Green Campaign Strategies, Students' Attitudes and Waste Management in Federal Colleges of Education, Southwest, Nigeria

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LCU/PG/002614

Being a Ph. D Thesis Submitted to the Department of Management & Accounting, Faculty of Management & Social Science, Lead City University, Ibadan, Oyo State, Nigeria

In partial fulfilment of the Requirements for the Award of Doctor of Philosophy Degree (PhD) in Business Administration

2025

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Certification

This is to certify that Sherifat Abiodun **AZEEZ** with matriculation number LCU/PG/002614, carried out this research work titled "Green Campaign Strategies, Students' Attitudes, and Waste Management in Federal Colleges of Education, Southwest, Nigeria" in the Department of Management and Accounting, Faculty of Management and Social Sciences, Lead City University, Ibadan, Oyo State, Nigeria, for the award of the Doctor of Philosophy (Ph.D) in Business Administration, and that this work has not been previously submitted for any degree or certification elsewhere.

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Head of Department

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Dedication

This thesis is dedicated to Almighty Allah, The Merciful, The Beneficent and The All-Knowing.

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Acknowledgement

Alhamdulillah! All praises and adorations belong to Allah.

I express my sincere appreciation to the Vice-Chancellor of Lead City University, Prof. K. A. Adeyemo, the Provost of the PG College, Prof. Oredein, and my diligent and tireless Head of Department, Dr. T. M. Akinbo, for their supports and contributions toward the success of my programme.

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Though many individuals and tools contributed to the success of this research, I take full responsibility for any error found in the work.

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Abstract

The global increase in waste generation, driven by population growth and accelerated production and consumption, has overwhelmed government-owned waste management agencies, necessitating the involvement of private informal sectors, including individuals, institutions, and communities, to promote environmental cleanliness and sustainability. Higher education institutions (HEIs) play a vital role in fostering sustainable waste management practices and cultivating a culture of environmental responsibility among students and staff. The aim of this study is to evaluate the effectiveness of green campaign strategies and students' attitudes toward waste management in Federal Colleges of Education in Southwest, Nigeria. The study is theoretically anchored on four interrelated frameworks, Waste Management Theory, Protection Motivation Theory, Social Marketing Theory, and the Theory of Planned Behaviour which collectively explain the interplay among green campaign strategies, students' attitudes, and waste management practices within higher education institutions. The research adopted a descriptive survey design and focused on students from the four federal colleges of education, in Southwest, Nigeria with a population of 11,320 and sample size of 386 determined by Taro Yamane formula. Data were collected using a structured questionnaire and analyzed with Statistical Package for Social Sciences (SPSS) version 26 and Smart PLS. The finding indicated that environmental advertising has a significant positive effect on waste management practices ((β = 0.429, t = 9.287, p = 0.000), social media platform has a significant positive effect on waste management among students (β = 0.423, t = 9.184, p = 0.000), eco-labelling has a significant positive effect on waste management among students (β = 0.404, t = 8.680, p = 0.000), incentive-based initiaives has a significant positive effect on waste management among students (β = 0.408, t = 9.177, p = 0.000). However, the study revealed that students' attitudes do not play a significant moderating role in the relationship between green campaign strategies and waste management (β = -0.006, t = 0.167, p = 0.867). The study concludes that green campaign strategies particularly environmental advertising, social media, and eco-labelling enhance waste management in Federal Colleges of Education across Southwest Nigeria. Posters, billboards, educational blogs, and colour-coded bins proved effective, while incentive-based initiatives require further reinforcement to sustain behavioral change. Although students' attitudes showed limited influence, peer interaction, proper orientation, and adequate facilities can strengthen students' active participation in campus waste management. It is therefore recommended that college management prioritize environmental advertising through clear, well-designed signage and posters, and leverage social media platforms for effective communication. Eco-labels should be visibly placed on waste bins to encourage waste sorting. Institutional authorities should also promote positive student attitudes by integrating waste management principles into academic programmes and empowering students as sustainability ambassadors to enhance campus waste management.

Keywords: Environmental Sustainability, Federal Colleges of Education, Green Campaign Strategies, Students' Attitudes, Waste Management

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Table of Contents

Certification		i
Dedication		ii
Acknowledgement		iii
Abstract		iv
Table of Contents		v
List of Tables		x
Table of Figures		xiii
Chapter One: Introduction		1
1.1	Background to the Study	1
1.2	Statement of the Problem	6
1.3	Aim and Objectives of the Study	7
1.4	Research Questions	8
1.5	Hypotheses	8
1.6	Significance of the Study	9
1.7	Scope of the Study	11
1.8	Limitations of the Study	12
1.9	Operational Definition of Terms	12
Endnotes		17
Chapter Two: Literature Review		19
2.1	Conceptual Review	19
2.2	Classification of Waste	22
2.1.2.1	Implications of Waste Classification for Sustainable Management	26

Lead City University DO NOT COPY

2.1.3 Overview of Waste Management 28
2.1.3.1 History of Waste Management in Nigeria 29
2.1.3.2 Statutory Regulations Guiding Waste Management in Nigeria 30
2.1.3.3 Benefits of Effective Waste Management 32
2.1.3.4 Methods of Solid Waste Management 36
2.1.4 Components of Waste Management 37
2.1.4.1 Waste Generation 38
2.1.4.1.1 Factors Affecting Waste Generation 38
2.1.4.2 Waste Collection 40
2.1.4.1 Waste Storage 41
2.1.4.2.2 Types of Solid Waste Collection systems 41
2.1.4.2.3 Types of Waste Collection Vehicles 42
2.1.4.3 Waste Separation 44
2.1.4.3.1 Contributions of the Informal Workers 45
2.1.4.4 Waste Recycling 45
2.1.4.4.1 Types of Waste Recycling 47
2.1.4.4.2 Economic Benefits of Waste Recycling 49
2.1.4.4.3 The Advantages of Waste Paper Recycling 50
2.1.4.5 Waste Recovery 52
2.1.4.5.1 Advantages of Resource Optimisation 53
2.1.5 Integrated Solid Waste Management Versus Traditional Waste Management 56
2.1.6 Waste Management Hierarchy 57
2.1.7 Waste Bank System 59

Lead City University DO NOT COPY

2.1.8.1 Solid Waste Management System in Nigeria 61
2.1.8.2 Waste Management in Higher Education Institutions 62
2.1.8.3 Waste Management Techniques for HEIs 65
2.1.8.4 Challenges of Waste Management in Developing Countries 68
2.1.9 An Overview of Green Marketing 70
2.1.9.1 An Overview of Green Campaign Strategies 71
2.1.9.2 Measurements of Green Campaign Strategies 73
2.1.9.2.1 Environmental Advertising 73
2.1.9.2.2 Social Media Platforms 80
2.1.9.2.3 Eco-labelling 88
2.1.9.2.4 Incentive-Based Initiatives 93
2.1.10 Impact of Green Campaign 97
2.1.11 Factors Affecting Green Campaign Strategies 106
2.1.12 Students' Attitude 110
2.1.12.1 Students' Knowledge 113
2.1.12.2 Students' Perception and Beliefs 114
2.1.12.3 Students' Behavioural Intentions 115
2.1.12.4 Students' Actual Behaviour 116
2.1.13 Factors Affecting Students' Positive Attitudes 118
2.2 Theoretical Review 120
2.2.1 Theory of Planned Behaviour (TPB) 121
2.2.2 Protection Motivation Theory (PMT) 124
2.2.3 Social Marketing Theory (SMT) 125

Lead City University DO NOT COPY

2.2.4 Waste Management Theory 126

2.3 Review of Empirical Studies 127

2.4 Conceptual Framework 140

2.5 Summary of Gaps in Literature 141

2.5.1 Summary of Reviewed Literature 141

2.5.2 Summary of Gaps in Literature 143

Endnotes 145

Chapter Three: Methodology 160

3.1 Research Design 160

3.2 Population of the Study 160

3.3 Sample and Sampling Techniques 161

3.4 Description of the Research Instrument 162

3.5 Validity of the Research Instrument 163

3.6 Reliability of the Research Instrument 164

3.7 Data Collection 165

3.8 Data Analysis 165

3.9 Ethical Approval 165

Endnotes 165

Chapter Four: Results and Discussion of Findings 170

4.1 Demographic Data Analysis 170

4.2 Presentation of Data 172

4.2.1 Research Questions 172

4.2.1.1 Descriptive Analysis on Green Campaign Strategies 172

Lead City University DO NOT COPY

4.2.1.2 Descriptive Analysis on Students' Attitude 176

4.2.1.3 Descriptive Analysis on Waste Management 177

4.2.2 Hypotheses 180

4.3 Discussion of Findings 214

Endnotes 219

Chapter Five: Conclusion 221

5.1 Summary of Findings 221

5.2 Conclusion 223

5.3 Recommendation 224

5.4 Contribution to Knowledge 227

5.5 Suggested areas for Further Research 228

Bibliography 229

Appendix 1: Pictorial Evidence of Waste Management 243

Appendix 2: Questionnaire 247

Bio-data 250

The University Compliance Certification 253

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List of Tables

Table 2.1 Quantity of municipal solid waste generated in some Nigerian cities (2024) 22

Table 2.2 Waste Generated in Campuses and their Characteristics 25

Table 2.3 Recyclables and their uses 47

Table 3.1 Population of the students in the selected FCEs in Southwest Nigeria (2023/2024) Academic sessions 161

Table 3.2 Summary of Sample Size for Students

Table 3.6 Validity Test of Research Instrument 163

Table 3.7 Reliability Test of Research Instrument 164

Table 4.1 Response Rate 170

Table 4.2 Demographics Profile of the Respondents 171

Table 4.3 Descriptive Analysis of Responses on Environmental Advertising 172

Table 4.4 Descriptive Analysis of Responses on Social Media Platform 173

Table 4.5 Descriptive Analysis of Responses on Eco-Labelling 174

Table 4.6 Descriptive Analysis of Responses on Incentive-Based Initiatives 175

Table 4.7 Descriptive Analysis on Students' Attitude 176

Table 4.8 Descriptive Analysis of Waste Management 178

Table 4.9 Factor Loading of Environmental Advertising and Waste Management 181

Table 4.10 Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion) 181

Table 4.11 Cross-Loading for Discriminant Validity 183

Table 4.12 Discriminant Validity (Heterotriat-Monotriat-HTMT) 183

Table 4.13 Common Method Bias: Latent Variable Correlation 184

Lead City University DO NOT COPY

Table 4.14	Collinearity Statistic (VIF)	184
Table 4.15	Structural Model Result of Environmental Advertising and Waste Management	185
Table 4.16	Factor Loading of Social Media Platform and Waste Management	189
Table 4.17	Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion)	189
Table 4.18	Cross-Loading for Discriminant Validity	191
Table 4.19	Discriminant Validity (Heterotriat-Monotriat-HTMT)	191
Table 4.20	Common Method Bias: Latent Variable Correlation	192
Table 4.21	Collinearity Statistic (VIF)	192
Table 4.22	Structural Model Result of Social Media Platform and Waste Management	193
Table 4.23	Factor Loading of Eco-Labelling and Waste Management	197
Table 4.24	Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion)	197
Table 4.25	Cross-Loading for Discriminant Validity	198
Table 4.26	Discriminant Validity (Heterotriat-Monotriat-HTMT)	199
Table 4.27	Common Method Bias: Latent Variable Correlation	199
Table 4.28	Collinearity Statistic (VIF)	200
Table 4.29	Structural Model Result of Incentive-Based Initiatives and Waste Management	200
Table 4.30	Factor Loading of Incentive-Based Initiatives and Waste Management	204
Table 4.31	Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion)	204

Lead City University DO NOT COPY

Table 4.32 Cross-Loading for Discriminant Validity 206

Table 4.33 Discriminant Validity (Heterotriat-Monotriat-HTMT) 206

Table 4.34 Common Method Bias: Latent Variable Correlation 207

Table 4.35 Collinearity Statistic (VIF) 207

Table 4.36 Structural Model Result of Incentive-Based Initiatives and Waste Management 208

Table 4.38 Structural Model Result of Green Campaign Strategies, Student Attitudes and Waste Management 211

Lead City University DO NOT COPY

Table of Figures

Figure 2.1	Waste Classification	23
Figure 2.12	Functional Elements of Waste Management	55
Figure 2.13	ISWM practices and Some Coping Mechanisms	56
Figure 2.14	Waste Management Hierarchy	59
Figure 2.19	Ajzen's Theory of Planned Behaviour	123
Figure 4.1	Structural Model of the Relationship between Environmental Advertising and Waste Management	187
Figure 4.2	Bootstrapping of the P-value of the Relationship between Environmental Advertising and Waste Management	187
Figure 4.3	Bootstrapping of the T-value of the Relationship between Environmental Advertising and Waste Management	188
Figure 4.4	Structural Model of the Relationship between Social Media Platform and Waste Management	195
Figure 4.5	Bootstrapping of the P-value of the Relationship between Social Media Platform and Waste Management	195
Figure 4.6	Bootstrapping of the T-value of the Relationship between Social Media Platform and Waste Management	196
Figure 4.7	Structural Model of the Relationship between Eco-labelling and Waste Management	202
Figure 4.8	Bootstrapping of the P-value of the Relationship between Eco-labelling and Waste Management	202

Lead City University DO NOT COPY

Figure 4.9 Bootstrapping of the t-value of the Relationship between Eco-labelling and Waste Management 203
Figure 4.10 Structural Model of the Relationship between Incentive-based Initiatives and Waste Management 210
Figure 4.11 Bootstrapping of the t-value of the Relationship between Incentive-based Initiatives and Waste Management 210
Figure 4.12 Bootstrapping of the p-value of the Relationship between Incentive-based Initiatives and Waste Management 211
Figure 4.13 Bootstrapping of the t-value of the Relationship between Green Campaign Strategies and Waste Management 211
Figure 4.14 Bootstrapping of the p-value of the Relationship between Green Campaign Strategies and Waste Management 211
Figure 4.15 Bootstrapping of the t-value of the Relationship between Students' Attitude, Green Campaign Strategies and Waste Management 213
Figure 4.16 Bootstrapping of the p-value of the Relationship between Students' Attitude, Green Campaign Strategies and Waste Management 213

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Chapter One
Introduction

1.1 Background to the Study

Rapid industrialisation, urbanisation, and population growth across the world have significantly increased municipal solid waste (MSW) generation, posing fundamental challenges to health, economic, and environmental development. Globally, municipal solid waste generation reached 2.32 billion tonnes in 2024, with 33% inadequately managed, contributing to environmental degradation and health hazards[1]. The alarming rate of waste generation, projected to 3.40 billion tonnes by 2050 is very disturbing for low income countries with unsafe sanitary landfills and incineration facilities leading to inefficient waste management mostly through open dumping and open burning[2]. Africa's MSW generation, driven by population growth, socioeconomic factors, and changing consumption patterns, increased from 174 million tonnes in 2016 to an estimated 244 million tonnes by 2025[1].

Nigeria is one of Africa's top waste generating countries as a result of inadequate waste management infrastructure and weak governance, high population density, socioeconomic conditions, and cultural practices of the inhabitants, aggravating the impacts of waste accumulation. In Nigeria, these factors are amplified by a population that grew from 213.4 million in 2021 to 225 million in 2022, with projections estimating 392 million by 2050[3]. The country generates approximately 32 million tonnes of MSW annually with an average of 0.79 kg/day per person, exceeding the West African average of 0.66 kg/day[3]. In urban centres like Lagos, rapid urbanisation and industrial growth have overwhelmed municipal authorities, with only 55% of MSW collected due to limited infrastructure and governance challenges[4]. In low-income areas, collection rates drop to 30%, as commercial waste collectors prioritise wealthier neighbourhoods, leaving underserved communities vulnerable to environmental and health

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risks[5]. In Lagos State, it is regrettably noted that rapid urbanisation and population expansion have intensified the solid waste management challenge[6].

The uncontrolled accumulation of waste in Nigeria has led to severe consequences, particularly during rainy seasons when uncollected waste obstructs drainage systems, causing flooding and disease outbreaks, such as cholera and malaria[7]. Open dumping and burning, prevalent due to inadequate collection systems, leading to air, soil and water pollution, and consequently climate change and global warming. Economically, the mismanagement of waste imposes significant costs, with global estimates indicating direct waste management expenses of USD 252 billion in 2020, alongside hidden costs of USD 361 billion from pollution and health impacts[1]. In Nigeria, the lack of budgetary allocation for waste system infrastructure limits the capacity of municipal authorities, particularly in underserved areas, perpetuating environmental and health risks[2].

Despite efforts by Nigeria's Federal and State governments, through agencies like the National Environmental Standards and Regulations Enforcement Agency (NESREA), Environmental Protetion Agencies (EPA) to establish waste management policies, implementation remains weak, indiscriminate dumping, limited recycling infrastructure, and poor regulatory enforcement persist[8]. The 2030 Agenda for Sustainable Development, particularly Goals 7, 9, 11, and 12, emphasises environmentally sound waste management, reduction, recycling, and reuse to achieve sustainable cities and communities[9]. However, Nigeria's progress toward these goals is hindered by inefficiencies in waste collection, lax regulations, and low public participation, particularly in waste segregation and recycling[4]. Globally, there has been a marked shift toward responsible waste management and environmental sustainability impact across all sectors of human activity, including the educational sector. In the developed nations, a multifaceted approach combining formal and informal efforts is increasingly being adopted to enhance waste

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collection, separation, recovery and recycling[10]. These efforts incorporate advanced technological innovations alongside community engagement initiatives, particularly through green campaign strategies aimed at fostering environmental awareness and promoting sustainability.

Efficient waste collection, segregation, and recycling are pivotal to reduce its environmental impacts and promote resource recovery. Developed nations have adopted advanced technologies and policies to enhance waste management, while developing countries like Nigeria face challenges such as inadequate financing, limited scientific know-how, and low public awareness[11]. In Nigeria, the reliance on conventional methods like open burning and unregulated landfilling creates unhealthy environments, particularly in urban areas[7].

The escalating waste management crisis in Nigeria, driven by rapid population growth and inadequate systems, underscores the need for comprehensive and collaborative strategies. Higher educational institutions, as centres of learning and innovation, are uniquely positioned to address these challenges by cultivating environmentally responsible practices among students. Educational institutions, particularly Federal Colleges of Education (FCEs), as microcosms of wider society, has significant role to play in fostering environmental consciousness and shaping sustainable behaviours among students and staff. Proper waste sorting, simple reuse and recycling are typical waste management practices that can be inculcated into students as part of their responsive behaviour on campus and in the society at large.

Green campaign is organised and sustained initiative that focus on promoting environmentally friendly practices, behaviours, or policies. It is a strategic tool for influencing and modifying individual behaviours and attitudes toward sustainable waste management. However, to achieve meaningful behavioural change, it is essential to provide environmental awareness through

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various forms, including lectures, workshops, awareness talks, and sensitisation programmes. Such educational and enlightenment interventions are pivotal in promoting attitudinal shifts among students. Green campaign strategies, including environmental advertising, social media advocacy, eco-labelling, and incentive-based initiatives, have proven effective in developed economies for promoting waste sorting and recycling[1]. Green campaigns are implemented to promote sustainable consumption and waste management practices, fostering environmentally responsible behaviour among students, staff, and other campus stakeholders. To address waste management challenges in tertiary institutions, cultivating a culture of sustainability within the college community is essential, with a focus on encouraging responsible waste management behaviour among students.

