



Prospects for Circular Economy Adoption in an Urban Open Market: Case Study of Mtapá Open Market, Gweru

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Abstract

The research developed a circularity framework that can be adopted at Mtapá urban open market in Gweru, Zimbabwe. The market has experienced a significant increase in vendors since many smaller open markets were closed in 2020 during covid-19 pandemic in a bid to clean up the city. However, rapid development and overcrowding have led to challenges in waste management which pose health risks to vendors. To address these challenges, the research utilised a descriptive case-study design combining both qualitative and quantitative data collection and analysis methods. Data was collected using questionnaires, semi structured interviews and direct-field observation. Analysis was conducted using soft wares such as Microsoft Excel and Statistical Package for Social Sciences (SPSS). Content analysis was used to analyse qualitative data. A relationship between level of education and participation in circular initiatives was tested, yielding a chi-square p-value of 0.001. This indicates that a lack of knowledge among vendors is a significant barrier to the adoption of circularity practices. The lack of waste recycling infrastructure was also a major barrier for waste management and waste recycling at Mtapá Open Market. The study highlights the importance of implementing circularity through developing a framework which lays out measures that can be adopted to enhance sustainability and address waste management. Therefore, the study concludes that there is need for circularity at Mtapá Open Market, that has opportunity for market growth and revenue generation. The study recommends the need for waste utilisation, recycling and adoption of circular economy with involvement of major stakeholders such as the Gweru City Council, Environmental Management Agency and Mtapá Open Market vendors.

Keywords Circularity · Circular economy · Open markets · Urban areas · Mtapá · Vendors

Introduction

Circular Economy is an economic system that revolves around substituting the outdated ‘end-of-life’ concept with practices that prioritize reducing, reusing, recycling and recovering materials in production and consumption [24]. In the context of this paper, Matos

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et al. [34] define circularity as practices that optimize resource use and minimize waste across the entire production and consumption cycle, emphasizing sustainability and economic efficiency. Patwa et al. ([55]) conducted a study that identified several circular economy initiatives: these revolve around R-systems, sustainable consumption, collection of spent goods, repairing, distribution, energy-resource efficiency, and waste management. These systems are often synthesized into 3-Rs (reduce, reuse and recycle), 6-Rs (redesign, reduce, reuse, remanufacture, recycle and recover), and 10-Rs (refusing, reducing, reusing, repairing, refurbishing, recycling, redesigning, repurposing, recovering and re-mining) waste hierarchy [23, 79].

The primary challenge is finding a means of meeting the needs of people while conserving environmental diversity and resources within limits conducive to human welfare [5, 21]. Therefore, the key objective of the circular economy is to promote sustainable development, which entails achieving a balance between environmental quality, socio-economic stability, and equality [4]. Morsetto [40] emphasises that the central focus of the circular economy is to promote sustainability by dissociating from economic development from the adverse effects of resource exhaustion and environmental stress. Ranta et al. [57] suggest that the concept of circular economy proposes that economic growth can be achieved by capitalising on untapped opportunities that arise from improved resource efficiency and reducing waste throughout the entire life cycle of products.

Korhonen et al. [26] assert that the linear '*cradle-to-grave*' model has dominated the development sector, resulting in significant environmental harm. Several authors [44, 65] describe the linear economy as a model that repossesses materials from the environment and converts them into final products that are ultimately disposed of at the end of their useful life. Linear economy, therefore, lacks emphasis on strategies for extracting value from the end-of-life cycle of goods [66]. The linear system has also been associated with excessive consumption of natural resources and in the long term it defines unsustainable development [7, 12, 36]. Numerous studies have identified circular economy as a sustainable alternative to the current linear economy model, as it was developed in response to the shortcomings of linear approaches to sustainable economic development [57, 60].

Internal barriers to the adoption of circularity within open markets include the absence of clear organisational policies, financial constraints, limited access to technologies, a lack of strategic partnerships, and a lack of prioritization of environmental values whilst on the other hand, external barriers stem from factors beyond open market control such as consumer behaviour, national legislation and policy [1, 10, 74]. Circularity provides opportunities that are more focused on closing loops, thereby improving resource efficiency while also offering benefits such as cost savings, a competitive edge, and access to emerging markets [1, 49, 68].

Some scholars [32, 39] provide an account of circular economy policy adoption in developed countries such as Japan, United Kingdom and France with an emphasis on reducing, reusing, and recycling. Ngan et al. [45] found that in Asian regions such as South Korea and Japan, there is a growing emphasis on raising awareness about individual responsibility in waste management, whilst in China the concept of circular economy is used to endorse urban development and attain equal developmental growth in the countryside. Škrinjaric [69] highlights those countries with higher gross domestic product (GDP), superior infrastructure, education and development, such as Germany, the Netherlands and Denmark, have shown better performance in implementing circular economy practices.

Muchangos [42] explores how, despite being at the epicentre of production and experiencing a rise in global consumption, the practical implementation of circular economy in low-income regions, often referred to as the global south, remains unclear. [39] also agrees,

stating that lower-income countries inherently exhibit more circular practices and raises the question of how to transform this into a developmental opportunity. On the other hand, Dunmade [8] and Grobler et al. [13] highlight that coordinated circular economy systems mostly in Africa are still in their initial stages, and the concepts of circular economy is still growing on the continent. Muchangos [42] suggests that while several African governments, particularly Nigeria, Rwanda and South Africa, are making efforts to promote circular economy, there is no individual policy or initiative by the African Union (AU) specifically targeting the achievement of circularity in the African economy. Sumo et al. [71] acknowledge that African businesses are involved in the sales of secondary products, it is common to find markets for “second-hand” products.

Nyakudya et al. [50] argue that there is insufficient information in Zimbabwe regarding the state and development of the circular economy and that most policies do not explicitly address the implementation of the circular economy. The authors Nipu [46] and Chikulo et al. [3] define the open market as a closed, semi-closed, or open area where traders sell goods, and in the Zimbabwean context, those market spaces are home to diverse groups of producers, traders, and consumers. A study by Sebele-Mpofu and Moyo [62] found that Zimbabwe’s informal economy is the second largest informal economy in southern Africa accounting for 60.6% of the GDP. Mlambo [38] agrees, stating that severe economic and political crises have led to the informal economy overshadowing the formal economy. Nyathi [51] highlights that the City of Gweru, like the rest of Zimbabwe, has been affected by deindustrialisation and the emergence of informal enterprises, which have revived economic activity in the city. According to Gweru Residence Forum [14], vending is a predominant activity in most urban localities and echoes the response to the prevailing adverse socio-economic conditions. Shabani et al. [64] suggests that Zimbabwe as a country emphasises waste collection while giving less attention to waste reduction, moreover, the application of recycling, reuse and reduction approaches is still developing in Zimbabwe.

