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Knowledge of Circular Economy among Waste Managers in Benin Metropolis, Edo State.

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Abstract. This research investigated the knowledge of circular economy among waste managers in Benin Metropolis, Edo State, Nigeria. The descriptive survey research design was adopted. The population consisted of 480 waste managers operating within the 3 Local Government Areas that make up Benin Metropolis. A basic random sampling procedure was used to pick a sample of 259 respondents. A 30-item circular economy knowledge exam and a self-created structured questionnaire were used to gather data. According to Cronbach Alpha statistics, the instrument's reliability coefficient was 0.71. Analysis of Variance (ANOVA), mean, standard deviation, percentages, and the independent samples t-test at the 0.05 level of significance were used to examine the data. The result revealed that the majority of waste managers possessed a moderate degree of familiarity with the concepts of the circular economy. The study further showed that knowledge of circular economy did not significantly differ based on educational level, age group, or gender of waste managers. The study concluded that waste managers generally possessed similar levels of knowledge of circular economy irrespective of demographic characteristics. The study recommended the implementation of formal and informal environmental education programmes, increased public sensitization campaigns, and strengthened stakeholder involvement in promoting circular economy practices among waste managers and the general public.

Keywords: Circular Economy, Waste Management, Recycling, Environmental Education, Waste Managers, Benin Metropolis.

1. Introduction

Waste generation and disposal have become major environmental concerns globally because of the fast population expansion, industrialization, and urbanization. Environmental deterioration, pollution, flooding, greenhouse gas emissions, and public health issues are all greatly exacerbated by improper trash disposal. Inadequate waste management in emerging nations like Nigeria practices have continued to threaten environmental sustainability and public health.

Traditional waste management systems in many developing nations are largely based on the linear economy model, where resources are extracted, utilized, and disposed of after use. However, the growing environmental burden associated with this model has increased the global shift toward the circular economy (CE) approach. In order to reduce waste production and maximize resource efficiency, the circular economy places a strong emphasis on material reduction, reuse, and recycling. Under this model, waste materials are treated as valuable resources that can be reintroduced into production systems.

The idea of a circular economy has drawn interest from all across the world as a viable approach to solving environmental problems. According to Lenzing.com (2023), circular economy aims to keep materials within a closed-loop system, thereby reducing dependence on virgin resources and minimizing waste generation. This approach differs significantly from the traditional linear model in which products are manufactured, consumed, and discarded.
In Nigeria, waste management remains a persistent challenge despite numerous interventions by government agencies and private organizations. Studies by Ogu (2000), Ogwueleka (2009), and Ezeudu et al. (2021) identified major challenges such as inadequate funding, poor infrastructure, weak policy implementation, and low public awareness. Benin City, the capital of Edo State, experiences severe waste management challenges characterized by indiscriminate dumping of refuse, blocked drainage systems, flooding, and environmental pollution.

To address these challenges, the Edo State Government has recently promoted circular economy initiatives through partnerships with private recycling firms and investors. These initiatives seek to transform waste into

wealth by encouraging recycling activities and creating employment opportunities. Recycling companies operating within Benin City now convert plastic waste resources into useful goods, promoting environmental sustainability with economic development.

Despite these efforts, the success of circular economy practices largely depends on the knowledge and participation of waste managers who play critical roles in waste collection, disposal, sorting, and recycling activities. Knowledge of circular economy principles among waste managers is therefore essential for effective implementation of sustainable waste management practices.

Previous studies have shown that environmental awareness and education significantly influence waste management practices. Uwamwezi (2015) found that knowledge is a major determinant of effective solid waste management practices. Similarly, Shen and Wang (2022) emphasized that environmental education is crucial for promoting circular economy transition. However, there is limited empirical evidence regarding the degree of circular economy awareness among waste managers in Benin Metropolis.

This study therefore examined the knowledge of circular economy among waste managers in Benin Metropolis with particular focus on differences based on educational level, age group, and gender.

