste in undesignated sites in urban areas is the source of increased pollution on land and water, however, this affects the overall health of inhabitants due to the potential to create disease epidemics, including malaria and cholera.

3.3 Impacts of food waste in Zimbabwe

The economy and environment of Zimbabwe are greatly impacted by food waste [33]. This implies that food waste's financial toll on households and the nation at large is one of its main effects. Wasting food is a waste of precious resources that could have been used to feed the hungry in a nation where food insecurity is already a serious problem [26]. This means food waste plays a role in Zimbabwe's general food scarcity as well as affecting specific families that are struggling to put food on the table. According to [27] food waste also has a negative impact on Zimbabwe's environment. Environmental impacts of food waste are summarised in Fig. 2. Food waste ends up in landfills where it breaks down and releases methane gas, a strong greenhouse gas that plays a role in global warming [43, 70]. Water,

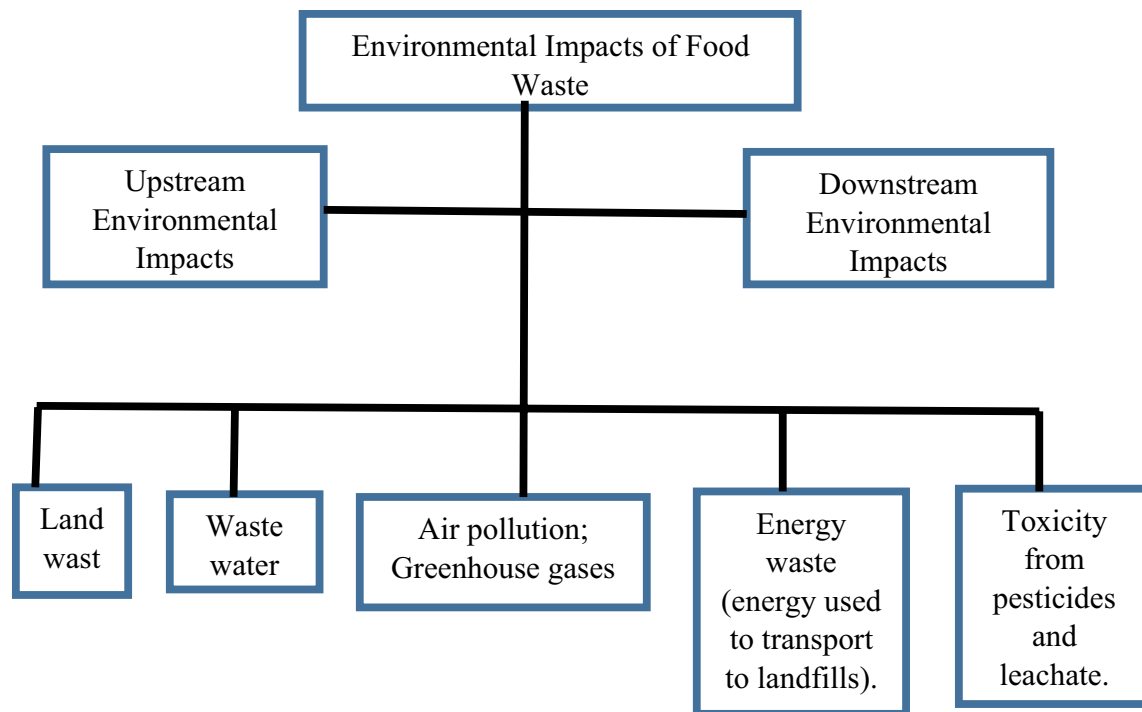


Fig. 2 Environmental Impacts of Food Waste. Source: [76]

energy and agricultural inputs are among the resources lost in the production of this wasted food. As a result of this, for environmental sustainability, food waste reduction is essential in a nation like Zimbabwe where natural resources are already under stress from a variety of sources, such as deforestation and climate change.