Limited research has been conducted on open markets in the context of circular economy. Existing studies, particularly those focused on Gweru, have primarily examined the impacts of Covid-19 on informal open markets located in the Gweru central business district. So far, studies have been focusing on the high-density areas of Mkoba and Mtapa, however, there has been little discussion about the Mtapa Open Market place. Furthermore, most studies concerning multi-functional markets in Zimbabwe have mainly focused on the Mbare market in the capital city, Harare. These studies often explore gender dynamics, food safety, and agriculture, without necessarily focusing on circularity in open markets like Mtapa. Consequently, there is a gap in studies relating to the Mtapa Open Market as a hub of informal businesses.

The Mtapa Open Market has been in operation for 4 years, since 2020, in the Mtapa urban high residential area of Gweru, Zimbabwe. Over time the market has expanded in both size and vendor population and yet the environment has had numerous changes from human activities. The urban market has been subject to a significant increase in waste production with below standard waste management practices. This has led to increased land degradation, water pollution of nearby water sources, and air pollution from light industries. Taking into account the increased population, the market has a plethora of safety, health, and environmental hazards. There is a need for the market vendors to adapt to circularity to ensure the sustainable continuity of the market place. The market place is a source of income for many, which addresses Sustainable Development Goals (SDGs), for example, no poverty, zero hunger, decent work, and economic growth (SDGs number 1, 2, and 8). The closure of the market would result in a socio-economic disaster for the community that relies on the market and hinder the success of the SDGs. There is a fundamental need

for a circular economy to be adopted as the current situation has been a result of the lack of such policy adoption. By adopting the circular economy principle into the urban market sphere, vendors would be able to reuse, recycle, and reduce the waste produced. This ensures continuity and balances the relationship between human activities and the natural green space they rely on. It is against this background that this study seeks to: (1) establish factors contributing to the lack of circularity at the Mtapa Open Market; (2) analyse the waste management practices at the Mtapa Open Market; (3) assess the level of awareness on circularity among stall vendors at Mtapa Open Market and (4) develop a Circularity framework at the Mtapa Open Market.

Methodology

Study Area

The study area is situated in the City of Gweru's Mtapa high density area. According to a study by Matsa and Tapfuma [35], Mtapa is considered one of the earliest suburbs in Gweru and is located approximately 3 km north-west of the Gweru central business district. The market is positioned at the intersection of Hamutyinei and Lower Gweru roads (Fig. 1).

In 2020, the Gweru City Council (GCC) made the decision to close down the Kom-bayi, TM Rank and Kudzanai markets in order to demolish illegal structures and combat the spread of Covid-19 (Tirivangasi et al. [73]). As a result, vendors from Gweru central business district were relocated to Mtapa, making it the largest open market in Gweru.

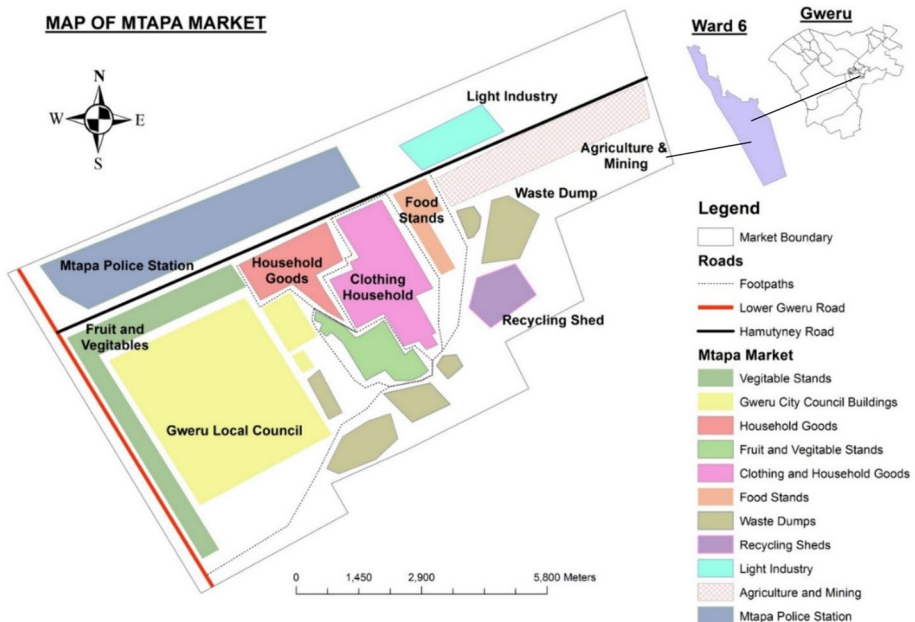


Fig. 1 Map showing location of Mtapa open market

According to Mathuthu [33], the market now accommodates approximately 3000 vendors, including local residents from the surrounding residential communities such as Mtapá, Mkoba and Ascot. Mathuthu [33] further states that there are also vendors travelling from as far as Chipinge to sell their wares at the market. The market also attracts vendors and farmers from regions surrounding Gweru.

Source: Google Earth and Geographical Information System

The main currency used at the market is the United States Dollar (USD) which has a more stable rate, followed by the South African Rand and the Zimbabwe Gold (ZiG). Dzawanda et al. ([9]) explain that the reliance on American currency helps maintain the spending power of Zimbabweans, as most goods and services at the market require USD. The market primarily caters to residents of low to middle income households, providing essential services and a range of household goods. Fresh fruit and vegetables are the most commonly sold items, while there is also significant presence of second-hand clothing (known as “mabhero”) stalls sourced from neighbouring countries like Zambia and Mozambique. Additionally, the market supplies agricultural equipment and inputs to local farmers and serves as a hub for equipment needs of artisanal miners in the surrounding areas of Gweru. The rapid development, diverse range of goods and services, and high population density have led to congestion at the market. The lack of water and sanitation facilities exacerbates health risks to the vendors [73]. Solid waste generation is also a significant issue, particularly in areas of the market that focus on trading vegetables and food products. Due to the lack of waste infrastructure at the market, waste dumps are a recurring problem.

Materials and Methods

A descriptive case study research design was employed since it involves a comprehensive analysis of a specific situation, making the context pertinent to the phenomena being studied, allowing for focused research within specific spatiotemporal boundaries [61]. To comprehensively address the research objectives, both qualitative and quantitative methods data collection methods were employed.