1.1 The Study's Objectives

The primary goal of this study was to assess the knowledge of circular economy among waste managers in Benin Metropolis.
The particular goals were to:

- Assess the degree of understanding of circular economy among waste managers.
- Examine whether knowledge of circular economy differs based on educational level.
- Determine whether knowledge of circular economy differs by age group.
- Examine whether knowledge of circular economy differs based on gender.

1.2 Research Questions

The study was directed by the following research questions:

- Does the level of knowledge of waste managers about circular economy in Benin Metropolis?
- Does knowledge of circular economy differ based on educational level?
- Does knowledge of circular economy differ by age group?
- Does knowledge of circular economy differ based on gender?

1.3 Hypotheses

The following null hypotheses were examined at the significance level of 0.05:

- Knowledge of circular economy is not significantly different based on educational level of waste managers.
- Knowledge of circular economy is not significantly different by age group of waste managers.
- Knowledge of circular economy is not significantly different by gender of waste managers.

2. Research Methodology

For this study, a descriptive survey research design was used. This study design was chosen because it makes it possible to collect data in a methodical manner in order to assess the level of circular economy among waste managers in Benin Metropolis.

The population for this study consisted of 480 waste managers who are in charge of evacuating, disposing, and managing wastes in the 3 Local Government Areas that makes up Benin Metropolis (Edo State Waste Management Board (EWMB), 2023).

The sample size of the study comprised 259 respondents representing 50% of the total waste managers in Benin Metropolis. This was obtained using simple random sampling technique to select 50 percent from each waste management company comprising the population.

A self-developed, structured questionnaire was utilized as the data collecting tool for this study in order to get the necessary information about waste managers' understanding of the circular economy in Benin City. The questionnaire was divided into two sections: Section A collected demographic information from respondents (such as gender, age range, and educational attainment), and Section B included multiple-choice questions for the waste managers' knowledge test. The garbage managers answered 30 multiple-choice questions to gauge their understanding of the circular economy. On the knowledge test, "correct answers" received a score of 1, while "wrong answers" received a score of 0.

The questionnaire was submitted to the project manager and two additional specialists from the Department of Health, Safety, and Environmental Education for review, editing, and approval prior to sending it to the responders in order to guarantee its accuracy. Cronbach Alpha statistics were used to quantify the internal consistency of the items in order to assess the instrument's reliability for the study. Twenty waste managers who were not included in the study sample were given the instrument once. After applying Cronbach Alpha statistics to the instrument

administration score, a coefficient score of 0.71 was obtained for the Knowledge test. The correlation coefficient value showed that the instrument was reliable.

The knowledge test and questionnaires were administered to the respondents (waste managers) by the research manager and two additional specialists and retrieved on the spot to avoid loss and ensure a hundred percent retrieval rate.

Data collected was analyzed using percentages for the respondents' demographic data as well as research question 1. Analysis of Variance (ANOVA) was used to test hypothesis 1, while the independent samples t-test was used to test hypotheses 2, 3, and 4. The developed hypotheses were examined at the significance level of 0.05. The waste managers rated their understanding of the circular economy on a scale of 0–10 for poor knowledge, 11–20 for intermediate knowledge, and 21–30 for high knowledge.

3. Results

Research Question 1: What is the level of knowledge of waste managers about circular economy in Benin metropolis?

Table 6: Percentage distribution of responses on level of knowledge of waste managers about circular economy

Level of Knowledge	Frequency	Percentage
Low	70	27.0
Moderate	150	57.9
High	39	15.1
Total	259	100.0

The data in table 6 showed that 70 (27%) of the waste managers indicated a low level of understanding about circular economy in Benin metropolis, 150 (57.9%) affirmed a moderate level of knowledge, and 39 (15.1%) had a high level of knowledge about circular economy. Thus, majority of the waste managers had a moderate level of knowledge about circular economy.