According to the Theory of Planned Behavior (TPB), various pro-environmental actions, such as students' positive attitudes in waste management and recycling are influenced by their attitude towards the behaviour, subjective norms (perceived social pressure), and perceived behavioural control. Subsequently, students' positive attitudes, the influence of peer groups, and their confidence in managing waste significantly contribute to their actual participation in maintaining a clean environment. Strengthening these determinants can enhance students' engagement in sustainable waste practices within the campus environment. The use of environmental advertising initiatives, social media platforms, monetary and non-monetary incentives and eco-labeling initiatives on campuses would enhance students' understanding and participation in environmental sustainability, contributing to a conducive learning environment, as evidenced by practices in advanced economies[12]. In Nigeria, such strategies remain underutilised, particularly in the educational sector, where they could enhance students' knowledge and participation in sustainable waste management practices.

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Students' attitudes towards waste management entail the students' psychological tendencies expressed towards favourable or unfavourable waste management behaviour. This encompasses their beliefs, feelings, values, and predispositions regarding the importance of waste reduction, proper disposal, recycling, and environmental sustainability within the campus environment[13]. Students' attitudes significantly shape their perceptions of waste management activities, their motivation to engage in sustainable practices, and their commitment to adopting environmentally responsible behaviours. These attitudes are shaped by various factors including education, cultural norms, social influences, past experiences, and exposure to green campaign strategies. However, there is limited understanding of students' attitudes and engagement in waste management in higher educational institutions despite their potential to drive community-level change[14]. A critical barrier to this is the financial fragility of Federal Colleges of Education, where limited funds are stretched across multiple institutional needs, often relegating waste management infrastructure and green innovations to lower priority.

Despite the challenges, low-cost green campaign initiatives such as waste reuse education, waste separation, and recycling, composting, and digital awareness initiatives can still be employed to build a culture of sustainability[15]. The strategic deployment of green campaign programmes, such as environmental advertising, social media advocacy, eco-labelling, and incentive-based initiatives would promote a cleaner environment and enhance waste processing, resource recovery, environmental sustainability, and job creation in the waste management sector[16].

A significant research gap exists in understanding how students' attitudes interact with green campaign strategies to achieve efficient waste management in Federal Colleges of Education (FCEs), in Southwest Nigeria. Prior studies have often examined these factors mostly in universities and overlooked the unique characteristics of FCEs. This study investigates the role

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of green campaign strategies in promoting sustainable waste management within Colleges of Education (FCEs) in Nigeria, focusing on students' awareness, attitudes, and engagement in waste segregation, reuse, and recycling. Through integrating green campaign initiatives and stakeholder collaboration, the research seeks to advance Nigeria's progress toward the Sustainable Development Goals and address the impending environmental crisis.

1.2 Statement of the Problem

Waste mismanagement remains a pervasive challenge in Nigeria, contributing to environmental degradation and public health hazards, particularly within Higher Education Institutions (HEIs) such as Federal Colleges of Education (FCEs). Inadequate infrastructure, limited environmental education, inefficient waste disposal systems, and the absence of robust recycling programmes have led to widespread waste accumulation in urban areas and on campuses, compromising ecological integrity, institutional reputation, and contributions to global sustainability goals[1].

Despite the global drive toward sustainable development and the proven efficacy of green campaign strategies such as environmental advertising, social media advocacy, eco-labelling, and incentive-based initiatives in promoting sustainable waste management, these approaches remain underutilised in Nigeria's FCEs[16]. Effective deployment of such strategies could foster cleaner academic environments, enhance resource recovery, and generate socioeconomic benefits, including job creation and cost efficiencies[10]. However, limited stakeholder engagement, coupled with complacent attitudes among students and staff, hinders the adoption of these initiatives[14].

Financial constraints further worsen the problem, as FCEs prioritise competing institutional needs over waste management infrastructure and green innovations[8]. Yet, low-cost interventions like waste reuse education, recycling, composting, and digital awareness campaigns could

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cultivate a culture of sustainability[15]. The lack of deliberate policies and measurable outcomes from prior waste management efforts within FCEs reflects systemic weaknesses, evidenced by the scarcity of functional waste bins and prevalent littering, with students discarding items like sachet water bags and food wrappers in the lecturer rooms, shrubs or gutters.

A critical research gap exists in understanding how students' attitudes interact with green campaign strategies to influence waste management outcomes in FCEs. Previous studies have often examined these factors in isolation or overlooked the unique context of FCEs[12,13]. Consequently, empirical research is needed to explore these interactions and provide actionable recommendations for enhancing green campaign strategies by fostering positive student attitudes toward sustainable waste management in FCEs.

1.3 Aim and Objectives of the Study

The main aim of this study is to examine the impact of green campaign strategies and students' attitude on waste management in Federal Colleges of Education in Southwest, Nigeria. From this aim, the specific objectives are to:

i. identify the impact of environmental advertising on waste management in Federal Colleges of Education in Southwest, Nigeria;
ii. assess the extent to which social media platforms has influenced waste management of students of Federal Colleges of Education in Southwest, Nigeria;
iii. examine the impact of eco-labeling on waste management in Federal Colleges of Education, Southwest, Nigeria;
iv. assess the impact of incentive-based-Initiatives on waste management in Federal Colleges of Education, Southwest, Nigeria;

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v. investigate the moderating effect of students' attitude on the relationship between green campaign strategies and waste management in Federal Colleges of Education in Southwest, Nigeria.

1.4 Research Questions

i. Does environmental advertising (signage, billboard, fliers) have any impact on waste management in Federal Colleges of Education in Southwest, Nigeria?

ii. What specific role does social media platform (Instagram, Facebook, education blog) play in waste management practices of students of Federal Colleges of Education in Southwest, Nigeria?

iii. How does eco-labelling (colour-coded waste bins, institutional policies) affect waste management in Federal Colleges of Education, Southwest, Nigeria?

iv. Do incentive-based initiatives (cash and non-cash incentives) have any effect on waste management in Federal Colleges of Education, Southwest, Nigeria?

v. What is the moderating role of students' attitude (knowledge and awareness, perception and beliefs, behavioural intentions and actual behaviour) on green campaign strategies and waste management in Federal Colleges of Education, Southwest, Nigeria?

1.5 Hypotheses

The following null hypotheses are formulated to guide the study

H_1: Environmental advertising has no significant impact on waste management in Federal Colleges of Education, Southwest, Nigeria.

H_2: Social media platform does not significantly influence waste management in Federal Colleges of Education, Southwest, Nigeria.

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H_3: Eco-labelling does not have any significant effect on waste management in Federal Colleges of Education, Southwest, Nigeria.

H_4: Incentive-based initiatives do not have a significant impact on waste management in Federal Colleges of Education, Southwest, Nigeria.

H_5: Students' attitudes do not play a significant moderating role in the relationship between green campaign strategies and waste management in Federal Colleges of Education, Southwest, Nigeria.

1.6 Significance of the Study

The study, Green Campaign Strategies, Students' Attitudes, and Waste Management in Federal Colleges of Education in Southwest Nigeria, offers significant benefits to the students, staff, management, stakeholders, future researcher and the larger society by addressing environmental, economic, and policy dimensions of sustainable waste management in Federal Colleges of Education.

This study would benefit large population of students by promoting environmental awareness and foster positive attitudes towards responsible waste behaviour. It will also enhance a cleaner and conducive learning environment that would supports well-being and academic focus.

For academic and non-academic staff, the study will promote effective waste management which would build a culture of environmental responsibility and minimizes occupational health risks associated with poor waste handling and creates opportunities for professional development through training and involvement in sustainability initiatives.

College management and leadership would also benefits from improved waste practices that would subsequently lead to improved public image and credibility for the institution. The study would also contribute to cost reduction, enhance profitability, and improve operational efficiency

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through waste minimisation and recycling within the campus. Furthermore, it informs policy formulation and strengthens the implementation of comprehensive environmental management strategies within the institution.

Additionally, the study would provide valuable insights into collaborative opportunities for educational stakeholder such as government agencies, non-governmental organizations, donor bodies, and community partners on how to promote environmental sustainability within the college and its environment. By fostering sustainable waste management, stakeholders can contribute meaningfully to the achievement of global environmental objectives.

The study will explore the need for government policies to incentivize informal waste management operators, promoting waste reuse and recycling to minimize resource depletion and support environmental sustainability.

Future researchers will benefit from this study as it offers a useful starting point for exploring the relationship between green campaign, students' attitudes and environmental behaviour on waste management. The finding can serve as a reference for future studies in various fields such as environmental science, entrepreneurship education among others. The research will enrich the literature on green campaign strategies, students' attitudes, and waste management in FCEs, encouraging further studies on the role of educational institutions in fostering sustainable practices.

At the societal level, the study would help to develop environmentally responsible graduates who would act as change agents in their communities and workplaces for efficient waste management. This would help in reducing environmental degradation, lowering waste management cost and public health hazard associated with unmanaged waste, and encouraging innovations in waste-to-wealth initiatives. By promoting sustainable practices in FCEs, the study

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will contribute to Nigeria's sustainability agenda, addressing global challenges such as climate change and resource depletion.

Overall, this study addresses critical environmental, economic, and policy issues, providing actionable insights for students, staff, management, businesses, and policymakers to advance sustainable waste management and foster a greener future in FCEs.

1.7 Scope of the Study

This study examines the influence of green campaign strategies and students' attitudes on solid waste management in Federal Colleges of Education (FCEs) in Southwest Nigeria, specifically FCE (Technical) Akoka, Lagos; FCE Abeokuta, Ogun State; FCE (Special) Oyo, Oyo State; and FCE Iwo, Osun State. FCEs were chosen for this study because they play a key role in training future teachers; other higher educational institutions are excluded. FCEs operate under nationally regulated Minimum Standard guidelines, making the findings applicable to other federal colleges and adaptable for implementation in other states and private colleges of education. The study sample comprised 386 full-time NCE students, randomly selected from Year 1 to Year 3 across the participating colleges. Data were gathered through a structured quantitative survey and analysed with descriptive and inferential statistical tools.

The research focuses on four green campaign strategies: environmental advertising (signage, posters, and billboards), social media (Facebook, Instagram, educational blog), eco-labeling (color-coded waste bins, institutional policies), and incentive-based programs (financial and non-financial rewards) among many other components. The study emphasis is on solid waste management processes mainly of generation, separation, collection, and recycling, excluding hazardous and medical wastes. In addition, the study also investigates students' attitudes encompassing their knowledge, awareness, beliefs, perceptions, behavioral intentions, and actual

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actions in order to ascertain the moderating effects these attitudinal factors and green campaign strategies on campus waste management.

1.8 Limitations of the Study

This study is subject to several limitations that may affect the generalizability and depth of its findings. Firstly, the research is constrained by access to relevant and accurate data as many online resources on academic materials relate to higher educational institutions in advanced countries. Most available academic materials focus on universities in developed countries, while there are very few researches on waste management in Federal Colleges of Education, especially in Nigeria. Also, the study was restricted to Federal Colleges of Education in Southwest Nigeria. It did not include institutions owned by state governments or private individuals, this limit its generalization to Southwest and not to the whole of the country. Furthermore, the study only examined a few selected variables related to green campaigns, students' attitudes, and waste management, even though there are many other relevant variables that could have been explored. Additionally, the shortage of locally based empirical evidence limits both the depth of analysis and the applicability of the findings to higher education institutions within Nigeria.

1.9 Operational Definition of Terms

Actual Behaviour: Actual behaviour refers to the real actions that individuals carry out, especially after gaining knowledge or deciding to act. In the context of waste management on campus, it includes the visible and measurable things students do such as separating waste at the source, properly disposing of recyclables and non-recyclables, and taking part in campus cleaning activities.

Behavioural Intentions refer to a person's stated readiness or plan to engage in a specific behaviour in the future. Behavioural intentions in waste management refer to the degree to which

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an individual plans or commits to engage in environmentally responsible waste management such as reducing, reusing, recycling, or properly disposing of waste materials.

Eco-labelling: Eco-labelling serves as a tool for guiding people's choices towards environmentally friendly products that generate less waste, are recyclable, biodegradable, or made from recycled materials. Eco-labelling can be so used to instruct students on proper waste separation through colour-coded bin thus contributing to efficient waste management.

Educational Blogs – These are online platforms or articles designed to inform, educate, and engage readers on environmental issues, sustainability practices, and eco-friendly living, using accessible and interactive content. They can be used to explain academic content, reflect on classroom practices, discuss educational trends, or share helpful tools on environmentally responsible behaviour.

Environmental Advertising - The use of promotional messages and media to raise awareness, influence public perception, and encourage environmentally responsible behaviour on the adoption of green products and practices. This is when messages are **deliberately created and promoted** (through posters, billboards, flyers, social media, etc.) to influence people's attitudes and behaviours towards protecting the environment.

Environmental Awareness: It refers to the knowledge, understanding, and consciousness individuals or groups possess about environmental issues and their impacts. It reflects the extent to which people recognize the importance of sustainable practices and are willing to adopt behaviours that minimize dangers to the environment and promote ecological balance.

Environmental Education – This includes a structured process of teaching and learning about the environment and sustainable practices, aiming to equip learners with the knowledge, values, and skills to engage in responsible environmental behaviour. It helps build knowledge, skills, and

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value needed to develop awareness, foster positive attitude, and engage in responsible behaviour in areas such as managing waste sustainably.

Environmental Sustainability means the ability of an institution to maintain or improve the quality of the environment while meeting its social, economic, and developmental objectives.. It emphasizes the balance between meeting present needs and safeguarding resources and ecosystems for future generations

Green Campaign Strategy is a comprehensive effort aimed at raising awareness, driving behavioural change, and advocating for environmental causes. It involves organised and sustained programmes that focus on promoting environmentally friendly practices or behaviours such as efficient waste management.

Green Marketing - It is the process of producing and selling products based on their environmental benefits, and such products must be eco-friendly. It helps companies adopt more sustainable business practices and promote environmental benefits.

Higher Education Institutions (HEIs) – These include universities, polytechnics, and colleges that provide tertiary education and serve as hubs for innovation, learning, and social transformation.

Incentives-Based Initiative: These are rewards or motivational tools, either monetary or non-monetary, designed to encourage individuals or groups to engage in responsible behaviours. In waste management, such incentives include cash refund, discount and awards designed to promote active participation in waste reduction, recycling, proper disposal, and other sustainable practices to promote efficient waste management goals.

Social Media Platforms refers to a collection of digital applications that enable users to create, share, and interact with content in real-time, facilitating communication and information

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dissemination across diverse audiences. Facebook, Twitter, Instagram, WhatsApp, TikTok, etc, social media serve are powerful tools for raising awareness, educating students, promoting sustainable practices, and fostering a community of environmentally conscious individuals.

Solid Wastes: They are the non-liquid, non-gaseous residue of our manufacturing, construction, cooking, recreation, agriculture and other activities that are being used and discarded.

Solid Waste Management System: This refers to a combination of various functional elements associated with the management of solid waste. The system, when put in place, facilitates the collection and disposal of solid wastes in the community at minimal costs, while preserving public health and ensuring little or minimal adverse impact on the environment.

Students' Attitude: This refers to the collective beliefs, perceptions, feelings, and behavioural tendencies that students hold toward environmental practices. This includes their level of concern for environmental issues, their willingness to participate in green initiatives (such as recycling or proper waste segregation), and their sense of responsibility toward maintaining a clean and sustainable campus environment.

Students' Knowledge: This refers to the extent of information, understanding, and awareness that learners possess about a particular subject such as waste management and environmental sustainability. It includes both theoretical comprehension and practical insights gained through environmental education, personal experiences, and social interactions.

Waste Collection: Waste collection involves gathering waste materials from homes, schools, businesses, and other places to disposal or recycling centers. and transporting them to designated sites, such as transfer stations, processing plants, or disposal facilities.

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Waste Generation: Waste generation refers to the amount of waste produced by individuals, households, institutions, or industries over a period of time. Waste generation occurs during production, consumption, and the conversion of raw materials into finished goods.

Waste Management refers to the process of collecting, transporting, disposing of, or recycling waste materials in an institution. It includes solid waste reduction, waste collection, waste separation and recycling. Solid waste management

Waste Recovery: It refers to any waste management operation that diverts a waste material from the waste stream and results in a certain product with a potential economic or ecological benefit. Waste recovery techniques consist of waste-to-energy and waste-to-material techniques.

Waste Recycling: This is the process of converting waste into reusable objects to prevent the throwing away of potentially useful materials and reduce the consumption of fresh raw materials. Recycling is the key component of modern waste reduction techniques.

Waste Separation is the process of separating different types of waste materials at the collection point based on their characteristics in order to promote recycling and resource conservation.

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Chapter Two

Literature Review

This chapter presents the conceptual review, theoretical review, empirical review and summary of reviewed literature as well as summary of gap in literature.

2.1 Conceptual Review

2.1.1 An Overview of Waste

Wastes are materials that the initial user or buyer can no longer use for their intended purpose, whether in production, transformation, or consumption, leading to a desire to dispose them off. These materials are deemed valueless in their current context and may pose risks, potentially causing death, illness, injury, or environmental degradation if not properly managed during treatment, storage, transportation, or disposal[1]. For instance, improperly disposed chemical waste from industrial processes can contaminate water sources, while mismanaged medical waste, like used syringes, can spread infections. Some waste, such as expired pharmaceuticals, contaminated food, or banned substances, is legally required to be discarded due to its potential harm. However, the concept of waste is inherently subjective; what one individual, community, or industry considers useless may hold significant value elsewhere. For example, discarded electronics in one region may be refurbished and reused in another, transforming the waste into a resource of economic importance through recycling or upcycling initiatives[1].

Waste is generated across various stages of human activity, including the extraction of raw materials such as mining, processing of raw materials into intermediate or final products e.g., industrial byproducts like palm kennel shaft, consumption of goods such as packaging materials, and other activities such as construction or agriculture. Waste varies widely in scale and form,

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ranging from small, everyday items like an old toothbrush to massive objects like a decommissioned school bus or even entire dilapidated buildings. For instance, when an unsafe building is demolished to prevent collapse, the resulting debris concrete, steel, and wood, becomes waste, requiring careful handling to mitigate environmental or safety hazards[2]. This diversity in waste size and type underscores the complexity of waste management, as different materials demand distinct disposal or recycling methods.

Economic development, urbanisation, and rising living standards have dramatically increased both the quantity and complexity of waste generated globally. Industrial diversification, such as the growth of chemical manufacturing or electronics production, has introduced new types of waste, including hazardous substances like heavy metals or toxic sludge. Similarly, the expansion of healthcare facilities has significantly increased biomedical waste, such as surgical waste or radioactive materials from medical imaging that can lead to adverse effects on human health and the environment if not properly managed[3] . For example, improper disposal of biomedical waste can lead to the spread of infectious diseases, while hazardous industrial waste can contaminate soil and groundwater, affecting ecosystems and communities. The rise in consumerism, driven by higher disposable incomes, has further exacerbated waste generation, with single-use plastics and packaging materials becoming major contributors to the waste stream.