To determine the target population, only market vendors that were registered with the Gweru City Council (GCC) were considered. The registered vendors are vendors that have been operating in the market for more than 9 months, otherwise seasonal vendors selling their wares for less than this period were not considered. The registered participants were also drawn from the cluster zones within the market that were demarcated by the GCC, these zones range from Zone A to Zone H. Within each zone there were various business activities such as; fruit, vegetables and grains, clothing and mabhero, groceries, agriculture, hardware and mining, arts and crafts and packaging. The total number of participants was 703. The key informants who were targeted for interviews included the Gweru City Council community services officer, the Mtapá vendors’ association president, Humwe-Eden NGO project officer, and the EMA District Officer. These were selected using purposive sampling. GCC was targeted because it is responsible for waste management at the market and has valuable information concerning the market’s governance, design, and regulations. Humwe-Eden NGO was targeted because it has a waste management project with Mtapá Open Market vendors. EMA was targeted because of its involvement in environmental regulations and waste management at the market.

The research utilised a sample size of 20% of the target vendor population which translated to 140. According to [18] and [54] it is deemed acceptable in research to have a sample size ranging from approximately 10–20% of the target population, since it allows for generalising of the findings with low error margin. Utilising documents provided by the GCC; the researchers employed stratified random sampling to produce 8 strata according to the market zones. From each stratum the target population was determined and 20% was selected using random sampling to participate in the study from each zone as shown in Table 1.

Data was collected using questionnaires from market vendors. Permission to carry out the study was first sought from GCC. The researchers self-administered the questionnaire to 140 participants in each Mtapu Open Market zone. Prior to administering the questionnaire, the researchers gained verbal consent from each of the participants. The process was concluded within a 4-day period and data was collected from two zones per day. Interviews were conducted with all the 4 key informants. The researchers sought consent from the interviewees and they all signed the informed consent form as proof that they had agreed to participate in the study. An interview guide was used to guide the interview process and researchers were taking down notes. Semi structured interviews were utilised as they provide a more in-depth overview as the interviewee has the opportunity to add more information in other key areas not specified by the interviewer. The researchers were able to identify themes arising from the data collected through interviews. Direct-field observations were also conducted to observe type of waste produced, volumes and how waste was handled at the market. An observation checklist was utilised during the process and a camera was utilised to take pictures. The researchers were able to have a first-hand account of the situation on the ground in the area of study.

To analyse data, data analysis software such as Microsoft Excel and Statistical Package for Social Science (SPSS) were employed. Data collected from questionnaire surveys was coded and then analysed using statistical tests such as the Pearson Chi-square test and frequency distribution. The chi-square test was utilised to assess whether the level of education and the interest in participating in circular initiatives are related or independent. The data was presented in the form of tables, graphs and pie charts with a descriptive interpretation of the results. Qualitative data collected from open-ended questionnaires, observations and interviews were analysed using content analysis.

The limitations of the research were that it focused on a case study of a local area of Mtapu Open Market. To mitigate this limitation, the research utilised a sample size of 20%

Table 1 Sample size determination procedure

Market Zone	Population	Sample size at 20%
A	83	17
B	21	4
C	66	13
D	132	26
E	88	18
F	101	20
G	146	29
H	66	13
Total	703	140

which broadened the number of participants in the case study. Future studies should concentrate on various markets from different countries in the Global South for comparative reasons.

Results and Discussion

Factors Contributing to lack of Circularity at the Mtapá Open Market

Education Status of Mtapá Open Market Vendors with Regard to Circularity

Figure 2 illustrates that 64% of the vendors received some education or training on circularity, while 36% were not educated on circularity. Among the vendors, 78% had attained secondary-level education indicating a basic understanding of circularity concepts. Secondary-level education includes general knowledge of geography and the environment with some basics on recycling and circularity concepts. Mtapá Open Market Vendors Association president emphasized that while some vendors had received education on circularity, their knowledge was rudimentary, and others were completely unaware of the complexities associated with circularity.

The researchers further investigated the various sources from which vendors learnt about circularity. 43% (43%) reported that they learnt about the concept during school years, 4% stated that they learnt about the concept through social media and television or radio programs, 6% indicated that Gweru City Council (GCC) and EMA (Environmental Management Agency) educated them on circularity concept whilst 1% learnt through pieces of training offered by NGOs. Additionally, 6% of the respondents highlighted that the Environmental Management Agency (EMA) had educated them on circularity. The EMA District Officer explained that they provide environmental education that encompasses circular economy concepts to all citizens of Gweru district including Mtapá vendors. This data highlights that the vendors of Mtapá have been educated in some form or way with regard to circularity and its cascading concepts, however, a slightly high percentage of vendors was not educated or was unaware of circularity. Geme et al. [11] argue that having knowledge of the Circular Economy (CE) does not automatically correlate with a

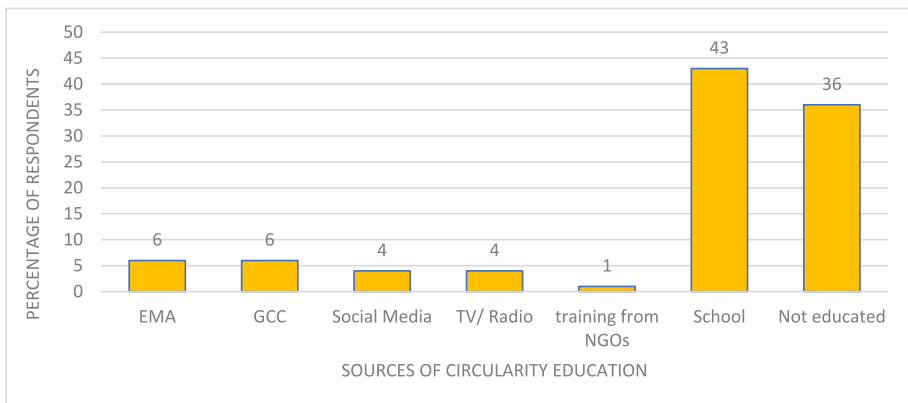


Fig. 2 Sources of circularity education

circularity transition. This therefore highlights that vendors in the southern African region need to be educated on the potential economic and social benefits of circularity to increase the adoption of circular practices at open markets.

Barriers of Circularity Practices

The barrier that was indicated by majority of respondents (47%) was a lack of knowledge and awareness as shown in Fig. 3. This aligns with statements made by the Humwe Eden projects officer and Environmental Management Agency (EMA) District Officer, who noted that while some vendors are engaging in circular practices such as recycling, reusing, repairing or repurposing, they may not be aware that they are practicing circularity. Sijtsema et al. [67] in their study noted that participants were already involved in circular initiatives but were not aware of it.