Research Question 2: Does the knowledge of circular economy among waste managers differ by level of education?

Hypothesis 2: Knowledge of circular economy is not significantly different based on level of education of waste managers.

Table 7: ANOVA Statistics on Knowledge of circular economy of waste managers based on level of education

Knowledge based on educational level	Sum of Squares	Df	Mean Square	F	Sig.	Decision
Between groups	23.692	4	5.923	1.022	.396	Ho is accepted
Within groups	1472.084	254	5.796			
Total	1495.776	258				

The data in the ANOVA table as relates to table 7 showed the F value is 1.022, df=4, 254. The p-value is 0.396 which is greater than 0.05 level of significance, hence the null hypothesis is accepted/retained, which means that knowledge of circular economy is not significantly different based on level of education of waste managers. This implies that waste managers irrespective of their level of education have same knowledge of circular economy.

Research Question 3: Does the knowledge of circular economy among waste managers differ by age group?

Hypothesis 2: Knowledge of circular economy is not significantly different by age group of waste managers.

Table 8: t-test statistics of waste managers knowledge of circular economy based on age group

Descriptive t-test analysis

Age	N	Mean	SD	Mean Difference	df	t	Sig.(2-tailed)	Decision
20-39years	233	17.06	2.44	-.325	257	-.651	.516	Ho is accepted
40-59years	26	17.38	2.08					

The data in table 8 showed that based on waste managers knowledge of circular economy by age group, the waste managers within the age group of 20-39 years had a mean of 17.06, while those within 40-59 years had a mean of 17.38. Hence, the waste managers within the age group of 40-59 years have a higher mean than those within 20-39 years. As a result, the waste managers within 40-59 years have more knowledge of circular economy than their counterparts within 20-39 years.

The data also showed a t-value of -0.651, df = 257 and a p-value of 0.516, testing at an alpha level of 0.05. The p-value is greater than 0.05, thus, the null hypothesis which states that knowledge of circular economy is not significantly different by age group of waste managers is accepted/retained, meaning that knowledge of circular economy is not significantly different by age group of waste managers. This implies that waste managers knowledge of circular economy is the same with respect to their age groups/brackets.

Research Question 4: Does the knowledge of circular economy among waste managers differ by gender?

Hypothesis 3: Knowledge of circular economy is not significantly different by gender of waste managers.

Table 9: t-test statistics of waste managers knowledge of circular economy based on gender
Descriptive t-test analysis

Gender	N	Mean	SD	Mean Difference	df	t	Sig.(2-tailed)	Decision
Male	185	16.96	2.44	-.457	257	-1.382	.168	Ho is accepted
Female	74	17.42	2.30					

The data in table 9 showed that based on waste managers knowledge of circular economy by gender, the males had a mean of 16.96, while the females had a mean of 17.42. Hence, the females have a higher mean than the males. As a result, the females have more knowledge of circular economy than their male counterparts.

The data also showed a t-value of -1.382, df = 257 and a p-value of 0.168, testing at an alpha level of 0.05. The p-value is greater than 0.05, therefore, the null hypothesis which states that knowledge of circular economy is not significantly different by gender of waste managers is accepted/retained, meaning that knowledge of circular economy is not significantly different by gender of waste managers.

4. Discussion of Findings

The results from research question 1, showed that majority of the waste managers had a moderate level of knowledge about circular economy. With respect to knowledge of circular economy, Msengi (2019) opined that waste minimization, reuse, and recycling rates vary substantially among individual households for various reasons, which include; attitude toward the environment, knowledge, demographic variable, and personality. Therefore, the only things that will have the long-lasting and substantial impact on the environment that is sorely needed are changes in individual attitudes, beliefs, and environmental standards, as well as the ensuing change in personal behavior. This will also apply to waste managers who when knowledgeable enough would see to proper implementation of circular economy. Corroborating this, Ekhasomhi (2022) stated that majority of the world's population today still have a low reception of waste recycling. Also, Msengi (2019) observed that a large number of people still do not participate in regular recycling; as despite this been an arena of environmental behaviour that has received a lot of attention, the pace at which people are adopting the recycling behaviour is still very slow.