Food waste also contributes to the rise of food prices in Zimbabwe [36]. This suggests that in Zimbabwe market prices are affected when significant amounts of food are wasted during the production, distribution, and consumption phases of the supply chain. As producers attempt to recover their losses from lost produce, this may result in higher pricing for consumers [5, 58]. In Zimbabwe where thousands of people already face difficulties related to cost and availability of nutritious food, increasing prices exacerbate hunger and malnourishment [29, 33]. This proposes that inequality in Zimbabwean society is made worse by food. In Zimbabwe food waste occurs at many points in the supply chain, despite the fact that a substantial portion of the population suffers from hunger and malnutrition [63]. In order to meet immediate nutritional demands and promote social cohesion in Zimbabwe, reducing food waste offers the chance to transfer surplus food to underprivileged populations.

3.4 Food waste management practices in Zimbabwe

In Zimbabwe, managing organic waste and composting are essential for reducing food waste [28]. This suggests that composting has gained popularity among communities as an environmentally friendly method of handling organic waste in Zimbabwe. In addition to lowering the amount of garbage dumped in landfills, composting produces nutrient-rich compost from food scraps and organic debris, which is a useful tool for enhancing soil fertility in agricultural applications [23, 34]. This implies that compost made from recycled solid waste such as food waste has the potential to be beneficial when applied to arable land since it may be utilised as a fertilizer to create fertile soil. In Zimbabwe, landfills are frequently utilized to dispose of solid waste [27]. In certain locations of Zimbabwe, the garbage is buried after being compacted. For instance, one of Zimbabwe's main locations for the dumping of solid waste is the Pomona landfill in Harare [42].

Additionally, implementing effective regulations and policies is essential for managing solid waste [39]. Zimbabwe has legislations that govern waste management, including the Environmental Management Act, which provides a legal framework for managing environmental issues, including solid waste [43]. Food waste is being recycled at home and even in business settings following the needs of the Environmental Management Act and the Urban Councils Act, which are instruments utilized by Zimbabwe's legal framework to encourage food waste reuse and recycling. This shows that the practice of food recycling and reusing is vital since it reduces expenses associated with social, economic and

environmental issues. Waste discharge that results in environmental contamination or harm to human health is forbidden by section 70 (1) of the EMA Act Chapter 20:27 [28]. Urban local authorities are assigned the duty of providing solid waste collection, transportation and disposal services in areas under their authority under the Urban Councils Act Chapter 29:15 [26]. In urban areas of Zimbabwe, local authorities play a crucial role in managing food waste to ensure environmental sustainability, public health and economic efficiency [42]. As a result of this, the responsibilities of local authorities in handling food waste encompass various aspects, including collection, transportation and disposal. This implies that local authorities are responsible for organizing the collection of food waste from households, markets, restaurants and other sources of food waste within urban areas. Local authorities establish schedules for waste collection and provide bins or containers for residents to dispose of their food waste properly [27, 51]. However, in Zimbabwe, garbage collection including collection of food waste from households is irregular in both low, medium and high density suburbs. Table 3 compares methods used to manage food waste in Zimbabwe.

3.5 Opportunities for improving food waste management in Zimbabwe

Like other developing countries Zimbabwe faces a number of challenges in trying to manage food waste [51]. Nevertheless, there are numerous opportunities for improving management of food waste in Zimbabwe. One of the key opportunities for improving waste management in Zimbabwe is related to increasing public education and awareness about the impact of food waste and the importance of reducing food waste. Through implementing waste educational programs in communities and schools, Zimbabwe can improve the knowledge of the citizens about economic, social and environmental impacts of food waste. Increasing waste management awareness through education improves consumer's behaviour in terms of food purchasing, consumption and discarding of food [4, 54]. Zimbabwe should invest in development of food waste management infrastructure. Investing in infrastructure for proper waste management presents a significant opportunity because it includes establishing recycling plants, composting facilities and efficient collection systems [56, 66]. This means Zimbabwe can significantly reduce the amount of food waste ending up in landfills by developing infrastructure tailored to handling food waste.

Embracing technology and innovation offers opportunities to streamline food waste management processes [35]. This means the use of smart bins for efficient collection, digital platforms to connect surplus food with those in need and technologies for converting food waste into valuable resources such as biogas or organic fertilizers can improve food waste management in Zimbabwe. Innovative packaging technologies, such as intelligent labels and indicators that monitor product freshness, can extend the shelf life of perishable goods [66]. This advocates that smart packaging solutions can contribute to reducing food spoilage and wastage at both retail and consumer levels. Additionally, implementing waste to energy technologies, such as anaerobic digestion or bioenergy production from organic waste, can not only reduce the volume of food waste but also generate renewable energy resources [51]. Zimbabwe can also apply data analytics for waste reduction in order to improve food waste management. Utilizing data analytics tools in food waste management provide valuable insights into consumption patterns, demand forecasting and inventory management [71]. Through analyzing food waste data, Zimbabwe's stakeholders can make informed decisions to minimize overproduction and reduce food waste.