For 10% of the respondents, the costs associated with recycling pose a barrier to active participation in circularity. Vendors mentioned that the capital to establish the circularity business and the cost of training to successfully run a circular business have discouraged them from implementing circularity. A study by Stumpf et al. [70] highlighted that the high upfront investment cost is a major obstacle to circularity adoption in small and medium-sized enterprises (SMEs). GCC community services officer emphasized that there is nothing that has been done in terms of funding for the circular economy in the city. This means there is a challenge to the achievement of SDG 11 of sustainable cities and communities where the circular economy is an integral part of continuity and development and the Vision 2030 goal for more investment in domestic enterprises. Ormazabal et al. [52] and Rizos et al. [58] pointed out that low incentives for practicing circularity initiatives and the difficulty of valuing future benefits over current daily business costs discourages stakeholders. To effectively implement circularity, there is need for funding to some extent, as it involves investments in infrastructure and redevelopment. This is an area that the governing body of the Mtpa Open Market, the Gweru City Council should consider since the

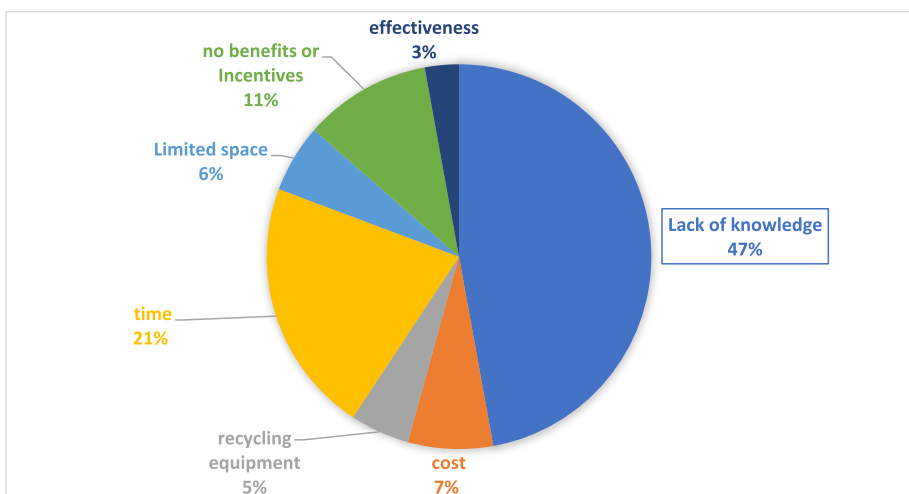


Fig. 3 Barriers of circular economy

economic benefits of formally establishing the market will provide income for not only market vendors but the local economy in Gweru.

7% (7%) of the respondents indicated that the lack of recycling equipment was a reason why they didn't practice circularity. The researchers also observed that there was sparse recycling infrastructure at Mtapa Open Market area. The EMA and GCC community services officers also acknowledged that the market is a temporary structure, limiting the investment that the local authority could proffer in terms of infrastructure. The researchers' observations further support these statements, as there is a severe lack of recycling infrastructure and waste management infrastructure in the market. For example, there was only one large waste collection point in the form of an industrial-sized skip bin. This is in contrast to the aim of Vision 2030 to have improved infrastructure development and service delivery. The distance from waste receptacles also affects their use, as an increase in distance leads to a decrease in their utilization [27]. Vendors mentioned that they lack equipment such as personal protective equipment to handle waste, appropriate bins to collect waste, and also facilitate waste separation. This is therefore contributing to the presence of waste dumps, which are more dangerous in the rainy season as pollution and other waste-related diseases increase, affecting the market vendors and local residential areas' quality of life.

21% (21%), of the vendors expressed that they did not have enough time to engage in circularity. Studies conducted on small and medium-sized enterprises by Rizos et al. [58] and Ormazabal et al. [52] also highlighted that lack of time in daily activities was a common reason why SMEs owners did not prioritize circular economy. Some vendors relied on informal waste recyclers who circulated the market collecting waste from vendors. According to the president of the Mtapa vendors association, the vendors were willing to pay as little as \$2 or \$1 United States Dollar (USD) to the informal waste collectors, as they do not have the time to dispose of their waste themselves.

For 6% of the vendors, limited space for storage of waste was the reason for not engaging in circular activities. The average stall at Mtapa Open Market is measured at around 2 m by 2,5 m. Due to the limited space, market vendors' stalls are more interested in utilizing available space for their day-to-day business rather than storing recycled materials [20]. Vendors in Zone A expressed concerns regarding the negative effects of having waste bins containing food waste on their business. They explained that when food waste accumulates for extended periods, it attracts pests such as fruit flies and rodents, with unpleasant odours being emitted. These pests in turn feed on their fresh produce leading to potential losses and smells that turn away customers. Hence, vendors opted to throw away waste than store it for recycling. This indirectly reduces the implementation of responsible and sustainable consumption and production (SDG 12) in an urban market context.

Around 11% of the respondents highlighted that they had perceived limited benefits and incentives for recycling or engaging in waste management practices. Vendors expressed concerns that waste collection, particularly in mixed waste streams, was a "dirty" job as it required waste collectors to go into unsanitary waste dumps [80, 81]. Vendors in market zones A to D, where goods such as vegetables and fruits are sold, specifically emphasized that waste produce is dumped at the local disposal site as the food waste has no fiscal value. For waste to generate a decent profit, it needs to be collected in large quantities. Vendors believed that outsiders, such as local farmers collecting food waste for animals, second-hand clothing sellers, and metal workers at the local scrap yard, were the ones benefiting from circular initiatives like recycling and reusing.

Approximately 3% of the respondents expressed concerns about the effectiveness of recycling initiatives in the market place. Despite the high waste volumes observed at

waste dumps at the Mtapa Open Market, vendors acknowledged the efforts of informal waste recyclers but did not spot any significant difference in waste reduction. However, the Humwe-Eden representative disagreed with this view stating that private waste recyclers were instrumental in reducing plastic waste volumes at the market. Ugwu et al. [75] also concur stating that using a recovery and recycling approach reduces solid waste volumes in any municipality or institution. Utilisation of waste ensures the market becomes a sustainable community (SDG 11).

Waste Management Practices at Mtapa Open Market

Types of waste produced at Mtapa Open Market

Figure 4 shows that the highest proportion of waste produced is plastic waste accounting for 33% of the respondents, followed by food waste (29%) and paper waste (18%). The results suggest that vegetable and fruit sellers in market zones A, B, C, D are the major producers of food waste. Other respondents (6%, 7% and 7%) indicated that they produce wood, metal and fabric waste respectively (Fig. 4). The integration of reverse logistics practices, as outlined by Mahadevan [30], can significantly enhance the efficiency and effectiveness of recycling and reuse operations within circular economy models. Mahadevan's framework emphasizes the importance of collaboration across different stages of the supply chain, crucial for the successful implementation of circularity initiatives at urban markets like Mtapa. In Zimbabwe plastic waste is the most commonly found waste in open markets, followed by food waste [37, 19].