Municipal solid waste (MSW) includes domestic waste like food scraps, paper, institutional waste like office supplies, and commercial waste like restaurant leftovers. This category does not include specialised categories like industrial, biomedical, hazardous, electronic, lead-acid battery, and radioactive waste. The generation of MSW is directly proportional to economic development, lifestyle changes, accelerated industrial growth, and rural-to-urban migration[4]. In

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wealthier nations or urbanising regions, higher standards of living lead to increased consumption of goods, such as packaged foods, electronics, and disposable products, resulting in greater waste volumes. For instance, urban areas in developing countries often see a surge in plastic waste as populations adopt modern, consumption-driven lifestyles. Rural-to-urban migration also concentrates waste in cities, overwhelming existing infrastructure. The correlation between economic growth and waste generation is evident in cities like Lagos or Mumbai, where rapid urbanisation has led to sprawling landfills and strained waste management systems[4].

The high rate of resource consumption associated with modern lifestyles has unintended consequences, generating waste volumes that exceed the handling capacities of many urban governments and agencies. In many cities, uncollected waste piles up in streets or clogs drainage systems, causing sewage blockages, flooding, and environmental degradation. For example, plastic waste in waterways can harm marine life, while organic waste in landfills produces methane, a potent greenhouse gas contributing to climate change. The challenges in waste management underscore the urgent necessity for collaborative efforts by governments, the private sector, communities, institutions, and individuals to attain effective waste management.

Strategies such as efficient waste collection, waste segregation, recycling initiatives, composting, and stricter regulations on hazardous waste are critical to reducing environmental impact and promoting sustainability[5]. Collaborative initiatives, like public awareness campaigns and partnerships with recycling industries, can transform waste management from a burden into an opportunity for resource recovery and environmental protection.

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Table 2.1. Quantity of municipal solid waste generated in some cities across Nigeria (2024).

Cities	Population Estimation	Estimated kg/ capita/day	Tonne/ Day	Tonne/ year
Minna	513,000	0.68	349	127,385
Enugu	820,000	0.74	607	221,555
Birnin Kebbi	150,000	0.67	101	36,865
Lagos	15,388,000	0.92	14,157	5,167,305
Port Harcourt	2,120,	0.85	1,802``	657,730
Bauchi	697,000	0.68	3474	172,910
Abuja	4,026,000	0.95	3,825	1,397,125
Ibadan	3,649,000	0.72	2,627	958,855
Kaduna	1,259,940,	0.70	1107	404227
Onitsha	561,066	0.69	387	141304
Sokoto	734,000	0.68	499	182,135
Jos	1,001,160	0.73	731	266,815
Benin City	1,973,000	0.78	1,539	561,735

Source: Research's modified from [6, 7 & 8]

The table shows the population and waste generation for 2024 data for thirteen Nigerian cities. It reveals a clear interrelationship between population size, urbanisation, and waste generation, with Lagos (15.4 million, 14,157 tonnes/day) and Abuja (4 million, 3,825 tonnes/day) dominating due to high populations and per capita rates (0.92–0.95 kg/capita/day). Smaller cities like Birnin Kebbi (150,000, 101 tonnes/day) and Minna (513,000, 349 tonnes/day) generate significantly less waste (0.68–0.67 kg/capita/day), reflecting lower urbanisation and consumption. The data underscores the urgent need for enhanced waste management systems across urban cities, and calls for improved data collection in smaller cities to address potential underreporting and inform sustainable urban planning.

2.1.2 Classification of Waste

Waste can be categorised based on its composition or origin to guide effective management and disposal strategies. By composition, waste includes garbage (organic matter like food scraps), rubbish (non-putrescible items such as paper, plastics, and glass), ashes (combustion residues), large or bulky wastes (e.g., furniture or appliances), dead animals (carcasses requiring

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specialized handling), industrial wastes (manufacturing byproducts), mining wastes (tailings and overburden), agricultural wastes (crop residues or manure), military wastes (specialized defense-related waste), and hazardous solid wastes (toxic or reactive materials like chemicals[9]. Waste can also be classified based on the source of generation namely municipal solid wastes (urban household and commercial refuse), domestic waste (from households), industrial wastes (from factories), biomedical/hospital wastes (e.g., medical sharps and infectious materials), institutional wastes (from schools and offices), agricultural wastes (from farming activities), and commercial wastes (from businesses and retail) [10]. These classifications inform tailored waste management approaches, addressing environmental and health challenges in urban settings like Nigeria.

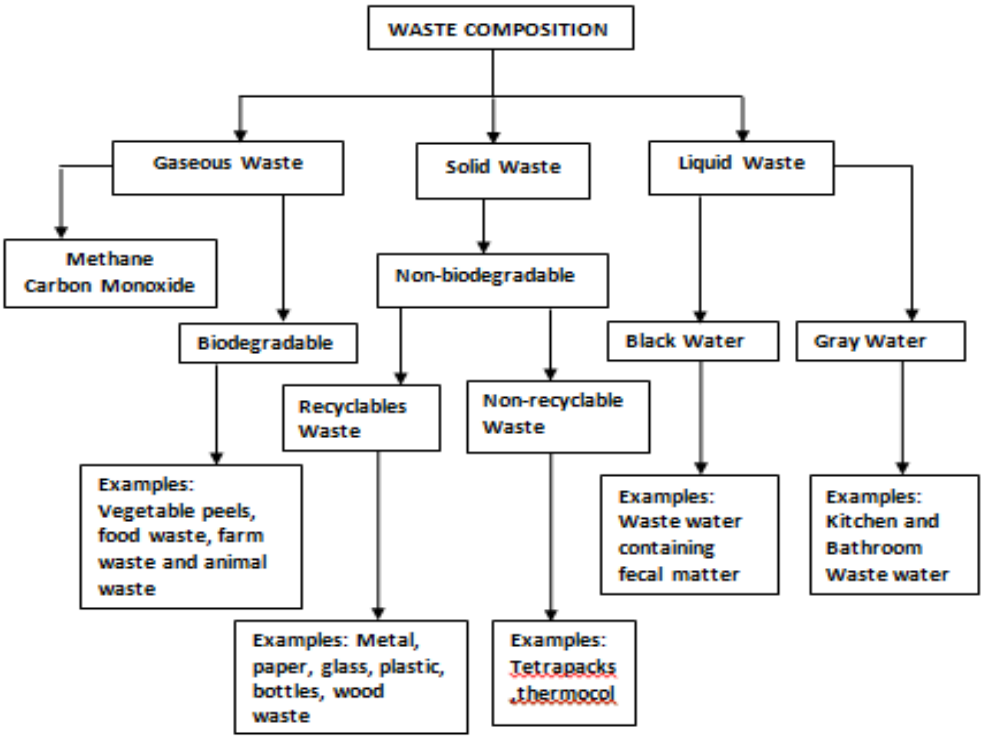


Fig. 2. 1 Waste Classification. Source[10]

Municipal waste can further be classified as biodegradable and non-biodegradable waste based on the ability of the waste to be disintegrated by natural processes of the environment; and hazardous and non-hazardous waste based on their potential to cause harm, injury and/or death to

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mankind and animal[9]. Of all the waste types, solid waste is the major issue posing a myriad of problems beyond the scope of various solid waste management systems in many developing countries, with Nigeria not being an exception. Solid wastes are the organic and inorganic waste materials such as product packaging, grass clippings, furniture, clothing, bottles, kitchen refuse, paper, appliances, paint cans, batteries, etc., produced in a society, which do not have any value to the first user again[10]. Knowledge of the sources and types of solid wastes, as well as the information on composition and the rate at which wastes are generated/ disposed is very essential for the design and operation of the functional elements associated with effective management of solid wastes.

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Table 2.2: Waste Generated in Campuses and Their Characteristics

Type	Characteristics	Recyclability	Items Considered	Source/Origin	Management Strategy(s)
Paper/card board	Combustible and biodegradable	Recyclable	Papers, tissue papers, cement bags, cartons, wrappers and cardboards.	hostels, lecture rooms, photocopying centres, offices and mini markets	Source separation Reusable Recyclable Energy Generation
Garbage	Organic, biodegradable; and combustible	Recyclable	leftover food, soups, sauces, bread, cakes, peel, and Spoilt fruits and vegetables.	Lecturer quarters and hostels, bread/cake production and consumption from kitchens and restaurants	Source separation: Compost formation, Energy generation, Feed for livestock
Plastics polythene and packaging foils	Not biodegradable, residue hardly decay	Recyclable	Plastic materials - caps, bags, bucket, spoilt plastic chairs, waterproof bags, automobile tyres, tubes, and ball pens.	Domestic and industrial wastes and may result from market, medical centres/hospitals and laboratories.	Recyclable
Metals/ Junks	Non - combustible nor biodegradable	Recyclable	Spoilt vehicles, automobile junks, cans, plates, buckets, spoons, plates, boxes, aluminium pots, scrap electronic equipment.	Hostels, guest houses, markets, and vehicles at the works department. Quarters and offices.	Source separation Recyclable Reusable
Ashes	Not combustible but biodegradable	Non-recyclable	Burnt wood, char coal, burnt leaves and paper.	Quarters, hostels, guest houses, and restaurants.	Soil treatment and enrichment
Rags	Combustible but not biodegradable	Recyclable	Abandoned cloths, Threads, cotton, wool and nylon	Domestic waste and may result from quarters, hostels and tailoring shops	Source separation Recyclable Reusable

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E-Waste	Some parts are combustible while others are non-biodegradable	Recyclable	Electric cables, printers, cartridges, phones accessories	Domestic and industrial wastes from electrical appliances/ parts from quarters, hostels and commercial areas	Source separation, Recyclable, Reusable
Leather	Combustible but not biodegradable	Recyclable	Shoes and bags made of leather	from quarters, hostels and commercial areas	Reusable and Recyclable
Sanitary waste	Non-biodegradable	Non-recyclable	Pads, diapers and cotton wool	from quarters and hostels	Hygienic disposal
Miscellaneous refuse	Some are Combustible but non-biodegradable	Some are recyclable, others non-recyclable	Hospital waste and waste from cottages, construction, and demolition rubble,	Hospital wastes and construction wastes.	Strategy is dependent on waste type.

Source: [11]

2.1.2.1 Implications of Waste Classification for Sustainable Management

Waste composition refers to the systematic process of identifying and quantifying different types of municipal solid waste (MSW), including paper, glass, plastics, organic waste, and others, generated within a specific time frame. This process is necessary to enhance proper solid waste management planning and informs decisions on waste collection systems, transportation logistics, energy recovery, materials reuse, and appropriate disposal methods. The quantity and composition of MSW vary significantly across different countries, regions, neighbourhood, and even households. These variations are primarily influenced by factors such as income levels, education, consumer habits, cultural practices, and the prevailing socioeconomic conditions[12]. In many African cities, including those in Nigeria, the bulk of solid waste generated is organic and biodegradable. With the application of appropriate technologies, these waste streams can be

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converted into value-added products, like waste to wealth, thereby promoting circular economic models as practised in advanced economies[13].

Biodegradable organic waste includes wastes such as food scraps and garden debris which can be converted into useful products like composts and biogas. In recent times, a growing number of initiatives have been introduced to adopt decentralised waste management strategies such as small-scale composting and anaerobic digestion from food waste. These technologies support energy generation, reduce landfill dependency, and create marketable outputs like organic fertilisers. In 2019, Blue Box Initiative and Household Organic Waste Separation were implemented by Lagos Waste Management Authority (LAWMA) to promote household-level waste segregation and recycling. Under this initiative, designated recycling collection bags were distributed to residents for the separate storage of recyclable and organic waste[14]. A pilot study conducted in selected districts of Surulere and Victoria Island indicated that over 60% of domestic waste was organic, comprising largely of food residues, vegetable scraps, and yard trimmings. These findings justified the establishment of pilot composting stations to process organic fractions into compost for urban farming.

Similarly, in the Federal Capital Territory, the Abuja Environmental Protection Board (AEPB) in collaboration with a private sector partner initiated a project at the "Gosa Dumpsite" implement an initiative for conversion of organic waste into biogas and organic fertilizer; the project processes waste collected from major markets, abattoirs, and restaurants. The anaerobic digestion system produces renewable energy used for on-site electricity, and the resultant digestate is packaged as agricultural fertiliser. The project has not only reduced methane emissions from organic waste decomposition but has also created employment opportunities for local waste pickers[15].

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Waste composition analysis is the physical process of sorting, weighing, and categorising different types of waste to determine their proportion within a given stream. In tertiary institutions across Nigeria, such as the University of Ibadan and the University of Lagos, waste audits frequently reveal that organic food waste, plastic bottles, and paper constitute the highest volumes of waste generated, primarily from hostels, cafeterias, and lecture halls[16]. These insights inform campus-based waste reduction initiatives and necessitate partnerships with recycling companies.

2.1.3 Overview of Waste Management

Waste management is a multidisciplinary field encompassing the generation, storage, collection, transfer, transportation, processing, and disposal of solid or gaseous wastes. It adheres to best practices in public health, economics, engineering, conservation, aesthetics, and environmental considerations to ensure sustainable outcomes and protect public health[17]. Effective waste management involves planning, coordinating, organising, executing, and controlling waste-related activities to enhance environmental stability, promote public health, and unlock economic value from waste through recycling, reuse, and energy recovery. Globally, it is critical to address the environmental impacts of urbanisation, with innovative approaches like waste-to-energy systems and circular economy models gaining traction[12].

The sustainable management of solid waste poses significant economic, social, and environmental challenges, particularly in developing nations[18]. In Nigeria, commonly use municipal waste disposal methods such as open dumping, open burning, incineration, unregulated landfills, composting, and disposal into drainage channels, streams, and rivers are outdated, inefficient and hazardous. These practices create health hazards, pollute water and air, and fail to manage the high volume of waste generated in urban and semi-urban areas, making

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SWM a major challenge[16]. For example, in cities like Lagos and Abuja, uncollected waste often clogs drainage systems, exacerbating flooding and spreading diseases[12]. Moreover, lack of modern infrastructure, such as sanitary landfills or advanced recycling facilities, compounds these issues, leading to environmental degradation and greenhouse gas emissions from decomposing organic waste.

Municipalities in developing countries, including Nigeria, often prioritise industrial and economic development over effective waste management, overlooking waste's potential as a resource. This gap has been partially addressed by the informal sector, including private enterprises and waste pickers, who collect, sort, and recycle waste to earn a living[17]. Their contributions are significant, diverting substantial waste volumes from landfills and fostering grassroots recycling initiatives. For instance, waste pickers in Lagos recover plastics and metals, supplying materials to local recycling industries[12]. However, this informal sector operates without formal recognition or support, limiting its scalability and safety. Integrating their efforts into formal SWM systems could enhance efficiency and sustainability.

2.1.3.1 History of Waste Management in Nigeria

Waste management in Nigeria has evolved from rudimentary communal practices to structured, though often inadequate, systems shaped by historical, colonial, and post-independence developments[18]. In pre-colonial times, urban communities in northern, western, and southern Nigeria were governed by local chiefs who maintained sanitation through organised systems. Women and households took turns sweeping public spaces, disposing of waste in surrounding bushes where it naturally decomposed[19]. These practices, rooted in communal responsibility, ensured basic cleanliness without formal infrastructure.

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During British colonial rule (1800–1960), environmental conservation was largely neglected, with economic development prioritised over sanitation[20]. The Public Health Act of 1909 introduced sanitary inspectors ("wole wole") to enforce household cleanliness, imposing fines for non-compliance[19]. The Township Ordinance No. 29 of 1917 classified urban settlements into three categories, but sanitation remained a low priority[20]. The Town and Country Planning Ordinance of 1947 recognised the need for separate administrative bodies for urban planning, yet failed to address emerging waste management challenges effectively[21].

During the Post-independence era, the Local Government Ordinances of 1950 and 1954 empowered traditional leaders (Emirs, Obas, Igwes) to oversee sanitation in urban and rural areas[22]. However, the absence of a national environmental policy led to ad-hoc responses to waste issues. A pivotal moment came in 1987 with the illegal dumping of toxic waste by an Italian company in Koko, Delta State, prompting the Harmful Waste Decree 42 of 1988 and the establishment of the Federal Environmental Protection Agency (FEPA)[22]. This incident marked Nigeria's first significant step toward formal environmental governance, laying the foundation for modern waste management policies.

2.1.3.2 Statutory Regulations Guiding Waste Management in Nigeria

The National Policy on Environment, launched in 1989, established a framework for environmental governance, emphasising sanitation and waste management as integral to sustainable development[23]. Administered initially by FEPA (Decree No. 58 of 1988, amended 1992), this policy set standards for environmental protection and waste management by prohibiting the dumping of hazardous waste on Nigerian land or waters, prescribing penalties for violations. The National Guidelines and Standards for Environmental Pollution Control (1991)

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mandated pollution control measures for industries, while the National Effluents Limitations Regulations (1991) required effluent treatment and set discharge limits[23].

In 2007, the National Environmental Standards and Regulations Enforcement Agency (NESREA) Act repealed the FEPA Act, becoming the primary regulatory framework for solid waste management[24]. NESREA enforces environmental standards, promotes sustainable waste practices, and collaborates with stakeholders to develop regulations[24] and the National Environmental Regulations (Sanitation and Waste Control) S.I. No. 27 of 2009 further supports sustainable sanitation practices to minimise pollution[24]. The Federal Ministry of Environment (FME), established in 1999 and absorbing FEPA's functions by 2015, oversees national environmental policy, while State Environmental Protection Agencies (SEPAs) and local government health departments manage regional waste issues[24].

Despite these frameworks, enforcement remains a challenge. The Nigerian Police together with NESREA struggle with limited capacity and coordination to achieve effective implementation of environmental laws for proper waste management. Robust enforcement of environmental laws is critical for sustainable waste management, as weak compliance undermines progress. For instance, illegal dumping persists in urban areas like Lagos, where waste overwhelms collection systems, clogging drains and exacerbating flooding are common occurrences during the early years with little improvement recorded recently[26]. To complement NESREA, agencies like the Federal Ministry of Environment (FME), Niger Delta Development Commission (NDDC), and State Environmental Protection Agencies (SEPAs) promote waste management initiatives[26]. However, financial constraints and poor management often limit their effectiveness like other agencies in the country. Lagos State has pioneered commercialised waste management through the Lagos Waste Management Authority (LAWMA), which integrates private-sector

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partnerships like the Blue Box Program to enhance recycling, in contrast with other states that treat waste management as a social service, straining budgets and infrastructure[27]. This disparity underscores the need for policy reforms to encourage private investment and community participation across Nigeria.

Globally, waste management is a pressing 21st-century challenge due to increasing waste volumes driven by urbanisation, industrialisation, and population growth[25]. In Nigeria, these factors, combined with poverty, low environmental awareness, and inadequate governance, exacerbate the problem[26] thereby sustaining the widespread use of the traditional disposal methods such as open dumping and burning, which continue to pose significant health and environmental risks[12, 26]. Innovative approaches, such as integrated solid waste management (ISWM), waste-to-energy systems, and green campaign strategies, are critical for a sustainable environment and safe living[13]. The ISWM emphasises waste reduction, reuse, and recycling, aligning with circular economy principles[12]. Community-driven initiatives, like waste picker cooperatives, and public awareness campaigns can further transform waste into a resource, reducing landfill dependency[27] and fostering economic opportunities[28] and such practices should be improved upon.