3.6 Challenges in implementing food waste management practices in Zimbabwe

Food waste management is a critical issue globally and Zimbabwe is not exempted. The City Council of Bulawayo in Zimbabwe struggles to provide efficient waste collection services, as demonstrated by the fact that certain low-income

Table 3 Comparison of Food Waste Management Practices in Zimbabwe

Management Practice	Description	References
Landfilling	In Zimbabwe food waste is disposed of in landfills. However, when food waste is disposed of in landfills, pollution and methane emissions occur	[28, 34]
Animal Feed	In rural areas of Zimbabwe edible food wastes are given to domestic animals to eat	
Composting	Food waste is gathered and allowed to break down onto nutrient rich compost	
Biogas Production	Food waste is utilized in anaerobic digesters to generate biogas for electricity generation and cooking	
Donation	To lessen food waste and assist those in need, extra food is donated to charitable organizations	

residential areas go more than a month without receiving solid waste collection services [72]. Food waste management efforts are affected with several challenges including inadequate infrastructure, limited access to markets, post-harvest losses and inefficient agricultural practices [50]. In Zimbabwe food waste management is affected with insufficient waste collection and disposal facilities, as well as limited access to technologies for composting or anaerobic digestion [63]. This means the primary challenges in implementing food waste management practices in Zimbabwe is the lack of adequate infrastructure and resources. Many individuals, community members and businesses do not fully understand the environmental and economic impacts of food waste in Zimbabwe, leading to lack of motivation to implement proper management practices [61]. This entails that there is limited education and awareness regarding the importance of food waste management in Zimbabwe. Cultural norms and behavioural patterns play a role in hindering food waste management efforts [2, 58]. In Zimbabwe attitudes towards food consumption, preservation and disposal are not in line with sustainable practices making it challenging to establish positive food waste management behaviours [29, 73].

Zimbabwe's susceptibility to climate related events such as floods and droughts further complicates food waste management [62]. This clearly indicates that climate change events can disrupt supply chains, exacerbate food losses and strain existing waste management systems. According to [32] economic constraints pose a challenge to effective food waste management in Zimbabwe. The costs associated with investing in advanced waste management technologies or establishing comprehensive recycling programs affect proper food waste management in developing countries and Zimbabwe is not exempted [33, 34]. The absence of a comprehensive policy framework specifically targeting food waste management is among the obstacles which affects the implementation of food waste management practices in Zimbabwe. Without clear regulations and guidelines related to food waste management, stakeholders fail to follow sustainable food waste management practices [36, 45].

4 Conclusion

The life cycle assessment of household food waste in Zimbabwe provides valuable insights into the environmental impacts associated with food waste generation, management and disposal. The study highlights the significant environmental burden linked to food waste including greenhouse gas emissions, energy consumption and resource depletion. Through analyzing the entire life cycle of food waste, from production and distribution to consumption and disposal the research underscores the importance of implementing sustainable waste management practices to mitigate effects of household waste. The findings of the review paper emphasize the need for targeted interventions to reduce food waste at the household level in Zimbabwe. Strategies such as improved food storage, meal planning and composting can contribute to minimizing waste generation and its associated environmental footprint.

4.1 Recommendations

Collaboration initiatives: In Zimbabwe there is a need to encourage collaborations between governmental, non-profit, and community organizations to develop joint projects that address food waste by including and supporting the community.

Implementation of policies which support the prevention of food waste. Encouraging the implementation of legislative measures that provide financial support for home composting or set rules for the handling of organic waste to encourage efforts to reduce food waste is essential.

Public awareness: Adopt focused public awareness programs to encourage behaviour changes that will lessen waste creation and inform households about the negative environmental effects of food waste.

Develop strategies to reduce food waste: Provide and encourage doable solutions that help families reduce food waste, like meal planning, appropriate storage methods, and composting programs.

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Declarations

Competing interests The authors declare no competing interests.

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