Respondents also highlighted that they make use of cardboard boxes for storage fruit and vegetable maturation, however they record high food waste volumes. Kamda et al. [17] highlight that in African context, 30% of food waste is produced from perishable foods. Metal waste primarily originates from the light industry located in market zone

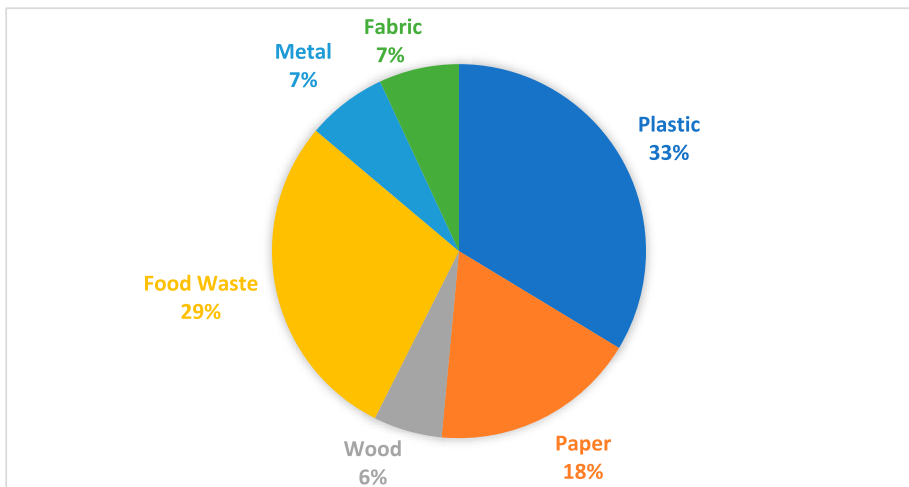


Fig. 4 Types of waste produced at Mtapa Open Market

H, where a scrap yard is located. The majority of fabric waste is produced in the market zones E, F and G where second hand clothes are sold.

Management of waste at Mtapa Open Market

The primary entity responsible for storage and collection of waste at Mtapa Open Market is the municipality, Gweru City Council (GCC) as stated by 89% of the respondents. This was also recorded in studies conducted by Rukani [59] and Shabani and Jerie [63] that municipalities are responsible for waste management. This finding is also supported by information obtained from the four key informants, who confirmed that since the Mtapa Open Market is an extension of the GCC, the council is responsible for waste storage through the use of skip bins and waste collection through their designated collection trucks. The Environmental Management Agency (EMA) District Officer clarified that the EMA's role is not directly related to waste collection but rather as a regulatory body advocating for proper waste management practices implemented by the GCC. Approximately 4% of waste management is carried out by the vendors themselves. The EMA District Officer acknowledged the establishment of vendor waste management committee at Mtapa Open Market. This committee collaborates with the Gweru District EMA and GCC to conduct waste collection for disposal. Private waste Recyclers account for 7% of waste storage and collection at the Mtapa Open Market as shown in Fig. 5 of waste collected by recyclers. Luthra [28] pointed out that informal waste pickers deliver services related to waste collection.

With regards to waste management practices among respondents, 42% utilise the GCC Skip bin, 36% use their own waste bins, 11% engage in recycling, 8% simply dump their waste and 3% sell their waste as depicted in Fig. 6. Maitre-Ekern and Dalhammar [31] highlight that consumers' role in circularity are as purchasers, maintainers, repairers, sellers and as waste discarders. The GCC community services officer confirmed that vendors at the Mtapa Open Market are responsible for the management of their own waste. The primary waste receptacle provided by the GCC at the market is the skip bin, located in a zone A, which is disproportionately positioned compared to other market zones.

The researchers observed that, vendors utilise their own makeshift waste bins which are often made from recycled materials such as cardboard boxes, used sacks and metal bins as seen in Fig. 7. Vendors that produce high volumes of high value waste such as plastic, food waste and metal waste do not sell their waste but allow those looking for waste to collect it freely from them. On the other hand, stakeholders within the market section that engage in



Fig. 5 Waste storage by private waste recyclers at Mtapa Open Market

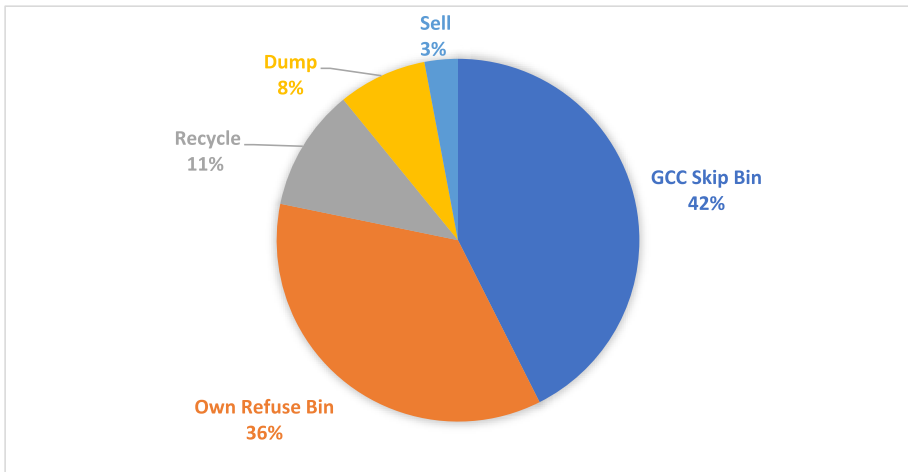


Fig. 6 Management of waste by Mtapa vendors

Fig. 7 Makeshift bin used by Mtapa Open Market zone A



waste recycling are private waste recyclers who sell their waste in bulk to buyers in other markets.

Challenges Associated with Waste Management at Mtapa Open Market

The primary challenge concerning waste management at the Mtapa Open Market is the absence of recycling bins, which results in dumping of waste [47]. Figure 8 demonstrates that 54% of the respondents agreed that the lack of waste recycling bins poses an obstacle to effective waste management. The GCC Community Services Officer revealed that the waste bin infrastructure at the market was severely inadequate for the volume of waste produced at the market. Furthermore, 29% of the vendors expressed concerns about the sporadic waste collection rates, which is a common challenge observed in many regions across Africa [43]. The vendor president and the EMA District Officer supported this claim