2.1.3.3 Benefits of Effective Waste Management

Efficient waste management is essential for the sustainable development of communities, environmental protection, resource conservation, and economic growth. With the increasing pace of urbanisation and industrialisation, waste management has emerged as a central concern in contemporary research, policy formulation, and sustainable development discourse[29]. The numerous benefits it offers to society include the followings:

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Environmental Protection - Effective waste management safeguards the environment by minimizing pollution, mitigating climate change, and preventing land and water contamination. It promotes cleaner surroundings and helps preserve biodiversity through the adoption of eco-friendly disposal and recycling practices.

Reducing Pollution - Proper waste management significantly reduces air, water, and soil pollution. For instance, the mismanagement of plastic waste often leads to microplastic pollution, severely impacting the aquatic ecosystem[30].

Mitigating Climate Change- Effective waste management mitigates climate change by reducing methane emissions from landfills and supporting recycling and composting practices[31]. Open burning, a common practice in many developing nations, can be drastically curtailed through structured waste strategies. Moreover, promoting sustainable waste-to-energy technologies contributes meaningfully to global greenhouse gas reduction goals.

Environmental Conservation: Waste management helps prevent pollution of air, water, and soil by regulating the disposal and treatment of hazardous and non-hazardous waste thus protecting the environment as well as lives of animals and plants within the environment. This is especially important in light of increasing industrialisation and urbanisation [31].

Resource Conservation: Through recycling, reuse, and waste reduction strategies, effective waste management conserves natural resources and minimizes the depletion of raw materials. It encourages sustainable production and consumption patterns, ensuring that valuable resources are efficiently utilized for future generations

Resource Recovery: Waste management has evolved to prioritise resource recovery through recycling and waste-to-energy technologies. Efficient waste management includes recycling and resource recovery, reducing the need for raw materials and thus conserving natural resources[32].

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Circular Economy: A well-managed waste system can support the transition to a circular economy, where resources are reused and recycled rather than being disposed of. Reuse and repair are essential in the development of the circular economy. The reuse of products and materials is more beneficial as it retains a product's inherent value by keeping it in use for longer[33]. Efficient waste management facilitates conservation of space and minimises the need for new landfill sites, helping to preserve land for other purposes. The concept of a circular economy, where products are designed for reuse, recycling, and repair, is gaining momentum.

Economic Benefits: Proper waste management contributes to economic development by generating employment opportunities in recycling, collection, and processing sectors. It also reduces government expenditure on environmental remediation and supports a circular economy through the recovery and reuse of valuable materials.

Job Creation: The waste management sector provides employment opportunities in waste collection, recycling, and disposal. Waste management is a major source of income in most low-income countries where many scavengers scout for materials recovery in the waste stream[34].

Cost Savings: Effective waste management can lead to cost savings for municipalities and businesses through reduced disposal costs and potential revenue from recycling. The higher the heap of waste, the higher the cost involved in disposing such, hence waste minimisation and management help to cut down waste cost as recycling and composting can be cheaper than land filling or incineration.

Energy Generation: Waste management enhances the useful life of materials by recycling, composting, and recovering energy through thermal processes such as incineration or methane capture at landfills. The energy produced during thermal treatment or methane combustion can be used to generate electricity or other power, thereby creating a synergistic loop[35]. Waste thus serves as an alternative source of energy at a cheaper rate.

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Sustainable Waste Management Practices for Circular Economy – Efficient waste management contributes greatly to the global call for circular economy. It emphasises the need for resource efficiency and reduction of waste generation through recycling and reusing materials. European Environment Agency (EEA), 2020 reports that through proper collection of municipal solid waste, very important metals and other valuable sources can be recovered and used in new products, thus achieving positive environmental impact and circular economy[36].

Community Engagement and Well-being: Encouraging public participation and awareness in waste management is vital. Local initiatives and community-driven waste reduction programs are gaining traction in both urban and rural settings to enforce a cleaner environment towards the well-being of all inhabitants of the community. Clean and well-managed neighbourhoods promote a sense of pride among residents and also serve as centres for tourists and businesses to boost the local economy.

Public Health: Proper waste management prevents the spread of diseases by managing the disposal of medical, electronic, and hazardous waste. The effective management of medical waste is helpful in curbing the spread of contagious diseases. For instance, the World Health Organisation (WHO) in 2020 prepared a report titled "Safe management of wastes from health-care activities in the context of the COVID-19 pandemic," to provide guidelines on managing healthcare waste during the pandemic[37]. The report provides useful hints in handling oh high volume of waste generated during the period, particularly the PPE.

Innovation and Technology: Recent advancements in waste management include the use of Internet of Things (IoT) sensors for waste monitoring, data analytics for optimising collection routes, and the development of new recycling technologies. Innovative techniques in material

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science and engineering have greatly facilitated the development of sustainable alternatives to single-use items, fostering waste reduction and wealth creation[38].

2.1.3.4 Methods of Solid Waste Management

Waste management involves the processes of collection, transportation, processing, recycling, and disposal of waste materials to in a manner that will reduce the negative impact of such wastes on the environment, the ecosystems and public health[39]. Various methods have been developed and implemented over time, categorised as follows:

Waste Minimisation: The simplest and most cost-effective method, waste minimisation focuses on reducing waste at its source. Practices include using reusable products, optimising packaging, and improving production efficiency. Source reduction relies on product design, consumer education, and sustainable practices to lower waste generation[39].

Landfills: Landfills are engineered sites for burying and isolating non-recyclable and non-compostable waste. Modern landfill management includes careful site selection, liner installation, leachate collection, and monitoring to prevent environmental contamination[40]. However, landfills pose long-term risks, such as groundwater pollution and greenhouse gas emissions.

Incineration: Incineration involves burning waste at high temperatures to reduce its volume and, in some cases, generate energy through waste-to-energy (WTE) facilities. WTE systems produce electricity or heat in controlled environments[41]. While effective for municipal and industrial waste, incineration can cause air pollution and ash disposal issues if not properly managed.

E-Waste Recycling: Electronic waste (e-waste) includes discarded electronics containing valuable and hazardous materials. Specialised recycling facilities dismantle e-waste to recover

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reusable components and safely dispose of hazardous substances, with refurbishing as a sustainable option[42].

Composting: This involves the natural process of decomposting of organic waste, such as food scraps and yard waste, into nutrient-rich soil for farming and gardening. It reduces landfill-bound organic waste and enhances soil health. Vermicomposting, a specialised form, uses specific earthworm species to convert organic waste into nutrient-rich biofertilizer, used for boost agricultural production, thus offering significant economic and environmental benefits[43].

Waste Auditing: Waste auditing systematically assesses an organisation's waste generation and management practices to identify opportunities for reduction, recycling, and sustainability. By analysing waste types, quantities, and disposal methods, audits help recover valuable materials, reduce landfill-bound biodegradable waste, and lower environmental and financial costs[44].

Other waste management methods exist, tailored to specific waste types or regional needs. The choice of method depends on factors such as waste composition, infrastructure, technological capabilities, environmental regulations, cost, and sustainability goals[45]. Integrated waste management systems often combine multiple methods to optimise resource recovery and minimise environmental impact.

2.1.4 Components of Waste Management

Effective waste management is essential for ecological, economic, and social sustainability in urban areas. A well-designed waste management model protects public health, preserves ecosystems, ensures efficient budget use, creates jobs, and enhances aesthetics[46]. Key functional elements include:

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2.1.4.1 Waste Generation

Waste generation occurs during production, consumption, and the conversion of raw materials into finished goods, originating from sources such as households, commercial areas, industries, institutions, and municipal services like street cleaning (See Appendix 4). Waste generation rates and compositions vary globally and within countries, influenced by factors such as industrialisation, climate, and socioeconomic development[48]. Developing nations typically produce municipal solid waste (MSW) with higher organic content (40%–60% biodegradable) compared to developed nations, where recyclable and inert materials are more prevalent[39,49] .

Waste generation is a critical global environmental challenge, driven by population growth, urbanisation, changing consumption patterns, and economic development[48]. These factors contribute to a significant rise in waste production, impacting human health and ecosystems[49]. The World Bank projects that global MSW will increase from 2.01 billion metric tons in 2016 to 3.40 billion metric tons by 2050, with developing nations experiencing a sharper rise in per capita waste generation due to economic growth[50]. Effective waste management is essential to mitigate these environmental and societal challenges.

2.1.4.1.1 Factors Affecting Waste Generation

Population Growth: The Increasing global population drives higher waste generation. The United Nations projects the world's population will reach 9.7 billion by 2050, with urban areas facing intensified waste management challenges due to higher waste concentrations[51]. As more people inhabit urban areas, the concentration of waste in these regions also rises. This calls for concerted efforts by all stakeholders to avoid the impending epidemics from waste mismanagement.

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Urbanisation: Urbanisation is occurring at an unprecedented pace. More people are moving to cities and adopting urban lifestyles, which often involve higher levels of consumption and waste generation. Rapid urbanisation increases consumption and waste production. By 2050, large percentage of the global population is expected to live in urban areas, aggrevating municipal solid waste (MSW) volumes in cities[50,51].

Consumerism: Rising consumerism, driven by single-use products, online shopping, and fast fashion, accelerates waste generation. Disposable goods and convenience-oriented lifestyles significantly contribute to MSW[39].

Economic Development: Economic development increases income levels and purchasing power, leading to greater consumption and waste. This trend is pronounced in developing nations, where per capita waste rises with economic growth[49].

Packaging: The growing packaging industry, particularly single-use plastics for e-commerce and convenience, contributes significantly to waste. Plastic packaging waste is a major environmental concern in developing countries like Nigeria[52].

E-Waste: The production and demand of state-of-the-art electronics, in collaboration with inexpensive gadgets, also account for a large quantity of e-waste. The rapid turnover of short-lifespan electronic devices and rising consumer demand for new technology drive significant growth in electronic waste (e-waste), with global e-waste reaching 59.1 million metric tons in 2022. Global e-waste reached 59.1 million metric tons in 2022, driven by rapid gadget turnover[53].

Food Waste: Food waste, a significant MSW component, increases with population growth and changing consumption patterns. About one-third of the world's food production is lost or wasted each year, complicating recycling because of its perishable nature[54].

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Fast Fashion: The fast fashion industry's rapid production of inexpensive clothing generates textile waste, as consumers frequently discard clothing to follow trends[39].

Tackling the above issues requires the application of comprehensive strategies such as waste minimisation, recycling, sustainable consumption, and behavioural changes. Effective waste management, starting from generation to disposal, encompasses reduction, reuse, recycling, collection, transport, treatment, and disposal to minimise environmental impacts[46]. Governments and organisations should enforce policies, promote circular economy initiatives, and invest in innovative technologies to foster sustainable waste management [48]. Consequently, implementing sustainable waste management practices, promoting circular economy initiatives, and investing in innovative technologies coupled with legal regulatory are crucial steps towards a more sustainable future.

2.1.4.2 Waste Collection

Waste collection involves gathering municipal solid waste (MSW) and transporting it to designated sites, such as transfer stations, processing plants, or disposal facilities. Transfer stations serve as intermediate points where waste from smaller vehicles is consolidated into larger ones and often sorted for recycling or disposal. Collection efficiency depends on factors like the number and placement of containers, collection frequency, service types, and routing strategies[8]. In developing countries like Nigeria, collection systems vary from municipal services to private and informal operations, such as wecyclers and informal waste collectors (locally known as mallam pushers" in Lagos[55]. However, limited and old collection vehicles frequently break down, hindering sustainable waste management efforts[56]. Optimising collection points and implementing colour-coded bins for waste separation can enhance segregation, streamline upcycling, and boost recycling rates.

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2.1.4.1 Waste Storage

Waste storage is another major component of waste management, as waste is not always collected at the point or time of generation, rather they are kept at a spot awaiting the right time for collection. Proper storage is therefore necessary to prevents contamination of biodegradable and hazardous materials, particularly in residential areas where heterogeneous waste accumulates. Common storage options include plastic containers, household dustbins, repurposed oil drums, and large bins for institutions, commercial areas, or service depots[57]. For sustainable waste management, waste must be stored appropriately and transported efficiently to recycling, recovery, or disposal facilities. Inadequate storage and collection systems worsen logistical challenges, especially in developing countries where municipalities allocate 75–95% of waste management budgets to collection but achieve only 50–70% MSW collection rates[56]. Efficient storage, collection, and transportation are essential for successful waste management Initiatives.

2.1.4.2.2 Types of Solid Waste Collection Systems

Waste collection is a cornerstone of municipal solid waste (MSW) management, aiming to collect source-separated waste on a regular base and cost-effective manner to facilitate sorting, reuse, and recycling[57]. The choice of collection system depends on the effort required from waste generators and collection agencies, with distinct challenges in developing countries like Nigeria:

Community Bins: Widely used in Nigeria and other developing countries, community bins involve large, centrally located storage sites that simplify collection planning. However, these sites often lead to indiscriminate dumping, scavenging by humans and animals, and waste scattering during transfer, increasing street cleaning costs[50,56]. To improve efficiency, bins should

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be strategically placed for generator convenience and designed to contain waste securely, facilitating secondary collection.

Block Collection: In this system, a collection vehicle follows a regular route, e.g., two to three times weekly and stops at street intersections, signaled by a bell. Residents bring their waste containers to the vehicle for emptying. Variations include municipalities providing standardised containers or bags, though cost considerations are critical. In urban Nigeria, inconsistent vehicle schedules and frequent breakdowns disrupt this system, posing risks and reducing efficiency[32,56].

Curbside Collection: This method requires residents to place standardised containers on the curb at scheduled times, with containers retrieved after emptying. Inconsistent container use (e.g., plastic bags, baskets, or loose piles) leads to waste scattering by animals or wind, while containers may be stolen or left out, complicating collection. Informal waste pickers often sort through curbside waste, further disrupting the process. This system is common among private or informal collectors in Nigeria, where collection rates often range from 50–70% due to logistical challenges[55,56.]

Door-to-Door Collection: Requiring minimal householder effort, door-to-door collection involves collectors retrieving waste directly from each household, emptying containers, and returning them. While labour-intensive, this system is viable in low-income countries like Nigeria, where labour costs are low. Its effectiveness depends on reliable scheduling and sufficient manpower, though walking between households can reduce efficiency[58].

2.1.4.2.3 Types of Waste Collection Vehicles

Waste collection vehicles are key actors in municipal solid waste (MSW) management, particularly in urban settings with diverse infrastructure and road conditions. The following are common types of waste collection vehicles used globally and in contexts like Nigeria:

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Compact Garbage Collection Trucks - In many developing countries with deteriorated and congested roadways necessitate the use of compact garbage collection trucks. These vehicles are equipped with modern technologies, such as waste compactors, to maximise collection capacity by compressing waste, allowing for efficient transport. Recent advancements include the development of electric and hybrid garbage trucks to reduce greenhouse gas emissions and air pollution (See Appendix 4). The adoption of electric vehicles in Nigeria, including potential applications in waste management, is being explored to support sustainable urban development and reduce carbon emissions, aligning with global sustainability goals [59]. These innovations aim to address environmental concerns while maintaining operational efficiency in constrained urban environments.

Waste Recycler Truck - In urban centres across Nigeria, such as Lagos, open trucks are frequently used for waste transport. These trucks are often overloaded, leading to spillage on roads and emitting strong odours during transit to dumpsites. This method poses significant public health and environmental challenges, including air pollution and road littering (See Appendix 4). Efforts to modernise waste collection in Nigeria include transitioning to covered, mechanised vehicles to mitigate these issues.

Open Waste Trucks

In informal waste collection systems, particularly in Nigerian cities, cart pushers use hand-pulled carts for house-to-house waste collection. These carts, often rudimentary, are operated by informal workers who charge a fee for their services (See Appendix 4).

Cart pushers also contribute to resource recovery by sorting recyclable materials, such as plastics and metals, during collection. In Lagos, the informal waste economy includes over 5,000 cart pushers, waste pickers, and recyclers, whose efforts support sustainable waste management

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despite limited formal recognition[62]. Although banned in 2018 under the Cleaner Lagos Initiative, cart pushers remain active in areas where municipal waste services are inadequate.

Carts for Waste Collection - Lagos generates approximately 10,000 tons of waste daily, nearly three times the waste output of Ghana[50]. Cart pushers play a vital role in managing this volume, particularly in underserved areas. Despite the 2018 ban, their services persist due to gaps in municipal waste collection capacity. These informal workers contribute to waste segregation and recycling, supporting Lagos' vision for a cleaner and more sustainable urban environment.

2.1.4.3 Waste Separation

Waste separation, or segregation, is the process of categorising waste based on its type, composition, and potential for recycling or treatment. It is a cornerstone of sustainable waste management, enabling resource recovery, reducing landfill use, and minimising environmental impacts[63]. Effective segregation at the source by the households, institutions, or businesses ensures that waste streams, including organic waste, paper, plastics, and metals, are managed appropriately.

In settings like the University of Lagos, the use of colour-coded, labelled bins facilitates waste separation at the point of generation[44]. For example, organic waste can be composted, while recyclables like paper, cans, and plastics are directed to recycling facilities. Proper segregation enhances the efficiency of downstream processes, such as recycling and waste-to-energy initiatives, and reduces the environmental footprint of disposal.

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2.1.4.3.1 Contributions of the Informal Workers n Waste Separation

The informal waste sector, comprising waste pickers, cart pushers, itinerant waste buyers/collectors (IWBs/IWCs), and scrap dealers, plays a significant role in Nigeria's waste economy. Waste pickers salvage recyclable materials such as scrap metals, plastics, glass, paper, electronics, textiles, and construction debris from dumpsites and urban refuse points. These materials are sorted and sold to scrap dealers, who clean and process them before supplying recycling industries[61]. This informal value chain contributes economic value to waste and supports livelihoods form many people from marginalised groups (See Appendix 4).

By integrating informal workers into formal waste management systems, cities can improve waste recovery rates and promote sustainable practices. For instance, sorted organic waste can be used for biofuel production, while plastics and metals can be recycled into new products. Recognising and supporting informal workers through training, access to equipment, and policy inclusion can enhance their contribution to achieving waste management goals[50] and employment opportunities. The primary task of waste recovery in Nigerian cities is being done by the waste pickers who rummage urban refuse dumps to salvage discarded materials such as scrap metals, plastics, bottles, paper, electronic and electrical equipment, household furniture, textile material, wood, construction and demolition wastes and separate accordingly before selling them to earn a living[64].

2.1.4.4 Waste Recycling

Recycling is the process of changing waste into new product and reducing the consumption of fresh raw materials. Recycling is a key component of modern waste reduction and is the third component of the waste hierarchy. Recycling converts waste materials into new products, decreasing the need for virgin resources, reducing landfill dependency, and minimising the

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environmental impacts of waste disposal, such as greenhouse gas emissions and pollution[63]. Common recyclable materials include paper, glass, plastics, and metals, are collected, processed, and repurposed into products such as packaging, containers, cooking utensils, and construction materials.