The findings of research question 2 in relation to hypothesis 1 showed that knowledge of circular economy is not significantly different based on level of education of waste managers. This implies that both more and less educated waste managers have the same understanding of circular economy; level of education does not affect their knowledge of circular economy. The researcher believes that much more has to be done immediately to stop catastrophic world change and implement a circular economy system and mindset. Hence, Maija, Nani and Holuszko (2023) posited that the most profound way to promote this transformation is to involve all people (waste managers inclusive) through education. Maija et al (2023) further stated that starting in pre-school and continuing all the way to university, education is the best way to enable the transition from a linear economy to a circular economy. Additionally, Shen and Wang (2022) opined that it has been shown that progress in environmental awareness contributes to decreasing environmental impacts. Therefore, environmental thinking should be included at all the levels of education as the best way to transit from linear economy to a circular economy is to educate people (Shen & Wang, 2022).

The findings of research question 3 in relation to hypothesis 2 showed that knowledge of circular economy is not significantly different by age group of waste managers. This implies that waste managers knowledge of circular economy is the same with respect to their age groups/brackets. This finding was contrary to the study of Kamweru (2019) who found that there is a significant influence of age on attitudes associated to solid waste management (SWM) activities. The findings suggest that people become more aware of their surroundings as they age. This could imply that older people were more inclined to have positive sentiments regarding SWM initiatives and to abide by the rules and legislation established by the government. Similarly, Adeoulu *et al*. (2014) portrayed similar positive correlation between age and respondent's knowledge and practices. However, in another study by Tatlonghari and Jamias (2010) indicated a weak and negative relationship between the two attributes. Compared to the older respondents, the younger respondents demonstrated higher levels of expertise.

The findings of research question 4 in relation to hypothesis 3 showed that that knowledge of circular

economy is not significantly different by gender of waste managers. This indicates that both male and female waste managers have the same knowledge of circular economy. This aligns with the finding of Davis and Greenstein (2009) who suggest that gender norms influence people's beliefs about appropriate tasks for women and men. The allocation of duties in private and public areas is thus determined by these views. Therefore, societal gender ideals and socialization processes are reflected in the gender division of labor and occupational sex segregation in solid waste management. Additionally, Circular and Conservancy (2019) also noted that while men are tasked with the more labour-intensive loading and unloading, women carry out repetitive and time-consuming activities such as sorting and separating. These gendered divisions of labor were not uncontested, despite the strong consensus over what constitutes a woman's and a man's work in SWM.

5. Conclusion

The study concluded that waste managers in Benin Metropolis generally possessed moderate knowledge of circular economy principles. Furthermore, knowledge of circular economy did not significantly differ based on educational level, age group, or gender. This suggests that awareness of circular economy concepts is relatively similar among waste managers irrespective of demographic characteristics.

The study emphasizes the necessity of ongoing environmental education and awareness initiatives to enhance understanding and use of circular economy principles in waste management systems.

6. Recommendations

In light of the results, the study suggested that:

- The government together with environmental agencies should intensify environmental education and awareness programmes on circular economy practices.
- Waste managers should receive regular training on recycling, reuse, and waste reduction strategies.
- Public sensitization campaigns should be strengthened through mass media, community outreach, and educational programmes.
- Government should provide adequate recycling facilities and modern waste management equipment.
- Policies promoting environmental sustainability and circular economy practices should be effectively implemented and monitored.
- Partnerships between government, private organizations, and non-governmental organizations should be strengthened to promote waste-to-wealth initiatives.
- Waste management authorities should encourage household participation in proper waste sorting and disposal practices.

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