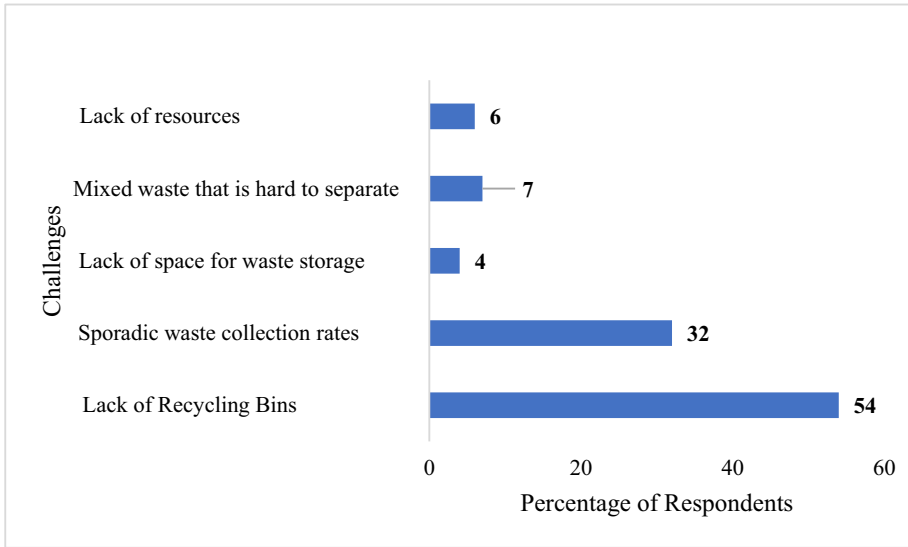


Fig. 8 Challenges associated with waste management



Fig. 9 Waste dump at Mtapa Open Market

emphasising that the Gweru City Council waste collection rate was irregular and unpredictable leading to the accumulation of waste. The negative effects of improper waste management include: pollution of surface and groundwater sources due to leachate, reduced water quality; health and safety risks related to waste dump burning, and pollution of soil [29, 37].

These issues have contributed to the formation of waste dumps within the Mtapa Open Market. The researcher also observed mixed waste dumps in more spacious sections of the

market as seen in Fig. 9. Managing mixed waste poses a challenge for vendors as it is difficult to separate and leads to unsightly conditions and unpleasant odours as highlighted by 7% of respondents. Additionally, 4% of vendors mentioned that they did not have space for waste storage which compels them to resort to dumping waste. Furthermore, 6% of vendors identified the lack of resources, specifically the absence of recycling bins near their business locations which makes waste management challenging. As disposal is inherent in a linear economy, illegal dumping is rampant in open markets, and the presence of informal dumps makes the mitigation and regulation of waste difficult [77].

Implementation Status of Circular Economy Initiatives

The data collected from vendors at the Mtapu Open Market reveals that circularity initiatives are being implemented to some extent. However, the main barrier to full implementation of these initiatives is the lack of knowledge among vendors. Schulz et al. (2019) emphasizes that transitioning to circular economy requires stakeholders to change their practices and perspectives. Out of the 140 participants, 53% stated that they had not yet implemented circular initiatives in their business or daily operations. However, 29% acknowledged that they reuse packaging as a circular initiative. Additionally, 7% reported using renewable energy sources, particularly during night time hours, as a circular initiative. Another 4% mentioned utilizing waste as animal feed, which was prevalent in zones where food waste was produced. Lastly, 7% mentioned the use of recycled waste materials in their business.

When participants were asked about the types of recycled goods or waste they utilise in their business, the most commonly utilised were cardboard boxes (29%), metal scraps (25%), plastic bottles (14%), and plastic sheets (14%). Paper waste and fabric waste were both mentioned by 4% of the respondents. This data aligns with statements made by the Humwe-Eden representative, who highlighted that most vendors practice circular initiatives, however, there is a level of ignorance of the relevance of implementing circular initiatives in their day-to-day business.

Regarding the perception of selling or promoting recycled goods, 75% viewed it as beneficial for their business, while 25% disagreed. When asked if they were interested in participating in circular economy initiatives at the market, 75% expressed their interest. The Environmental Management Agency District Officer also confirmed that vendors would be interested in participating, as they already engage in some circular activities such as collecting waste to sell or use domestically as compost and due to the presence of private waste recyclers at the Mtapu Open Market. The 25% of participants who expressed disinterest mentioned their lack of knowledge and conformity to their current business operations and uncertainty about the profitability of circular initiatives.

A Pearson's Chi-square test (Table 2) was conducted to examine the relationship between education or training level of participants and their level of interest in participating in circular economy initiatives.

The results yielded a p-value of 0.001, indicating a strong relationship between the two variables. This suggests that participants' lack of knowledge about circular economy practices contributes to their reduced willingness to engage in circular activities. These findings align with previous studies by Rizos et al. [58] and Geme et al. [11], which emphasize that barriers of circular economy, such as lack of knowledge, hinder the transition to a circular economy.

Table 2 Chi-Square test on interest in participating in circular economy

Chi-Square Tests	Value	df	Asymptotic Significance <i>p</i> -value (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	84.000 ^a	1	0.000		
Continuity Correction ^b	80.308	1	0.000		
Likelihood Ratio	96.367	1	0.000		
Fisher's Exact Test				0.001	0.001
N of Valid Cases	140				

General Attitudes towards Circular Economy Practices

A Likert scale was employed to gauge the attitudes of vendors towards recycling, as it is a measure of perceptions and opinions [72]. The responses were categorized as strongly agree, agree, uncertain, disagree and strongly agree as shown in Fig. 10. The results show that there is a level of uncertainty regarding the quality of recycled products, with brand-new products still dominating the market. The Mtapá vendor president emphasized that recycling requires more time and expertise to extract quality products from waste, while new products are hassle-free. This aligns with the observation by [76] who argued that recycled goods require significant preservation to maintain their quality and require additional effort to be sold as new products.

Regarding the potential for recycling to generate higher income for market stall vendors at Mtapá, 54% strongly agreed, 11% agreed, 24% were uncertain and about 12% strongly disagreed. This indicates that market stall vendors see recycling as a potential alternate income stream to the usual business. Figure 11 shows vendors weighing recyclables to be collected and sold for profit. [52] states that efficient resource use and

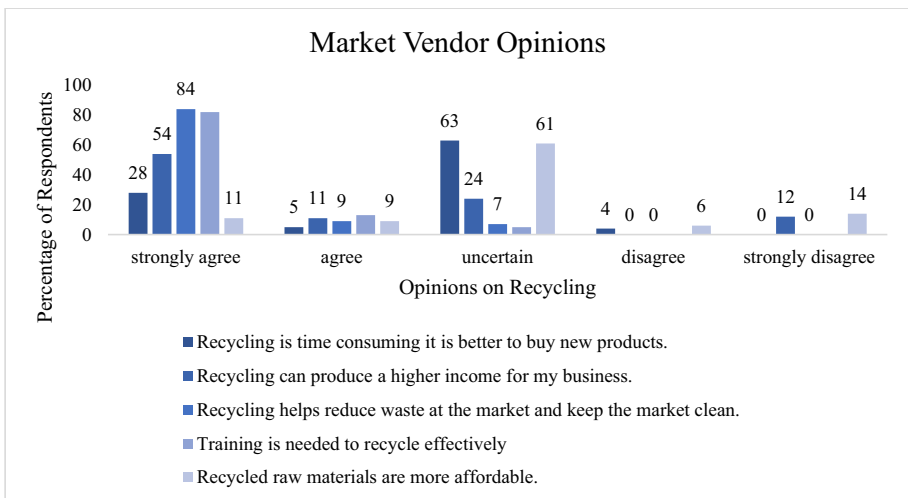


Fig. 10 Market vendor opinions on circular practices



Fig. 11 Private waste collectors weighing recyclables

value creation through recycling contribute to cost reduction and financial benefits for those participating in circular activities.