In Nigeria, recycled plastics are used in applications like greenhouse covers, mulches, films, bags, and containers. Recycled paper is converted into new office paper, while metals are repurposed into household items like cooking pots. Additionally, materials like foamed polystyrene and cellophane are recycled into products such as tires and footwear. These processes conserve natural resources, reduce landfill dependency, and lower greenhouse gas emissions. In a laudable project, Nigeria has taken a significant step toward enhancing its waste management capabilities with the commissioning of locally fabricated Reverse Vending Machines (RVMs). These machines will be deployed across 25 strategic locations in Abuja, Federal Capital Territory (FCT), as part of a collaborative initiative between the United Nations Industrial Development Organization (UNIDO) and the Abuja Environmental Protection Board (AEPB) as advancement in Nigeria's efforts to reduce plastic waste, enhance collection through digital technology, boost recycling rates, and promote a circular economy[65].

The informal sector significantly contributes to recycling by collecting and sorting materials for sale to recycling industries. However, challenges such as inadequate infrastructure and lack of formal recognition hinder the sector's potential. Strengthening partnerships between formal and informal systems, alongside investments in recycling facilities, can enhance waste recovery and support Nigeria's circular economy goals[50].

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Table 2.3 Recyclables and their uses

Solid Wastes	Uses
Paper	Newspaper, packaging materials, crate of eggs, tissue paper
Plastics (various types) PET/1.	Bottles, milk jugs, pipes, thin film packing, battery casings
Hair, bristles, wool, feather	Brushes, lanolin, fertiliser, wigs, blankets, carpets, fabrics, yarns, pillows, mattresses
Hoofs, horns	Buttons, combs, hair pins, novelties, washers, glue, gelatin fertiliser
Bones	Buttons, cutlery, handles, ornaments, glue, gelatin, bone meal
Hides, skins, feet	Horse whips, seats, belts, handbags, book binding, shoes, gloves, Oil,
Intestines	Stockfeed, surgical ligature, musical (guitar) strings, tennis strings, sausages and Putty containers
Ruminal contents, excreta	Methane gas, manure
Fats / Cholesterol	Soap, machine oil, candles, leather dressings, cartilage
Glands and special organs	Pharmaceutical products (insulin, gallstones, corticosteroids), Pepsin
Aluminum	Soft drink and beer cans, cutlery
Glass	Various glass products, decorative pieces, and brick aggregates
Yard wastes, organic wastes	Compost, biogas
Construction wastes	Filling materials
Batteries	Recycling for lead, copper, plastics and reuse
Tyres	Road paving, building, and shoe soles

Source[66]

2.1.4.4.1 Types of Waste Recycling -

Human societies have used waste recycling for centuries. Throughout these centuries, they have kept inventing new methods to recycle different types of waste (See Appendix 4). Some of the waste recycling types evident in present-day societies include e-waste, bio-waste, plastic, fashion apparel, radioactive waste, paper recycling, etc. It positively influences human societies to reduce their carbon footprint and regulate waste effectively[67].

i. **Plastics Recycling:** Plastic containers and other household products are increasingly recycled, and, like paper, these must be sorted at the source before processing. Plastic recycling serves as a solution to environmental pollution. Plastics are made up of polymers and resinous, making it

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difficult for them to decompose else they are melted down to make other products (See Appendix 4). Most importantly, plastic containers like water bottles, beverage containers, milk bottles, soap boxes, etc., are recycled. Various thermoplastics may be remelted and reformed into new products. Thermoplastics must be sorted by type before they can be remelted and are ground or shredded for use as fillers or insulating materials**.**

ii. Paper Waste Recycling The paper industry also contributes to the total municipal waste generated by institutions and households. Over the last few decades, paper waste has increased significantly, posing a severe threat to the environment and the sustainable development goal of waste management. Most of the paper waste collected from educational institutions, industries, and households is sent to recycling, while the remaining paper waste, such as paper towels, paper cups, laminated paper, etc., is sent to landfills and incinerated, as per the material types. The recycling of paper facilitates the process of converting paper waste into new paper product (See Appendix 4). Through recycling, new products such as cardboard, notebooks, newspaper prints, etc., are developed from paper waste, which can again be recycled many times[70]. Investments in water, electricity, funds, etc., are needed to ensure paper recycling without any issues.

iii. **Metal and Iron Sheet Recycling -** Ferrous and non-ferrous products (i.e., iron and steel) can be recycled by both internal and external methods. Metal cuttings or imperfect products are recycled by shredding, remelting, recasting, and redrawing entirely within the steel mill. The process is much cheaper than producing metal from the basic ore. Examples of materials recovered from metal include cooking pots, aluminium siding doors, & window frames, bed frames & mattress springs, bridges, cast iron sinks and bathtubs, etc
The recycling of paper involves the process of converting paper waste into new paper product (See Appendix 4). The source of scrap sheets are from old automobile bodies and beverage cans.

2.1.4.4.2 Economic Benefits of Waste Recycling

While the environmental advantages of recycling waste paper are widely recognised, it's important to highlight that this practice also brings about substantial economic benefits. From job creation to reduced waste management costs.

i. **Job Creation and Industry Growth:** Recycling waste paper fosters the growth of a vibrant and dynamic recycling industry. This industry generates a range of employment opportunities, from collection and sorting to processing and manufacturing. These jobs span various skill levels and contribute to economic stability within communities.

ii. **Resource Efficiency and Cost Savings:** Recycling waste paper is inherently more resource-efficient than paper production from virgin materials. By utilising recycled paper fibers, companies can reduce their consumption of raw materials, energy, and water. These cost reductions contribute to enhanced profitability and economic resilience.

iii. **Reduction in Waste Management Costs:** As landfills become overcrowded, waste management costs soar. Municipalities and governments spend significant resources on managing, transporting, and disposing of waste. By recycling waste paper, a considerable portion of waste is diverted from landfills, leading to reduced waste management costs and improved allocation of public funds.

iv. **Advocacy for the Circular Economy:** The circular economy framework strives to extend resource usage and extract optimum value from them. Recycling waste paper is integral to this framework. As the appetite for recycled materials rises, industries are motivated to pioneer inventive techniques for reclaiming and treating waste paper. This transition not only advances ecological sustainability but also propels economic progress through innovation.

v. **Market Demand for Recycled Products:** By choosing products made from recycled paper, consumers create a market demand that supports the growth of the recycling industry and encourages businesses to adopt greener practices.

vi. **Investment in Green Technologies:** Advancements in recycling technologies, such as improved paper de-inking processes and more efficient sorting systems, result in higher-quality recycled materials from paper sources in the form of tissue papers, cardboard paper, etc.

vii. **Environmental Cost Savings:** By reducing the strain on natural resources, conserving energy, and curbing greenhouse gas emissions, recycling contributes to avoiding the long-term economic costs associated with environmental degradation, such as healthcare expenses due to pollution-related illnesses.

2.1.4.4.3 The Advantages of Waste Paper Recycling

Recycling waste paper is widely celebrated for its environmental benefits, but its economic advantages are equally important. This practice drives job creation, enhances resource efficiency, reduces waste management costs, and supports innovation, making it a cornerstone of a sustainable and prosperous economy. By converting paper waste into valuable resources, recycling waste paper delivers multifaceted economic benefits that extend far beyond the recycling bin.

The recycling of waste paper stimulates the growth of a vibrant industry by generating a diverse array of employment opportunities. Jobs in collection, sorting, processing, and manufacturing cater to various skill levels, bolstering economic stability within communities[67]. As consumer demand for recycled products rises, this market preference encourages businesses to adopt greener practices, further expanding the recycling sector. This synergy between job creation, industry growth, and market demand underscores recycling's role as an economic engine[72].

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In addition to fostering employment, recycling waste paper offers significant cost-saving opportunities. Compared to producing paper from virgin materials, using recycled fibers reduces the need for raw materials, energy, and water, leading to lower production costs and enhanced profitability for companies. Moreover, by diverting waste from overcrowded landfills, recycling alleviates the financial burden on municipalities and governments, who otherwise face escalating waste management expenses. These savings allow for better allocation of public funds, amplifying the economic impact.

Recycling waste paper also plays a pivotal role in the circular economy, where resources are kept in use for as long as possible to maximise their value. Rising demand for recycled materials spurs investment in green technologies, such as advanced de-inking processes and efficient sorting systems, which improve the quality of recycled products like tissue papers and cardboard. This innovation not only supports environmental sustainability but also drives economic progress by creating new opportunities for technological development and market expansion.

By conserving natural resources, reducing energy consumption, and curbing greenhouse gas emissions, recycling helps mitigate the costly consequences of environmental degradation, such as healthcare expenses tied to pollution-related illnesses. Recycling packaging waste reduced greenhouse gas emissions from waste emissions and about 80 % of external costs of residual waste management can be avoided[74].

Finally, recycling waste yields long-term environmental cost savings with profound economic implications. By conserving natural resources, reducing energy consumption, and curbing greenhouse gas emissions, recycling helps mitigate the costly consequences of environmental degradation, such as healthcare expenses tied to pollution-related illnesses. In essence, the economic advantages of recycling waste paper—spanning job creation, cost efficiencies,

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innovation, and environmental savings—make it an indispensable practice for building a resilient and sustainable economy.

2.1.4.5 Waste Recovery

Waste Recovery, sometimes called, Resource Optimisation refers to the efficient use of resources, including materials, energy, and human capital, to reduce waste generation, maximise waste recycling and recovery, minimise environmental impact, and enhance overall waste management processes. This involves various strategies and techniques aimed at maximising the value and utility of waste materials, reducing waste disposal costs, and minimising the environmental footprint associated with waste management[74]. For instance, broken and old glasses are sold to small-scale industries or processed and recycled to cullet for use in the glass industry for manufacturing ashtrays and candle holders. Crushed glass is incorporated into countertops, tiles, and engineered stone, adding both aesthetic and functional value to the products and at the same time, reducing the extraction of virgin materials and thus enhance optimal utilisation of the scarce resources.

Resource optimisation in waste management not only benefits the environment by reducing the strain on natural resources and limiting pollution, but also has economic advantages. It can lead to cost savings through reduced disposal fees, revenue generation from recycling programs, and potential income from the sale of recovered waste items.

In recent years, Sustainable Materials Management (SMM) was been promoted as a strategic approach aimed at maximizing the efficient use of materials throughout their life cycle, with the goal of reducing environmental impacts and conserving natural resources[73]. Sustainable solid waste management programme is now gaining more recognision because it promotes circular economy (CE) principles which facilitate high proportion of recyclable materials within the

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waste stream[75]. By utilising waste as a resource, we can conserve the valuable with limited raw materials. Green product not only helps to conserve natural resources and money, but also reduce harmful effects from them on the environment by diverting waste from landfills and incineration[76]. This diversion can also decrease the environmental and social costs associated with waste disposal. Waste is a valuable resource everyone should be aware of and acknowledge this, starting from those who manufacture products and continuing with the population who consumes these products; there should be continuous efforts to reuse, recover, and recycle product resources during product manufacturing and consumption phases[77].

2.1.4.5.1 Advantages of Resource Optimisation

Circular Economy Principles: The circular economy concept has gained significant traction in recent years. It promotes the idea of keeping resources in use for as long as possible, extracting their maximum value, and then recovering and regenerating products and materials at the end of their life cycle. This approach reduces waste generation and optimises resource utilisation. Waste management is a principal advocate in promoting circular economy principles. The circular economy focuses on optimising the use of resources, including energy, water, and raw materials. It promotes efficient production processes, resource recovery, and the substitution of non-renewable resources with renewable alternatives. Formalisation of informal recycling or resource recovery activities and waste management policies with established institutions would enhance the adoption of CE in the MSWM system in Nigeria[78].

ii. Extended Producer Responsibility (EPR): This is an environmental policy approach where producers are held responsible for the entire lifecycle of their products, particularly the post-consumer stage, including take-back, recycling, and disposal, aiming to reduce environmental impact by incentivizing sustainable design. It encourages producers to design

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products with recyclability in mind and to take responsibility for the end-of-life management of their products. EPR programmes are gaining popularity worldwide, shifting the responsibility for managing waste and recycling from consumers and municipalities to producers.

iii. Waste-to-Energy Technologies: The adoption of advanced waste-to-energy technologies, such as anaerobic digestion, incineration with energy recovery, and landfill gas capture, helps maximise the energy potential of waste materials while reducing landfill volumes. These technologies are becoming more efficient and environmentally friendly. Recent research focuses on improving their sustainability and reducing emissions[80].

iv. Waste Minimisation Strategies: Companies and municipalities are increasingly adopting waste minimisation strategies, such as source reduction, product design for recycling, and promoting a "zero waste" approach. These efforts aim to reduce the overall volume of waste generated and enhance the efficiency of resource use.

v. Public Awareness and Education: This initiative enlightens the public awareness about sustainable waste management practices. Government agencies and environmental organisations are organising campaigns to educate the public about appropriate waste sorting and disposal to optimise resource recovery. Researchers and companies are continually developing innovative recycling technologies to improve the quality and efficiency of recycled materials.

vi. Waste Transfer or Transportation: This functional element involves the transfer of wastes from the dumpsites to landfills or disposal sites. The use of smaller collection vehicles is preferred, where necessary, to overcome the problem of narrow access lanes. The factors to consider when designing a transfer station include the type of transfer operation, capacity, equipment, accessories and environmental requirements.

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vii. Waste Processing: Waste processing is mostly through reuse, recovery or recycling. Processing is required to alter the physical and chemical characteristics of wastes to enable resource recovery and recycling[73]. The important processing techniques include compaction, thermal volume reduction, manual separation of waste components, incineration and composting. Certain recovered materials like glass, plastics, paper, etc., can be recycled as they have economic value.

viii. Waste Disposal: Disposal is the ultimate fate of all solid wastes, be they residential wastes, wastes from municipal and industrial treatment plants, incinerator residues, composts or other substances that have no further use to society. Thus, Land Use planning becomes a primary determinant in the selection, design and operation of landfill operations. A modern sanitary landfill is a method of disposing of solid waste without creating a nuisance and hazard to public health. Generally, engineering principles are followed to confine the wastes to the smallest possible area, reduce them to the lowest particle volume by compaction at the site and cover them after each day's operation to reduce exposure to vermin. One of the most important functional elements of SWM, therefore, relates to the final use of the reclaimed land.

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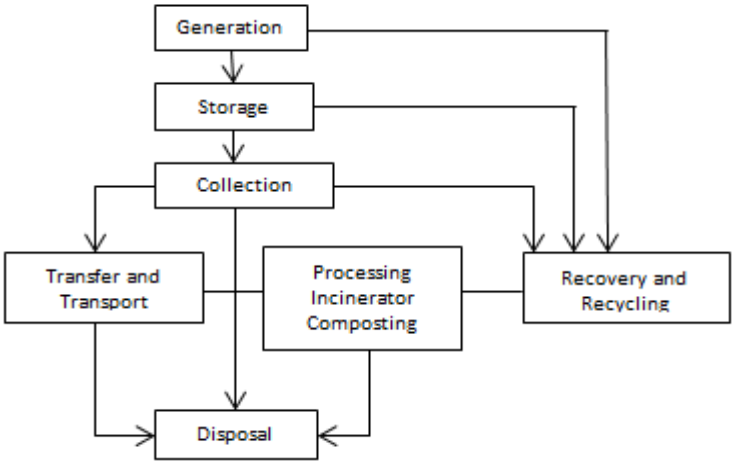


Fig. 2.12 – Functional Elements of Waste Management - Source: [46]

2.1.5 Integrated Solid Waste Management versus Traditional Waste Management

Integrated Solid Waste Management (ISWM) is a modern aspect of waste management that aims to preserve the functions of the environment and public health, make waste a resource, and improve the efficiency of the use of raw materials. Most countries and many industries have different ways of recycling waste into valuable energy that reflect or make up for some cost savings, like recycling of excess heat to heat water, plastic to refuse-derived fuel (RDF), aluminium to stainless cooking utensils and several others[80]. These processes are collectively referred to as ISWM.

ISWM differs from the traditional approach to waste management by giving opportunities to stakeholders' participation in waste management and inclusion of scientific and technological innovations for waste recovery and recycling[80]. ISWM encompasses the application of the 3Rs principles (reduce, reuse, and recycle) of waste management with other means of enlightenment and behaviour modification of waste generators like engagement of community, business entity, and local government to achieve the economic benefits of waste for enhanced environmental sustainability[65]. It includes some coping mechanisms to manage the waste as shown in fig 2.13[81].

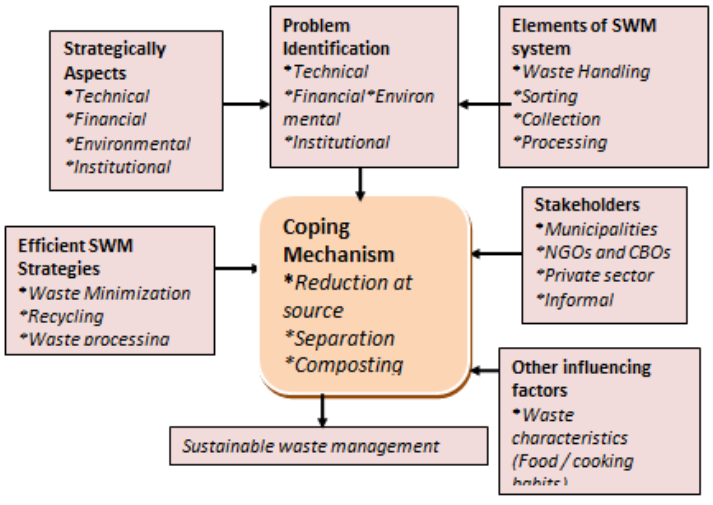


Fig. 2.13 – ISWM practices and Coping Mechanisms - Source: [81]

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ISWM extends the coverage of waste management beyond the traditional solid waste management of collection, transportation, and inefficient disposal of waste to overcome the challenges of rapid urbanisation, population growth and industrialisation. It gives room for innovation in terms of recycling and reselling of recovered items to reduce the heaps of waste stream and make a living in the informal sector

2.1.6 Waste Management Hierarchy

This is one of the approaches to waste management. Waste hierarchy is a concept that prioritises waste management methods according the optimal preservation of the environment. It gives top priority to reduce waste in the first place, preparing it for re-use, then recycling, then recovery, and last of all, disposal, which is the least preferred of all the methods. Strategies for waste management can be divided into a hierarchy of treatment options, which include reduce, re-use, recycle, recover and the least preferred option, disposal, with improved monitoring[81]. Waste strategies that reduce waste at the source are cost-effective if properly implemented, while disposal is the least desirable option, waste items that cannot be prevented should be recovered, reused or recycled; and minimal waste should be disposed. The ultimate aim of waste hierarchy is to reduce the amount of waste generated; this will save money, conserve natural resources and energy, as well as protect the environment.

Reduce - Reduce is the first and most preferred waste management. Reducing the waste at the prime source is the first step of the waste hierarchy and is the most effective way to prevent waste from being generated in the first place. It is done through developing awareness by the authorities amongst the individuals. From production to transportation and eventual consumption, all commodities consume up large amounts of raw materials and energy, which poses a detriment to the environment by causing resource depletion and pollution creation.

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Source segregation of waste through various capacity-building and coping mechanisms for getting recyclable material for recycling and treatment processes are therefore very essential.

Reuse - The second approach, which is waste reuse, involves using old items that have value or utility rather than throwing them away. One of the ways to reduce the quantity of waste generated is for residents to reuse old items that have value or give them to others instead of throwing them away by keeping and reusing old polythene bags, giving out old dresses to people that need them[82]. Reuse is a great way to give an item an elongated life span by using it more than once. This means that none of the components of the product are wasted and can be used again for the same or another purpose.

Recycle - Recycling is the next approach in the waste management hierarchy, and this is a daily routine for some households. Many components of solid waste generated by households can be recycled manually, such as newspapers used as wrappers or flower vases, while plastics are recycled in industries for slab or polythene bags and sold for profit[44]. Items that can be recycled include: plastic, paper, aluminium, steel and glass. Recycling aims to close the loop on resource consumption and preserve them for continued use by turning them into new products. For example, milk jugs and other plastic containers can be made into new bottles and containers, or old tires recycled to make a fence, paper recycled into toilet paper and tissues, and aluminium waste can be turned into cooking pots, etc.

Recovery - This is the recovery of waste without any pre-processing. It involves using one product to serve a different purpose and creating a new use for an old product. For example, waste oils that cannot be refined for reuse in vehicles can be burned for energy recovery. Recovering energy from waste oil reduces our dependence on coal and imported oil.

Disposal - Disposal is the least preferred option in the waste management hierarchy. Disposal can be through open dump sites or sanitary landfill sites[62]. Open dumping of waste leads to environmental pollution; thus, experts advocate the use of landfills for the final disposal of waste. The hierarchy of WM needs to be strictly followed to focus on the long-term, environmentally, economically sound results. For effective adoption of waste management and pollution reduction, it is important to consider the hierarchy of waste management, starting with elimination, isolation, substitution, engineering and administrative controls and that processes like recycling, reusing, refilling, just to mention a few, are examples of waste management approaches. Most countries and many industries have different ways of recycling waste into valuable energy that reflect or make up for some cost savings like recycling of excess heat to heat water.

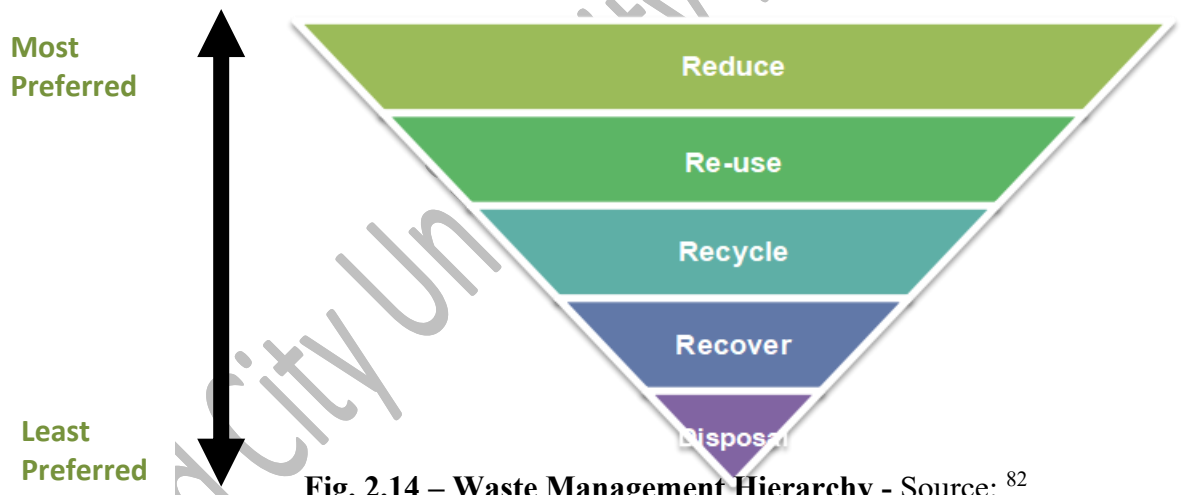


Fig. 2.14 – Waste Management Hierarchy - Source: [82]

2.1.7 Waste Bank System

Waste banks system is a community-focused approach to waste management, utilising the 3R principle of reduce, reuse, and recycle to foster sustainable practices and support the circular economy. Unlike conventional waste disposal systems, these banks function similarly to financial institutions: individuals deposit sorted waste, such as plastics or paper, and receive a passbook to record their contributions. These deposits can later be exchanged for cash or other

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benefits. It is a means of effectively transforming waste into a valuable asset. Operated by local communities, businesses, or governments, waste banks not only help maintain a cleaner environment but also raise awareness about the importance of responsible waste management[83].

Within the framework of the circular economy, waste banks play an essential role by promoting the reuse and recycling of materials. This reduces the demand for new resources and cuts down on waste that would otherwise end up in landfills. By keeping resources in circulation for as long as possible, waste banks contribute to sustainable production and consumption habits. Additionally, they alleviate the financial burden on municipalities by lowering waste management costs and mitigating environmental risks, paving the way for a healthier and more sustainable ecosystem.

From an economic perspective, waste banks provide substantial benefits to communities. They create income opportunities by selling recyclable materials or crafting new products from waste, establishing a reliable revenue source. Beyond that, they generate jobs ranging from waste collection to processing and spark entrepreneurial ventures through innovative recycling ideas. These economic advantages position waste banks as a vital instrument for boosting local economies and enhancing financial stability, particularly in areas seeking sustainable growth.

For African countries, the adoption of waste banks holds immense potential. Drawing inspiration from developed nations that use strict regulations and inventive solutions like converting waste into energy. African nations could harness this model to address their waste management challenges. By turning waste into a resource for income and energy, waste banks offer a dual benefit: tackling environmental issues while promoting sustainable development. This approach could empower local communities economically and environmentally, providing a tailored solution to meet the continent's unique needs.

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2.1.8.1 Solid Waste Management System in Nigeria

Waste management is a pressing global issue, prompting both developed and developing countries to implement legislative and policy frameworks to regulate it. In Nigeria, the government has taken proactive steps to safeguard the environment and protect public health from hazardous waste by establishing various agencies such as the Federal Environmental Protection Agency (FEPA), the National Environmental Standards and Regulations Enforcement Agency (NESREA), and state-level for instance there is Lagos State Waste Management Authority (LAWMA)[84]. These agencies are saddled with the responsibility of enforcing environmental laws and fostering sustainable waste management practices. Despite their efforts, significant challenges still exist in municipal waste management.

A persistent problem is the widespread practice of open burning and indiscriminate dumping, which contravene laws like Section 14 of Lagos State's environmental sanitation law. These practices degrade the environment and pose serious health risks, such as respiratory diseases caused by toxic smoke inhalation. Additionally, the rapid exploitation of natural resources and advanced industrial technologies has intensified waste generation. As raw materials are processed into consumer goods, harmful by-products are produced, and when improperly discarded, they contaminate the environment and threaten public health.

Sustainable municipal solid waste management (MSWM) requires a structured process, encompassing waste generation, sorting, collection, transportation, treatment, and disposal. In Nigeria, however, these stages are poorly implemented. Household waste is rarely sorted, and collected waste is often dumped untreated into open spaces, drains, and waterways, exacerbating environmental pollution[85]. To counter this, some states have commercialised waste management, engaging the informal sector to collect and process waste. This approach reduces the financial burden on the government while creating economic opportunities for local communities.

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Entrepreneurs and private sector involvement are vital for developing innovative solutions and lowering waste management costs.

Considering the exponential growth of waste generation and its detriment to health and the environment, some states incorporated informal sectors to support and earn revenue from the management of waste rather than leaving it for the government as a social cost[86]. All stakeholders concerned with the safety and the beautification of our environment need to realise the negative consequences of nucleated solid wastes found in residential neighbourhoods and many places in cities. The involvement of entrepreneurs in solid waste management planning would solve most MSWM challenges and enhance reduction in waste service cost in urban cities with higher employment generation and productivity[87].

Recent advancements include the adoption of green campaign strategies in waste management. Green campaign strategies are coordinated efforts designed to raise awareness, modify public behaviour, and encourage environmentally responsible practices. These strategies, typically applied in waste management, include environmental advertising, social media platforms, eco-labelling, and incentive-based initiatives. Green campaign strategies offer a comprehensive approach to managing waste effectively[88]. Through these efforts, Nigeria aims to build a more sustainable waste management system that balances environmental preservation with economic benefits.

2.1.8.2 Waste Management in Higher Education Institutions

Education plays a pivotal role in raising awareness about environmental responsibilities and fostering sustainable practices among populations. Higher Education Institutions (HEIs), often regarded as microcosms of society due to their diverse facilities like hospitals, restaurants, banks, offices, lecture halls, laboratories, and event centers, generate a wide variety of waste, including

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organic waste, mixed plastics, paper, construction and demolition debris, electronic waste, office waste, lamps, furniture, metal, and hospital waste[3,44]. Researches indicate that a significant portion of HEI waste is organic, followed by mixed plastics and paper and that the waste streams present opportunities for resource conservation and environmental protection through effective management and recycling[89].

Given their scale and autonomy, HEIs are uniquely positioned to implement innovative Solid Waste Management (SWM) practices. As models of best practices, HEIs can influence surrounding communities by institutionalising sustainable waste management strategies[44]. In Nigeria, with approximately 200 Colleges of Education comprising 27 federal, 47 state, and 126 private institutions, excluding universities and polytechnics, the potential for impactful waste management is significant[90]. The large populations within these institutions generate substantial waste, underscoring the need for robust SWM systems. Starting from the September/October 2025 academic session, all FCEs will offer both degree and Nigeria Certificate in Education (NCE) programs concurrently[91], expanding their reach and opportunities to promote innovative waste management practices as the larger the population the greater the waste generation rate.

A study at the University of Lagos (UoL), Nigeria, revealed that 75% of campus waste is recyclable, with 30% organic materials, 28% mixed plastics, and 24% paper[44]. This highlights the potential for resource recovery and income generation through improved source separation of the university's waste. Similarly, at the University of Nigeria, Nsukka, organic and polythene waste constitute 32.36% and 34.29% of total waste, respectively, with peak waste generation during academic periods[3]. Approximately 96.58% of this waste is recyclable, and 51.85% is biomass, suggesting that Waste-to-Energy (WtE) technologies could generate about 1.1 MWh of electricity daily. At Henan Agricultural University’s Longzi Lake Campus in China, 79% of

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waste was found to be recyclable[92]. These findings underscore the global potential for recycling in HEIs to achieve the economic and environmental benefits of wastes.

However, studies reveal challenges, including unauthorised recycling by staff and waste pickers on campuses. To achieve well-coordinated waste management, sustainable development, and maximise economic benefits from waste, HEIs must enforce waste control mechanisms, promote attitudinal changes among students and staff, and adopt modern waste management techniques to enhance recovery and recycling rates. Green campaign strategies, incorporating students' attitudes as a moderating factor, are critical for addressing environmental concerns and fostering sustainability. Collective efforts from management, staff, and students are equally essential for effective waste management that will contribute to a cleaner environment and national sustainable development.

Implementing SWM techniques in HEIs enhances environmental sustainability, reduces resource consumption, and lowers waste collection and disposal costs. Tools such as environmental advertising, educational programs, eco-labelling, and social media can engage researchers, staff, students, and communities in Nigeria's HEIs, encouraging participation in recycling initiatives. Incentive-based programs, such as cash rewards, have proven effective in reducing landfill waste and promoting sustainable behaviours. These interactive initiatives allow stakeholders to contribute ideas and feedback, further advancing environmental sustainability.

Effective waste management in HEIs is crucial for maintaining healthy learning environments, protecting public health, conserving resources, and promoting sustainable development. It requires collaboration among management, students, staff, businesses, and communities to reduce, reuse, recycle, and dispose of waste responsibly. Institutionalising modern SWM

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techniques is cost-effective and has a ripple effect, as students and staff transfer the knowledge and behavioural changes to broader society, amplifying the impact of these initiatives.

2.1.8.3 Waste Management Techniques for HEIs

Higher Education Institutions (HEIs) can adopt sustainable waste management (SWM) techniques to enhance environmental sustainability and reduce operational costs. Some key simple technologies include source separation to boost recycling rates, underground waste collection systems to minimise the odour and improve aesthetics, and composting for organic waste to produce fertiliser. Simple Waste-to-Energy (WtE) technologies, like small-scale anaerobic digesters, can convert organic waste into biogas for energy[93].

i. Underground Collection System – This is a waste management technology in which bins or containers are installed below ground level. In this system, waste is stored in underground or semi-underground compartments, leaving only the disposal inlets visible at the surface[93]. This approach helps to maximize space, reduce odors, improve aesthetics, and enhance the efficiency of waste collection and storage. This involves the placement of a plastic waste container with only the inlet/opening showing on the floor surface for evacuation with the use of specialised technology. The use of underground collection systems helps to improve living conditions in urban areas and also provides the opportunity of utilising above-ground surfaces for other purposes[66]. The underground surface utilisation is essential for attaining sustainable development in the school environment, to maintain a clean environment and reduce the effects of stench coming from waste.

ii. Waste shredding Machines - The shredders are useful machines for the volume reduction of bulky waste such as reams of paper, paper materials, cans, tires, and the shredding of different materials such as scrap iron, aluminium, copper, plastic, as well as municipal solid waste and

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industrial waste[94]. The application of shredders is essential for eco-centres, landfills, wrecking and all the organisations that work in the field of waste management and recycling. The machine can be fabricated in the school's technical workshop due to its simplicity The recycling of paper involves the process of converting paper waste into new paper product. They come in different sizes and for different purposes, such as paper shredders, can shredders, plastic shredders, etc (See Appendix 4).

iii. Compost and Soil amendment - Campus refuse, as municipal solid waste, includes garbage and rubbish. Garbage contains highly decomposable food waste (e.g., kitchen scraps), while rubbish is the dry, nonputrescible component of refuse. Once glass, plastics, paper products, and metals have been removed from domestic refuse, what remains is essentially organic waste. This waste can be biologically decomposed and turned into humus, compost mound and soil amendment, which can be applied in large quantities on campus farm land to enrich the soil as against the use of chemical as fertilisers with its havoc effect on human health.

iv. Thermal Conversion - This technology employs the application of water, heat, or pressure to transform both organic and inorganic waste materials into valuable end products. Through a thermal processing system, raw materials such as plastics, computer casings, used tires, and agricultural residues are converted into useful molecular compounds, including fuel gas, oil, and other economically beneficial substances such as the conversion of waste to energy (WTE)[93].

v. Pyrolysis - Pyrolysis refers to the destructive distillation of the solid waste to recover its energy in the absence of air. This process yields various products like oil, char, which are recyclable and are preferred for low moisture-containing waste, as more heat is required for the treatment of high moisture waste[38].

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vi. Energy Recovery - Energy recovery from waste is the conversion of non-recyclable waste materials into usable heat, electricity, or fuel through a variety of processes including combustion, gasification, anaerobic digestion, and landfill gas (LFG) recovery and these process are often called waste-to-energy process (WTE) Waste to Energy (WTE) is a proven environmentally sound Waste to Energy (WTE) provides a renewable alternative of energy in the world where we have limited fossil reservoirs[41].

vii. **Metal and Iron Sheet Remodeling -** Ferrous and non-ferrous products (i.e., iron and steel) can be recycled by both internal and external methods. Metal cuttings or imperfect products are recycled by shredding, remelting, recasting, and redrawing entirely within the steel mill. The process is much cheaper than producing metal from the basic ore[71]. Examples of materials recovered from metal include cooking pots, aluminium sliding doors, window frames, bed frames, window burglary mattress springs, bridges, cast iron sinks and bathtubs, etc. The major sources of scrap sheets is from old automobile bodies and beverage cans.

viii. **Paper and other cellulose products -** Paper alone accounts for more than one-third by weight of all the material deposited in landfills. The stream of wastepaper consists principally of newspaper, office, copying, and writing paper; computer paper, coloured paper, paper tissues and towels; boxboard; corrugated cardboard; and kraft paper (used for paper bags). The major steps of paper recycling are sorting, shredding and pulping; de-inking and drying. The common uses of recycled paper are tissues and toilet papers of different colours; napkins and paper towels, greeting cards, newspapers and magazines.

ix. Reclamation of Construction and Demolition waste - Construction and demolition (C&D) debris (e.g., wood, brick, cement, concrete, and metals) can be reclaimed and reused to help reduce the volume taken up by such materials in landfills. Concrete debris consists mostly

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of sand and gravel that can be crushed and reused for road base/gravel. Clean wood from C&D debris can be chipped and used as mulch, animal bedding, and fuel. Asphalt can be reused in cold-mix paving products and roofing shingles.

2.1.8.3 Challenges of Waste Management in Developing Countries

Limited Financial Resources and Infrastructure - Insufficient funding restricts investments in modern waste management technologies and equipment in developing countries, particularly in the public sector. Private firms face high-interest loans and short repayment periods, limiting their capacity. For instance, many private collectors use poorly designed open-cabin tippers, causing waste spillage and odours as the vehicles move from poorly constructed roads [93]. The integration of public-private partnerships (PPPs) in waste management will assist in funding modern waste collection vehicles and treatment facilities, where private investment to supplement public budgets.

Rapid Urbanisation - Rapid urban growth increases waste generation, outpacing collection, transportation, and disposal capacities. Urbanisation refers to the concentration of people in a particular settlement with or without governments permitting development. It sometimes poses problems as most of these people live in slums and other inhumane places like landfills, posing health risks. The use of urban master plans prioritizing designated landfill for waste dumps away from residential areas and investing in compact, modular waste processing units to manage increased waste volumes will be acceptable coping mechanism for this challenge.

Weak Legislation and Policy Implementation - Existing legal frameworks guiding waste management for sustainable development need to be reviewed. The constitutional strength of solid-waste management policy in Nigeria is weak and ineffective; most time, not adequately monitored or reviewed to meet the current trend in the environment[75.] Outdated and poorly

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enforced waste management policies in Nigeria fail to address current environmental challenges. For instance, the principle of "polluter pays" can be implemented through both **penalties** (e.g., fines, pollution taxes) and incentives (e.g., tax breaks, subsidies for green technologies, or reduced levies for compliance). By rewarding compliance and penalizing violations, governments motivate individuals, businesses, and institutions to follow environmental laws while encouraging innovation in waste reduction and pollution control.

Lack of Accurate and Updated Data - Scarce and outdated data on waste generation in the public and private sectors hinders effective planning. Most studies on waste management are confronted with the issue of accurate data on the amount of waste generated in both the public and private sectors. Even where the data is available, they are not updated as necessary. The absence of legal frameworks for data collection and interpretation exacerbates this issue.

Ignorance and Nonchalant Attitudes - Many residents, unaware of sanitation ethics, dispose of waste in open areas, expecting free public collection services. Most households, due to limited resources and exposure, foster indifference to environmental cleanliness; some will even trek to a far place to drop their waste carelessly in stress. The introduction of the "not in my backyard initiative" and community education campaigns using local media and workshops to raise awareness about proper waste disposal and its health benefits will bring about positive behavioural change in this area.