A significant majority of respondents (84%) strongly agreed that recycling has potential to effectively reduce waste at the market and maintain cleanliness at the market. Additionally, 9% agreed with this notion, while 7% expressed uncertainty. This highlights the positive correlation between market cleanliness and recycling, as recycling reduces waste streams [59]. The Mtapa vendor association president emphasized the importance of the role of private waste recyclers collecting waste around the market and farmers that collect food waste in keeping the market clean. Participants exhibited a positive inclination towards the need to effectively engage in recycling.

Developing a circularity framework for the Mtapa Open Market

The research identified several challenges that hindered the implementation of circularity at the Mtapa Open Market. In response, respondents were asked to provide recommendations to improve the situation. As shown in Figs. 12 and 27% of respondents indicated the need for training and workshops dedicated to circularity in order to improve knowledge on circularity to market vendors. The Mtapa vendors' association president emphasized the importance of educating vendors on how to make profits from recycling and convert waste into valuable products for resale. The Humwe-Eden representative highlighted the importance of recognizing waste as a valuable resource that can be utilized by all market stakeholders.

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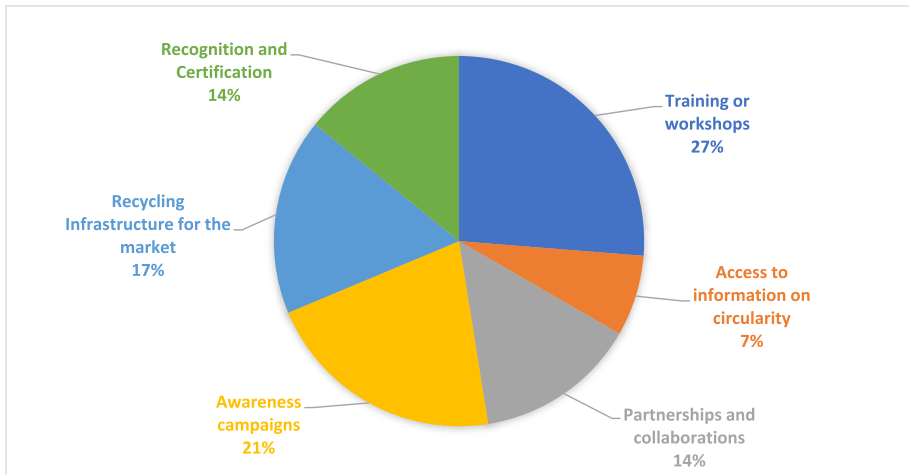


Fig. 12 Vendor recommendations on circularity adoption at Mtapa Open Market.

collect food waste in keeping the market clean. Participants exhibited a positive inclination towards the need to effectively engage in recycling.

To improve knowledge, 21% of respondents stated that awareness campaigns should be conducted at the market. The EMA officer mentioned that EMA regularly conducts awareness campaigns at the market, including during the Zimbabwe Presidential-mandated national first Friday of the month clean up campaigns. However, partnerships and collaborations (14%) between major stakeholders in the Mtapa Open Market are needed to ensure circularity education encompasses not only waste disposal but also the sustainable utilization of waste, following the principles of 10 Rs. Access to information about circularity was recommended by 7% of the respondents. The Mtapa vendor president emphasized that communication is crucial in engaging vendors in circular initiatives.

Recognition and incentives were suggested by 14% of the respondents as a means of encouraging vendor participation in circular activities. This is supported by Mpangang'ombe et al. [41] whose study in Malawi's Blantyre market had vendors suggesting that incentivising is a motivating factor to participate in circular economy. Importantly, 17% of vendors noted the need for recycling infrastructure at the market, particularly recycling bins that support waste separation at the source. All four key informants agreed that having infrastructure in place is a fundamental step towards adopting a circular economy at the market.

Based on the findings of this study, the researchers developed the PRIEE framework (Partnerships, Recycling, Infrastructure, Education and Empowerment Framework) for circularity adoption at the Mtapa Open Market (Fig. 13). The framework seeks to be a stepping stone for circular economy adoption in open markets around Zimbabwe and Developing countries. This framework is built upon the principles of circular economy, aligning with Zimbabwe's Vision 2030 and the United Nations Sustainable Development Goals. The development of the framework also drew inspiration from the ReSOLVE framework developed by Arup and the MacArthur Foundation. These frameworks emphasize key action areas such as regeneration, sharing, optimization, loop creation, virtualisation and exchange [2, 16, 78]. The African Circular Economy Facility was also instrumental in the development of the framework for circularity for

P.R.I.E.E. FRAMEWORK

For Circularity At Mtapu Open Market.

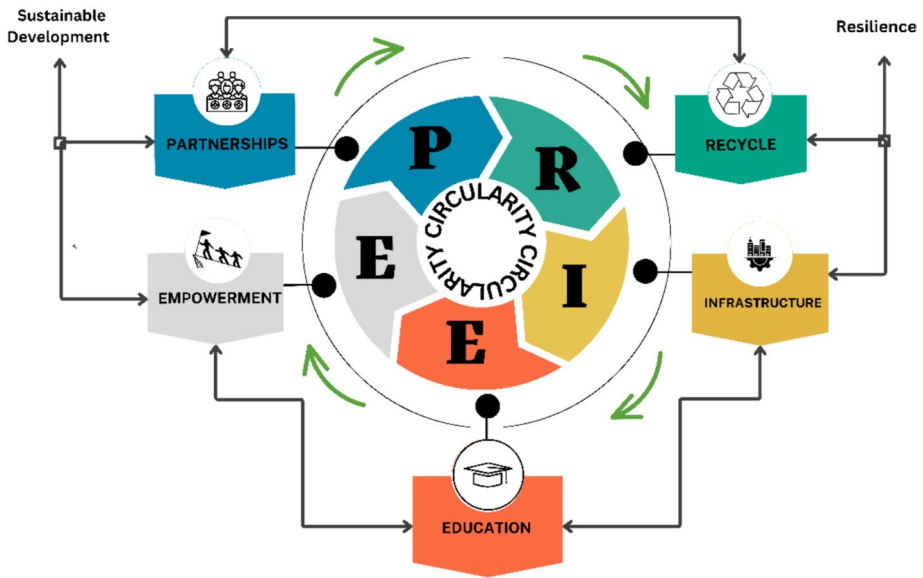


Fig. 13 PRIEE framework for circularity at Mtapu Open Market (Source: field data, 2024)

Mtapu Open Market as its main focus is on capacity building, technological advancement and circular financial equity for Africa in Africa [6, 22].