Inadequate Staffing and Technical Expertise - Understaffing in sanitation sectors leads to poor waste monitoring. Existing staff often lack personal protective equipment (PPE) and training in modern waste management techniques. Increase the recruitment of sanitation officers and provide regular training on contemporary waste management practices, alongside the mandatory provision of PPE to ensure safety.

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Informal Waste Sector - Informal waste pickers and scavengers, operating without legal recognition or PPE, play a significant role in waste management but face the consequences of their unprofessionalism and public stigma. Their activities intensify during economic crises, yet their integration into formal systems remains challenging. Formalise the informal sector by registering waste pickers, providing PPE and training, and integrating them into municipal recycling programs with fair wages.

Lack of Land Use Planning - The absence of comprehensive land use plans in cities, despite Nigeria's early urban planning education, results in poorly located dumpsites and undefined waste management operations. Most urban cities no longer follow the Urban and Regional Planning Institution, and buildings are constructed without drainage, causing blockages and floods during the rainy season. It is now mandatory for the regional planning authority to always enforce stringent laws for building construction and street planning.

2.1.9 An Overview of Green Marketing

Green Marketing refers to a holistic marketing concept wherein the production, marketing, consumption and disposal of products and services happen in a manner that is less detrimental to the environment[97]. Green marketing is the production and selling of products that are presumed to be environmentally safe. Thus green marketing incorporates a broad range of activities, including product modification, changes to the production process, packaging changes, as well as modifying advertising, in simple words green marketing is the process of doing business which includes consumer goods, industrial goods and even in service, every stages i.e., product, pricing, promotion and place without affecting the environment or doing activities which is ecofriendly in nature by using the concept of reduce, reuse and recycle[98]. It entails sustainability, eco-

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innovation, circular economy and other related terms that describe the production and marketing of products that are recyclable, organic, re-usable, easily decomposable, biodegradable, naturally made with non-toxic chemicals and eco-friendly packaging[99].

Green marketing is often classified or referred to as environmental marketing, societal marketing and ecological marketing, which are more comprehensive and integrated concepts of marketing, starting right from the production process through consumption to the disposal of products, and keeping in mind their effects on the environment[100].

2.1.9.1 An Overview of Green Campaign Strategies

Green campaigns as one of the components of green marketing principles are strategic initiatives designed to promote sustainable behaviours and practices that minimise environmental hazard, particularly through proper waste management on the principles of the 3Rs (reduce, reuse and recycle)[96]. Green campaign strategies are rooted in the framework of green marketing, which integrates the traditional 4Ps (Product, Price, Place, and Promotion) along with the extended elements of People, Process, and Physical Evidence to promote environmentally friendly products and practices. On campus, this involve designing eco-friendly Product, offering affordable sustainable price, establishing recycling hubs (Place), promoting waste management through awareness campaigns, engaging students and staff in sustainability efforts, embedding waste management practices into daily routines (Process), and maintaining a visibly clean environment (Physical Evidence).

Green campaigns serve as strategic tools designed to highlight pressing environmental issues and also to promote environmental consciousness among the populace, thereby advancing the goal of environmental sustainability. It is one of the most crucial steps in implementing waste management by fostering public awareness about the significance of waste reduction and proper

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waste management. Green campaign is a strategy that protects the environment, consumers, and workers by improving industrial efficiency, profitability and competitiveness, and to create harmonious conditions between commerce and their surroundings to achieve a sustainable environment free of waste and its hazards by environmental consciousness among individuals[113].

Green awareness campaigns show how knowledge, practices, awareness, and attitude towards waste need to be improved to move towards efficient waste management. Regular awareness through educational programmes such as campus newsletter and social media, incentives and rewards; competitions and film shows; and the use of colour-coded waste bins and signage at strategic locations will promote proper waste management practices among students, staff, and other community members will greatly enhance waste management[89].

In Higher Education Institutions (HEIs), green campaign strategies aim to foster waste reduction, recycling, and sustainable consumption among students by leveraging targeted communication and engagement tools to influence attitudes and behaviours[99]. Recent trends on environmental sustainability and circular economy principles emphasise the adoption of efficient waste management practices like recycled packaging, reduced emissions, and renewable energy investments to support sustainable developmental goals[100]. By leveraging tools such as environmental advertising, social media, eco-labelling, and incentive-based initiatives, and other green campaign strategies, higher education institutions can reduce landfill waste, enhance recycling, and promote sustainable behaviors among students, thereby contributing to the development of a zero-waste campus culture[101].

Green campaign strategies in this study are operationalised through environmental advertising, social media platforms, eco-labelling, and incentive-based initiatives. These strategies align with green marketing's holistic framework. These strategies tackle waste management challenges

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while promoting systemic change and fostering a culture of sustainability within Federal Colleges of Education in Nigeria.

2.1.9.2 Measurements of Green Campaigns strategies

2.1.9.2.1 Environmental Advertising

Environmental advertising, also termed green advertising or environmental awareness marketing, is a vital component of green campaign strategies that promotes the environmental benefits of products, services, or behaviours by highlighting eco-friendly features. Rooted in green marketing principles, it aims to raise public consciousness about environmental challenges, such as waste management, and persuade individuals, particularly students in Higher Education Institutions (HEIs), including Federal Colleges of Education (FCEs), to adopt sustainable practices like reducing, reusing, and recycling[102].

Within FCEs, environmental advertising serves as a communication tool to foster a culture of sustainability, shaping students' attitudes and behaviours toward effective waste management. It involves the use of various media channels, including signage, posters, billboards, digital screens, and videos, to disseminate messages that encourage eco-friendly and environmentally sustainable behaviours. Its effectiveness is grounded in the Theory of Planned Behaviour, which posits that individual behaviour is influenced by attitudes, subjective norms, and perceived behavioural control[102]. By consistently exposing students to visual prompts such as posters promoting proper bin usage or campaigns highlighting the environmental impact of recycling and the dangers of waste mismanagement, it can impact positive attitudes, reinforce social norms, and strengthen students' intentions to engage in sustainable waste management practices[103]. For example, environmental advertisements emphasising the reduction of plastic

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waste through reusable containers can nudge students toward adopting low-waste behaviours by using reusable containers rather than single-use plastic.

In Federal Colleges of Education, like other HEIs, environmental advertising plays a critical role in addressing waste management challenges by delivering strategically crafted messages that inform, influence, and motivate students. These messages, displayed through campus signage, flyers, banners, and digital campaigns, are designed to modify attitudes and beliefs, encouraging practices such as waste segregation, composting, and reduced single-use plastic consumption[104]. For instance, a campaign poster illustrating the lifecycle of recyclable materials can educate students on the importance of sorting waste, reducing contamination in recycling streams. Additionally, environmental advertising can incorporate storytelling, such as showcasing student-led initiatives to reduce campus waste, to create emotional connections and foster a sense of collective responsibility.

HEIs, including Federal Colleges of Education, are uniquely positioned to lead environmental sustainability efforts due to their access to expert faculty members and educational resources[3]. Through environmental advertising, these institutions can propagate awareness and transfer knowledge about sustainable waste management practices, both on campus and in surrounding communities. For example, campaigns can highlight the environmental and economic benefits of recycling, such as reduced landfill costs and resource conservation, encouraging students to participate in campus recycling Initiatives[105]. Moreover, FCEs can leverage their academic expertise to develop innovative tools, such as apps for tracking waste reduction or workshops on upcycling, to complement advertising efforts and enhance student engagement[28].

In the developed countries, various initiatives have been implemented to communicate the impact of environmental advertising into various institutions of learning. The University of

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Malaysia's "No Polystyrene" campaign, which encourages students to use recyclable PET bottles instead of polystyrene, demonstrates how targeted advertising can reduce specific waste streams on campus[106]. Similarly, the "No Plastic Bag" campaign promotes reusable alternatives, supported by signage and digital promotions, fostering a zero-waste culture. The University of Cape Town, the school's waste management campaign, which uses billboards and social media to educate students on composting and biogasification, result in measurable reductions in organic waste sent to landfills is another laudable initiative that can be adopted by other HEIs and FCEs in developing countries[46].

The above initiatives highlight the potential of environmental advertising to drive behavioural change and support circular economy principles, such as converting waste into biogas or compost for agricultural use[106]. Despite its potential, environmental advertising in HEIs, particularly in developing countries like Nigeria, faces significant challenges. Rapid population growth, increasing solid waste generation, inadequate infrastructure, and limited expertise hinder efficient waste management through the use of effective environmental advertising[104]. Additionally, political interference, corruption, low awareness, and even individuals' lackadaisical attitude to waste management benefits exacerbate these issues, particularly in Nigerian Colleges of Education[35].

To overcome these barriers, HEIs must implement consistent sensitisation campaigns that highlight both environmental and cost benefits, such as reduced waste disposal expenses through the 3Rs of waste management: reuse, reduce and recycling and biogas production. For instance, a campaign emphasising paper recycling could reduce campus waste management costs while educating students on sustainable practices, similar systemic conversion of food waste to

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compost for the school garden and plastic re-use or outright ban by the College management will greatly enhance environmental sustainability and reduce waste cost.

Components of Environmental Advertising

i. Signage

Signage is a form of environmental communication that refers to printed or graphical messages displayed in physical locations to convey important behavioural cues[108]. In waste management, signage often includes messages such as "Use the Bin," "No Littering," "Separate Waste Here," or "Not in My Backyard" strategically placed around streets and environments. These messages function as visual prompts that remind individuals of their expected behaviour in waste disposal. At the HIEs level, environmental signage within campuses including "no littering" messages, directional signs for waste bins, colour-coded bin for waste segregation serve not only as informational tools but also as behavioural reminders that reduce the cognitive load associated with decision-making on waste disposal[108] When these messages are persistent and well-situated in areas like cafeterias, hostels, lecture halls etc in form of bill boards, signage and fliers, they can result in improved student compliance with waste management protocols. Empirical studies suggest that signage is most effective when it is clear, colour-coded, and context-specific. For example, directional signage that guides students to recycling bins or waste sorting points enhances compliance and signage with instructions on the use of coloured bins. Integrating communication tools like colourful signage, posters, and outdoor advertisements and strategically mounted billboards within the institution led to a 60% reduction in waste-related violations on campus[109]. This implies that signage directly supports awareness and brings about positive action in waste disposal.

The Theory of Nudging, proposed by Thaler and Sunstein, provides a theoretical foundation for

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understanding signage as a behavioural nudge. By subtly influencing behaviour without restricting individual choice, signage encourages students to adopt responsible waste disposal practices[110]. This is particularly relevant in developing countries like Nigeria, where inconsistent verbal instructions and weak institutional enforcement often undermine waste management efforts. In such contexts, well-designed signage serves as a reliable and constant visual reinforcement, compensating for gaps in oversight and communication. For example, in Southwest Nigerian colleges, the absence of adequate signage systems is a notable barrier. Many campuses rely on faded, misplaced, or outdated signboards that fail to address current waste management challenges, such as the need for proper waste segregation or recycling. This creates a cognitive void, leaving students uncertain about correct disposal practices and contributing to littering and poor waste sorting.

To address these challenges, Federal Colleges of Education in Nigeria could invest in a robust signage system that is visually engaging, multilingual, and tailored to local waste management realities. Incorporating local languages alongside English, using vibrant colours, and aligning signage with international waste management symbols could enhance clarity and accessibility. For instance, colour-coded signs (e.g., blue for recyclables, green for organic waste, and red for hazardous waste) placed in high-visibility areas could streamline waste sorting processes. Additionally, integrating digital signage or interactive displays could further engage tech-savvy students, fostering a culture of environmental responsibility. By prioritising such investments, colleges can not only improve immediate waste management outcomes, such as reduced littering and better waste segregation, but also cultivate long-term attitudinal shifts toward sustainable practices. Ultimately, strategically designed signage has the potential to transform campus waste management by serving as both an informational tool and a powerful behavioural catalyst.

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ii. **Flyer**

Posters and flyers serve as versatile communication tools, delivering concise, impactful messages. They are readily available to promote effective waste management practices. Unlike static, location-bound signage, posters and flyers offer flexibility, enabling widespread distribution across diverse campus settings such as classrooms, notice boards, hostels, student centres, and common areas. Their mobility and adaptability make them powerful instruments for environmental awareness campaigns, capable of reaching students in different areas of the campus. Internationally, poster-based campaigns have successfully addressed complex environmental issues, including climate change, recycling, and pollution control. In a study in Brazil, it was noted that by strategically distributing environmental flyers across university departments, the department recorded a 30% increase in the use of designated recycling bins[111]. The visual appeal of posters and flyers, often incorporating striking images, infographics, bold colours, and emotive or motivational language, makes them highly effective in capturing attention and conveying urgent environmental messages.

To maximise their impact, the design of posters and flyers must be tailored to the psychographics of the student audience, particularly in tertiary institutions. Young adults are more likely to engage with messages that are creative, humorous, or culturally resonant. For example, campaign initiatives by writing slogans like “Keep Naija Clean, Start with Your Bin!” target a youth audience can foster behavioural change[109]. Additionally, incorporating visually engaging elements, such as infographics that break down waste segregation processes or cartoons that inject humour, can further enhance the appeal and memorability of these materials.

Posters and flyers are particularly effective during key moments of student engagement, such as orientation programs, environmental awareness weeks, and students ’ union week or in other

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campus special events. Introducing waste management guidelines, such as proper sorting of recyclables, organic waste, and non-recyclables, can help to instil sustainable habits from the outset of a student's campus experience. However, their impact is often transient unless reinforced by complementary strategies, such as consistent signage, digital campaigns, or hands-on activities like waste sorting workshops. A significant challenge with flyers, in particular, is their potential to contribute to littering, ironically becoming waste themselves if not properly managed. To mitigate this, distribution strategies should include clear directives on proper disposal, such as designated drop-off points for used flyers, and campaigns should incorporate follow-up mechanisms, such as surveys or waste audits, to measure sustained behavioural change.

To enhance the effectiveness of posters/flyers for waste management, colleges can adopt innovative approaches, such as producing eco-friendly posters and flyers made from recycled materials. Collaborating with student organisations to co-create campaign materials can also increase engagement, as peer-driven initiatives often resonate more deeply with the student body[108]. Federal Colleges of Education in Nigeria with financial constraints could adopt the use of well-designed posters and flyers with cost-effective as scalable solution to bridge awareness gaps, reduce littering, and promote proper waste segregation. By combining cultural relevance, strategic placement, and consistent reinforcement, posters and flyers can serve as dynamic tools to foster a campus-wide culture of environmental responsibility.

iii. Billboards

Billboards are large-scale outdoor advertisements typically placed at strategic, high-traffic locations within or around educational environments. While often used for commercial marketing, billboards are increasingly being utilized for social and environmental messaging.

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Due to their size and visibility, billboards have a **high recall rate**, making them suitable for promoting long-term environmental values and policies[110]. The impact of billboards on waste management behaviour stems from their ability to create environmental consciousness through repetition and salience. However, the effectiveness of billboards is dependent on content quality, visual impact, and message framing. Emotional appeals, such as images of polluted campuses or slogans like "Your Trash, Your Shame," can provoke self-awareness and social responsibility. A well-known example comes from a university in India where billboards with rotating environmental quotes contributed to a visible decline in indiscriminate littering over a semester[100]. In Federal Colleges of Education in Nigeria, billboards are underutilized. Where they exist, they are often outdated or carry non-environmental content. Proper investment in green-themed billboards, especially near entry gates, cafeterias, and lecture blocks, could amplify environmental awareness. When synchronized with student-led campaigns or events, billboards can act as a macro-level reminder of micro-level responsibilities such as bin usage, recycling, and avoiding single-use plastics.

Conclusively, environmental advertising through signage, flyers/posters, and billboards can significantly shape waste management behaviours in Federal Colleges of Education in Southwest Nigeria. The current implementation gap presents a valuable opportunity for intervention. By adopting strategic, student-centred, and culturally relevant environmental advertising practices that involve all stakeholders, these practices will shift campus waste management culture toward more sustainable waste habits.

2.1.9.2.2 Social Media Platforms

Social media platforms serve as powerful digital tools for promoting sustainable waste management, particularly in developing countries where public awareness of environmental

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issues remains limited. These platforms are instrumental in educating citizens about the environmental and health risks associated with improper waste disposal, as well as highlighting the economic potential of waste-to-wealth initiatives[115]. Through targeted educational campaigns using blogs, videos, infographics, and interactive content, social media disseminates practical information on waste reduction, recycling, composting, and environmentally friendly disposal methods. Social media platforms play a vital role in educating the growing population in developing countries about the importance of efficient waste management in enhancing environmental sustainability. These platforms not only create public awareness but also foster behavioural change and encourage the adoption of sustainable lifestyles.

With its broad accessibility and cost-free nature, social media has become one of the most effective channels for raising awareness in the millennial era. It not only informs but also fosters behavioural change and encourages the adoption of sustainable lifestyles. Users, especially youth, are empowered to learn the value of waste minimisation and proper disposal methods, helping to entrench a culture of sustainability in their daily practices.

The ongoing wave of globalisation has reshaped communication patterns, with digital media increasingly replacing traditional platforms. Social media, now deeply embedded in everyday life, facilitates the swift, transnational exchange of information through text, audio, and visuals[115]. It is an effective vehicle for green campaign content, particularly among younger demographics who depend heavily on digital tools for accessing timely information[116]. People learn the value of waste reduction, recycling, composting, and the correct disposal method from these initiatives in order to adopt sustainable lifestyles through some of these social platforms. Highlighting the benefits of proper waste management and providing practical guidance can lead to significant behavioural changes.

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The globalisation era has transformed communication patterns, replacing traditional media with digital platforms. Social media is now an integral part of everyday life, enabling rapid, borderless information sharing and supporting long-distance communication through text, audio, and visuals[115]. It is a very effective medium for green campaign content, particularly among youth who rely heavily on digital tools for accessing current information.

The development in communication technology brings forward the new media, replacing the conventional ones. Social media is a part of the new media that can no longer be separated from our society's life. As a component of new media, social media allows users to engage virtually, share multimedia content, and participate in long-distance communication. Its affordability and the widespread availability of digital devices have made it an attractive medium for both private individuals and institutions aiming to raise environmental awareness. Campaigning in public digital spaces has the potential to mobilise communities and drive significant social change[115]. The University of Lagos, Akoka, uses green campaign strategies such as radio jingles, placement of colour-coded bins, informative signage, and environmental lectures coordinated by faculty and commercial stakeholders to enlighten students on waste management[89]. These initiatives reportedly led to improved waste segregation and reduced contamination in recyclable waste streams.

Social media has also proven effective in altering waste-related attitudes. Campaigns with well-structured content, particularly those shared on platforms like Instagram, have generated positive responses and enhanced user engagement in sustainable waste practices[115]. Institutions and governments increasingly incorporate social media into broader e-governance, communication reform, and environmental education strategies. Platforms such as Facebook, Instagram,

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WhatsApp, and YouTube are now commonly used to disseminate environmental content, promote green behaviour, and mobilise communities.