Source: Field data (2024)

Partnerships

The PRIEE framework (Fig. 13) for circularity adoption prioritises the need for partnerships and collaborations between organisations and the market stakeholders to successfully implement, organise and develop circularity initiatives at the Mtapu Open Market. Rukani [59] emphasises the need for collaboration among governments, non-governmental organisations and cities to transition to circular economy, with a strong support system serving as a foundation. The EMA District Officer stressed the involvement of market vendors in the development of practical circularity initiatives, from the planning stage to the implementation stage, without imposing a solution on them. The Humwe-Eden representative also agreed, highlighting the importance of involving stakeholders in the transition process to circular economy. This approach aligns with SDG number 17, which emphasizes the significance of partnerships for the development goals. The partnerships should include stakeholders that can facilitate the implementation of other facets of the framework.

Recycling

The PRIEE framework incorporates and enhances the R-principles (refuse, reduce, reuse, refurbish, recycle and repurpose) as a supporting structure for developing circularity at the Mtapá Open Market. These principles are particularly scalable and applicable within the market system. Establishing recycling committees at the Mtapá Open Market is crucial to create an organised and formalised system for waste collection and reintegrating waste into the market system. The recycling committees are responsible for developing waste recycling structures in collaboration with external stakeholders, conducting education and awareness programs and integrating R-principles into each section of the market. By implementing recycling initiatives, the framework addresses the issue of waste and reduces waste volumes at the market place, thereby mitigating the negative impacts associated with waste dumps [22, 25]. The framework also advocates for stakeholders to source their raw materials from sustainable sources and reduce use of linear products. Desmond and Asamba [6] support this approach highlighting that maximizing resource utilisation is a core principle of circular economy. Additionally, the framework emphasizes the importance of end-of-life responsibility and management for products sold by vendors at the market. It recognizes that both market vendors and consumers need to be more conscious and aware of circularity principles. By implementing and promoting the R-principles at the market place, progress is made towards achieving SDG 11 of sustainable communities and cities, SDG 12 of responsible consumption and production and SDG 15 which relates to life on land.

Infrastructure

A gap in terms of recycling infrastructure was identified at open market, which aligned with observations made by the researchers and the EMA District Officer. Adequate infrastructure is essential to promote and achieve circularity at the market [15]. The framework for circularity adoption at Mtapá Open Market emphasizes the need for formalizing and restructuring the market place. The EMA District Officer pointed out that the market is currently a temporary structure, but with the increasing population demand and sporadic mushrooming of new vendor sites, there is need for restructuring the market. The mixing of vendors in certain areas leads to mixed waste streams, where usable recyclable waste gets contaminated with other non-usable waste. By restructuring the market, dedicated waste recycling infrastructure can be established, making the recycling process much more efficient by segregating waste streams. Investment in waste infrastructure becomes feasible when the market itself is formalised and developed. The development of infrastructure at the market contributes to the achievement of SDG 9, which focuses on industry, innovation and infrastructural development.

Education

Education and awareness play a crucial role in bridging the knowledge gap that exists at the market. It is essential to develop education programs that are tailored to the specific needs and resources of the market stakeholders, ensuring that practicality is not compromised [53]. The programs should educate stakeholders on how to generate meaningful income from waste and how to incorporate R-principles into their business. By

providing education on circular economy business models, vendors are more likely to actively participate in circularity initiatives. Effective communication is also key to implementing any circular program. It is important to establish adequate communication channels and ensure that the disseminated information is easily accessible, understandable and practical, as highlighted by the Humwe-Eden representative. As part of the framework, the development of an in-house information centre at the market can facilitate the physical dissemination of information. Through these education and awareness programs, the framework contributes to achieving SDG 4 (quality education) and Vision 2030 goal to accessible education for all.

Empowerment

Capacity building is closely linked to partnerships, and there is need to establish strategic and sustainable partnerships for capacity building at the Mtapa Open Market [22, 48, 56]. The stakeholders interviewed all agreed that capacity building is essential for successful implementation of circularity at the market. The current economic situation in Zimbabwe provides an ideal backdrop for innovation and sustainable development. Local authorities must also learn from other countries, such as Rwanda's green growth and climate resilience strategy which focuses on resource utilisation in SMEs and Mauritius circular economy policy framework, which has strategies for all sectors including micro sectors like SMEs to adopt circular economy practices [22]. By promoting the capacity building, the framework contributes to achieving SDG 10, which focuses on reducing inequalities by providing opportunities for all members of the Mtapa Open Market to enhance their livelihoods while caring for the environment.

Conclusion

The lack of circularity has resulted in high waste volumes and underutilisation of waste, leading to missed opportunities for market growth and revenue generation at Mtapa Open Market. Major barriers to circular adoption at the Mtapa Open Market include a lack of knowledge, inadequate waste recycling infrastructure, time constraints for market participants, and concerns about the effectiveness of recycling initiatives. To address these barriers and improve vendor perceptions of circularity, the study aimed to strike a balance between practical solutions and enhancing stakeholder buy-in for circular economy initiatives. Strategies were identified to reduce waste volumes and promote the efficient utilisation of waste at its end of life, creating economic opportunities and fostering a more sustainable and inclusive community. Suggested strategies to overcome barriers are that strategic partnerships must be formed with relevant stakeholders, such as the local authority, private waste recyclers, non-governmental organisations and educational institutions. Local educational institutions, such as Midlands State University, Gweru Polytechnic and Environmental Management Agency (EMA), should play an active role in promoting and enhancing circular education and awareness as these will provide vendors with practical knowledge and skills related to circular economy practices, waste reduction and recycling.

The development of the PRIEE framework, which incorporates the R-principles of refuse, reduce, reuse, refurbish, recycle and repurpose, is instrumental in guiding the implementation of circular economy practices at the market place. By adopting this framework, the Mtapa Open Market can contribute to the broader sustainable development goals

and support of Zimbabwe's ambition of becoming an upper middle-income economy by 2030.

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Code Availability not applicable.

Declarations

Ethics Approval Approval was obtained from the ethics committee of Midlands State University. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent to Participate and Publish Verbal informed consent was obtained from all individual participants included in the study. Additional informed consent was obtained from all individual participants for whom identifying information is included in this article.

Conflict of Interest Authors declare that they have no conflict of interests.

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