Social media platforms and educational tools have large coverage and can be effectively utilised to spread information on environmental sustainability and its benefits among youth. Consequently, integrating green campaign strategies, especially via social media and environmental advertising, into educational institutions can significantly enhance students' awareness of sustainable waste management and contribute to a healthier, more conducive learning environment[118]. HEIs are adopting social media initiatives to enlighten the campus occupants, and this has led to increased segregation accuracy and reduced contamination in recyclable waste streams[117]. Governments, institutions, and environmental organisations now leverage social media in line with e-governance strategies, communication reforms, and knowledge management frameworks. Platforms such as Facebook, Instagram, WhatsApp, and YouTube are increasingly used to disseminate environmental content and mobilise communities. This study focuses on Facebook, Instagram and Education blog.

i. Facebook

Facebook is the main platform used for social media as an information inquisition and communication tool. This tool can also be used to create awareness of the benefit of a green campaign. Facebook reaches a wider range of age groups, as users across different generations are generally familiar with the platform compared to other social media channels. This makes it a valuable tool for social media marketing, providing a significant opportunity to reach diverse target audiences through a single platform. Environmental advertising can effectively be done through Facebook through attractive messages and visual display to appeal to the populace on environmental sustainability issues.

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A study in Penang titled “exploring the concept and consequences of green campaign on social media platforms” confirmed that majority of the respondents choose Facebook as their main used social media. They agreed that Facebook tend to be the most effective social media for green campaign awareness because it is easier to use and allows video, audio and lengthy wording to be used at the same time[99].

ii. Instagram

With the advance of gadget nowadays and no monetary requirement needed for the social media account make it more popular among the society, it is very easy for information on waste management to spread widely among greater proportion of the younger generation who rely mostly on use of social media for information on recent and trending issues[99]. Social media is the most suitable medium to be used to reach society to share green campaign content in form of audio, visual and written content. On this basis, various information related to environmental sustainability for instance, especially concerning waste management, can be shared on facebook, instagram, whatsapp and other online platform to educate people efficient waste management.

Based on the aforementioned, Instagram is considered a proper target media for the government communication strategy on socializing their programs through the social campaign. One way to express concern for the environment is through a campaign. The campaign is a tool to spread information, increase public awareness and concern, and promote changes in the target audience's behavior[115]. Campaigning through public space as social media can open the path to the participation of society in environmental related issues and also serve as a great power to create positive and more significant social changes.

A study titled “The Waste Management and the Environmental Campaign “KangPisMan” to Awareness of the Environmental Sustainability's Importance” that explores the effect of the

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Instagram social media in Bandung City in Indonesia. KangPisMan is the local term for reduce, sort, and reutilize waste environmental campaign. The study focused on the effect of followers' waste management attitude using the Instagram account campaign model and focusing on two main aspects of the campaign message, content and structure. The finding shows that attractive campaign messages with good content and structure delivered by KangPisMan generated positive followers' responses. These findings reveal further that Instagram account used for the environmental campaign purposes needs coordinated management efforts to provide clear Initiatives description, creativity, attractive image visualization, communicative and easy-to-understand messages. Besides that, the applicable waste management messages contents must be generally accepted, motivational and be able to drive the people to act positively on managing their wastes.

iii. Educational Blog

Green campaigns for waste management in educational institutions involve a multifaceted approach, integrating educational programs, practical activities, and awareness-building strategies to foster sustainable waste practices. These initiatives aim to cultivate a culture of environmental responsibility by engaging students, faculty, staff, and even parents through interactive and innovative methods. By combining knowledge dissemination with hands-on experiences, such campaigns drive behavioural change, enhance awareness, and promote positive responses to waste control, ultimately contributing to more sustainable campus environments.

Interactive workshops and presentations serve as cornerstone activities in green campaigns, providing targeted education on waste reduction, recycling, and environmental sustainability in institutions. During the sessions, practical insights and trainings on waste management practices,

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such as proper waste segregation, composting, and the environmental consequences of improper disposal are delivered to students, teachers, and parents audience. By engaging formats like group discussions, case studies, and Q&A sessions, workshops foster active participation and critical thinking. For instance, a workshop demonstrating the lifecycle of recyclable materials can demystify recycling processes, empowering participants to make informed decisions.

Educational blogs, videos, infographics, and social media campaigns deliver accessible, visually appealing content that educates students and the broader campus community about waste reduction, recycling techniques, and the environmental impact of poor waste practices. For example, short animated videos illustrating the consequences of single-use plastics or infographics outlining waste segregation guidelines can resonate with tech-savvy students, making complex information digestible and engaging. For instance, during the 2025 World Environment Day digital outreach in Ekiti State, coordinated by the Ekiti Student Skill Up with YOMA Initiative (a digital empowerment partnership with UNICEF and Ekiti State Government), students from multiple tertiary institutions, including EKSU and FUOYE, led awareness efforts[112]. The initiative used social media, online forums, and community outreach to raise consciousness about plastic pollution and promote plastic recycling and proper disposal practices in Nigerian higher education institutions.

Art projects and competitions are another educational initiative that offers creative avenues to promote waste reduction while fostering environmental consciousness. Initiatives such as art and craft projects that repurpose waste materials by creating sculptures from discarded plastics or mosaics from bottle caps encourage students to view waste as a resource, sparking creativity and reinforcing the value of sustainability[113]. Public displays of these artworks, whether in campus

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galleries or communal spaces, serve as visual reminders of the potential for waste transformation, inspiring broader community engagement.

Additionally, educational institutions can organise recycling and waste reduction competitions, incentivising participation through rewards like scholarships, prizes, or recognition for residence halls or departments excelling in waste reduction or clean-up efforts. Such competitions foster a sense of community and friendly rivalry, motivating students to adopt sustainable habits.

While these educational initiatives and training programs are effective in raising awareness and encouraging sustainable waste practices, their long-term success depends on consistent reinforcement and institutional support. Workshops and digital campaigns must be regularly updated to remain relevant and engaging, while competitions and art projects require ongoing funding and coordination to maintain momentum.

To address this, institutions can integrate waste management education into curricula, establish student-led environmental clubs, or partner with local organisations to provide continuous support. These initiatives offer cost-effective, scalable solutions to bridge awareness gaps and foster a culture of environmental stewardship in federal colleges of education with limited resources. By combining interactive education, digital outreach, and creative engagement, green campaigns can transform waste management practices, cultivating lasting habits that extend beyond the campus into broader communities.

Any of the above platforms can be used to create awareness of the green campaign strategies for management higher institution waste, however, it is necessary to ensure that using the correct social media platform is crucial in order for the message to be effectively conveyed. Choosing the right medium is crucial as it enable the message to reach the correct target audience and to

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ensure the budget used is fully effective. It is vital to choose correctly as there are so numerous social platforms to choose from.

2.1.9.2.3 Eco-labelling

Eco-label is one of the underlying tools for green marketing campaign that influences consumers to buy environmentally friendly products. In the waste management context, eco-label refers to a visible certification mark or symbol placed on campus materials, bins, or products to indicate that they meet environmental standards related to sustainability, recyclability, or safe disposal[119]. It serves as an informational and motivational tool to guide students, staff, and faculty in making eco-friendly decisions, particularly in how they generate, sort, and dispose of waste**.** Research has also suggested that green campaign and waste management have grown rapidly through eco-tourism, sustainable, innovative techniques, and green labelling, which are increasingly gaining importance in motivating environmentally friendly behaviour[120].

As part of broader green campaign strategies, eco-labels provide visible, standardised indicators that guide waste disposal behaviour, encourage responsible consumption, and reinforce institutional environmental policies[118]. Eco-labels in HEIs serve dual roles: as **i**nformational cues and behavioural nudges**.** For instance, clearly marked bins with eco-labels such as "Recyclable," "Organic," or "Hazardous Waste" significantly enhance sorting accuracy and reduce contamination rates. Eco labelling strategy of green campaign also emphasises the reusing of papers, rare metals & plastic, which are easily decomposable, biodegradable, naturally made, to maintain ecological balance and that the unsustainable use of natural resources should be stopped by imposing taxes or fines on companies whose packaging infringes on sustainable development goals. Therefore, eco-label symbols should provide clear, accurate information about green products or services, using credible labels that support and encourage consumer adoption.

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Additionally, they should educate consumers on proper waste disposal methods to foster responsible environmental behaviour and contribute meaningfully to environmental sustainability.

Eco-labels also support institutional policy by reinforcing existing waste management frameworks. When embedded into campus-wide environmental campaigns, they become part of a larger ecosystem that promotes waste minimisation and circular economy practices. As part of broader green campaign strategies, eco-labels provide visible, standardised indicators that guide waste disposal behaviour, encourage responsible consumption, and reinforce institutional environmental policies[120].

i. Colour-Coding

Colour-coding is a visual system wherein waste bins are marked by distinct colours to represent specific categories such as biodegradable, recyclable, hazardous, or general waste; others are marked for paper, glass, plastic and metal (See Appendix 4). For example, green often represents organic waste, blue for recyclables, red for hazardous, and black for residual waste. This method enables intuitive participation and reduces the cognitive effort required for waste sorting[44]. The implementation of colour-coded waste bins is to simplify waste sorting, reduce landfill dependency, and encourage responsible waste behaviour among campus users. The use of different coloured waste bins for different types of waste, such as recyclable, non-recyclable waste, decomposable and non-decomposable, is a vital process of green campaign towards effective waste management by making it easier to sort waste, and making it possible to sell recyclable wastes at source to generate income for the school.

Evidence from studies suggests that colour-coded systems enhance environmental consciousness, reduce contamination in waste streams, and support institutional sustainability goals. HEIs that

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adopt this strategy report increased segregation accuracy and reduced contamination in recyclable waste streams[121]. Introducing colour-coded waste separation bins and optimising waste collection centres will enhance waste segregation and facilitate recycling in tertiary institutions[121]. In supporting this, it was also reported that 75% of waste generated at the University of Lagos is recyclable and that 30% of the waste constitutes organic materials, 28% are mixed plastics, and 24% paper[44]. Also greater proportion of waste generated in higher institutions is recyclable, and some members of staff are already engaged in unauthorised waste recycling on campus, while waste pickers/scavengers also enter the campus and undertake unofficial recycling of university waste[3]. Similarly, another study reported that the University of Lagos, Akoka in 2014 implemented a waste management policy which included waste and environmental management orientation for new students, regular awareness jingles on the university's radio station, colour-coded waste bins and signage at strategic locations throughout the campus, and waste management awareness lectures with faculty officers and commercial operators[89]. These studies conclude that proper waste separation at source through the use of colour-coded bins has great potential for recovery and income generation from HEI waste. The colour-coded waste separation bins should be strategically placed at the strategic waste generation points.

Advocating for the use of green initiatives, such as colour-coded bins to separate waste into different categories for efficient recycling, will promote sustainable waste management on campus. This can be supported by providing incentives (monetary and non-monetary as a reward for students and staff who engage in proper waste sorting.

Higher Education Institutions (HEIs) can leverage any of the green campaign initiatives or a strategic combination of two or more to educate students and staff on the benefits of waste

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sorting at source and the adoption of sustainable environmental practices. The adoption of colour-coded waste bins in HEIs represents a low-cost, high-impact strategy for promoting waste segregation and sustainable campus practices. For maximum efficiency, this strategy should be supported by continuous environmental education, regular bin maintenance, and administrative commitment. As campuses continue to serve as microcosms of society, embedding such practices fosters environmentally responsible graduates and institutional leadership in sustainability. It is anticipated that the implementation of similar Initiatives in Federal Colleges of Education would significantly enhance the awareness and capacity of both students and staff regarding efficient waste management practices.

ii. Institutional Policies

Institutional policies play a pivotal role in shaping and sustaining effective waste management systems within Federal Colleges of Education. These policies provide the structural and administrative framework necessary for the implementation of green campaign strategies such as eco-labelling, the deployment of colour-coded waste bins, and the promotion of active student-staff engagement in environmental sustainability practices. A well-defined institutional policy not only demonstrates a college's commitment to environmental stewardship but also ensures the consistent integration of sustainability objectives into everyday campus operations.

Typically, such policies delineate clear guidelines on waste segregation, recycling, composting, and the safe disposal of hazardous materials, serving as operational blueprints for environmental conduct. Importantly, institutional efforts should align with national and global environmental frameworks, including regulatory provisions from the National Environmental Standards and Regulations Enforcement Agency (NESREA) and Nigeria's progressive stance on plastic waste reduction. For instance, the national ban on single-use plastics set to take full effect in January

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2025 compels educational institutions to implement compliant waste management policies, beginning with public sector entities[86].

Within the scope of green campaign strategies, institutional policies serve to formalise eco-labelling practices by establishing standards for signage, waste stream identification, and educational outreach. These policies enhance waste segregation by increasing the visibility of waste categories, promoting structured information dissemination, and fostering greater compliance from campus users. The consistent use and maintenance of colour-coded waste bins mandated by institutional policy reinforce correct disposal habits and drive behavioural change within the academic community. Moreover, comprehensive waste management policies often include the provision of environmental training, workshops, and awareness campaigns, embedding sustainability into the institutional learning environment and culture.

A relevant example of policy-driven green initiatives in higher institution is the Green Campus Project, launched in 2023 by the Statewide Waste and Environmental Education Foundation (SWEEP Foundation) in collaboration with The Coca-Cola Foundation[122]. The project, initiated at the University of Ibadan, targets plastic pollution reduction and promotion of recycling through structured institutional interventions such as the establishment of recycling hubs, formal environmental education Initiatives, and the deployment of waste segregation infrastructure. The aims propagating sustainable institutional policy is to educate undergraduates on environmental conservation, support administrative cost savings by reducing landfill dependency, and engage over students in campus-based recycling activities. However, this model has not yet been extended to Federal Colleges of Education, indicating a critical policy and implementation gap that needs to be addressed.

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Furthermore, institutional policies function as governance tools by ensuring accountability, defining responsibilities, and setting enforcement mechanisms. In some Colleges of Education, such policies are harmonised with national directives, such as the National Environmental Sanitation Policy or guidelines issued by the National Commission for Colleges of Education (NCCE). By embedding green practices into institutional frameworks, Federal Colleges of Education can cultivate an environmentally responsible academic culture, ensure a cleaner and more sustainable campus environment, and ultimately serve as catalysts for broader environmental reform within society. Thus, institutional policies transcend administrative function; they are transformative instruments essential for the long-term realisation of environmental sustainability within the Nigerian educational system.

2.1.9.2.4 Incentive-Based Initiatives

Incentives and rewards are prominent tools for promoting sustainable behaviours in waste management. Incentive-based initiatives play a vital role in promoting efficient waste management within Nigerian higher education institutions (HEIs) by aligning environmental responsibility with tangible rewards. Incentive-based initiatives, such as monetary or non-monetary rewards, effectively motivate environmentally sustainable actions, particularly in college settings encourage individuals and communities to adopt eco-friendly practices. A study discovered that recognition, material incentives, academic rewards such as credits or scholarships and opportunities for further education or employment are among the internal contextual factors influencing college students' waste separation behaviour[105]. The use of green campaigns, such as incentives and discounts for using reusable containers, enhances sustainable waste behaviour. To promote waste to wealth and unlock its full potential, proactive measures like tax-free incentives are required from the government and stakeholders. These will educate

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the public on the benefits of converting waste to energy and conserving natural resources for future generations.

Deposit-refund: Implementing deposit-refund systems for students or offering rewards like discounts, loyalty points, or recognition for participating in recycling or bring-your-own-container campaigns can boost engagement. For example, deposit-refund systems, where consumers return empty containers like bottles or cans to designated collection points for a refund, have proven successful in encouraging responsible waste disposal. While such systems were once common in the soft drink industry, their use has declined. Research shows that such incentive-based strategies significantly increase student participation in campus waste management Initiatives[105]. These initiatives align with green marketing's pricing element, making sustainable choices economically appealing and driving waste reduction to landfills.

Gamification in sustainability involves applying game design elements such as points, badges, leaderboards, and rewards to encourage sustainable behaviours and increase engagement in environmental initiatives. By making sustainability fun, interactive, and rewarding, gamification motivates individuals, communities, and organisations to adopt eco-friendly practices, particularly in areas like waste management, energy conservation, and carbon footprint reduction.

Recognition and material incentives: These incentives aligned with academic and career advancement proved more effective, as students are more likely to engage in waste separation when it contributes meaningfully to their educational goals or enhances their future opportunities. This suggests that higher education institutions should design incentive systems such as giving award for environmental ambassadors, neatest hostels etc. This will integrate

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environmental responsibility with academic and professional development to foster more active and lasting student involvement in sustainable waste practices.

Another crucial point is the integration of financial or material incentives directly tied to waste collection efforts. For instance, in the University of Lagos, "Green Eco Hub" initiative offers meal tickets or bottles of drinks in exchange for depositing plastic bottles. Students who returned 500 bottles were even granted vouchers or cash rewards[121]. This approach transforms waste collection from a purely altruistic act into an engaging activity with immediate personal benefit. As a result, the storage and deposit of over 250,000 collected bottles illustrate the strategy's impact in shifting student behaviour towards recycling,

Amazingly, grant-supported incentive projects such as the SWEEP–Coca-Cola Foundation Green Campus Project amplify the motivational effect by offering logistical and financial support to participating students. Launched across several campuses in April 2023, the program provided stipends, PPE, and logistical assistance to 250 trained student volunteers per institution, who were actively involved in managing recycling drop-off stations.

By combining environmental education with concrete incentives, these programs ensure that students are both resourced and motivated to enable efficient waste sorting and plastic aggregation on campuses.

The Green Campus Initiative offers a model where students earn academic credits or tuition reductions in exchange for collected waste, effectively integrating waste management into their educational goals[122]. This official recognition of environmental work not only incentivises sustained participation but also reinforces the value of ecological responsibility within academic frameworks, enhancing its relevance and legitimacy. Similarly, experiential ventures like

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Wecyclers have empowered low-income communities and can be replicated on campuses by offering cash and commodity rewards in exchange for recyclables.

In partnership with the Nigeria Bottling Company, UNILAG launched the Green Eco Hub and the "Recycle Bottles 4 Drink" campaign, rewarding students with drinks, meal tickets, or water packs for collecting plastic bottles. Despite collecting over 250,000 bottles in a semester, the program fell short of its 1.5 million target, showing the need for wider student engagement[123]. Complementary awareness campaigns, such as "Track, Collect, and Recycle," were also introduced. The main challenge observed is the area of transporting sorted waste, and plans are underway to deploy an eco-friendly vehicle to support the university's sustainable logistics efforts.

Cash for Trash: Some regions implement programmes that provide direct financial incentives to residents who take their recyclable wastes to curbsides or participate in composting[115]. They can receive cash rewards or discounts on waste collection fees based on the amount of waste they divert from landfills.

These models suggest that when combined with campus infrastructure and outreach, incentive-based frameworks can catalyse systematic improvements in waste management behaviours. The examples illustrate how incentive-based strategies in Nigerian HEIs generate measurable increases in waste collection, foster sustainable behaviour, and embed recycling into academic and community structures. The introduction or impact of these initiatives has not been noticed in colleges of education. This is a clarion call to the NCCE, college management, staff and student unions, and other stakeholders in FCEs to embrace such initiatives that will not only improve the campus learning environment but also serve towards achieving sustainable goals.

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2.1.10 Impact of Green Campaign

Green campaign initiatives are making a huge contribution to environmental sustainability by advocating the use of renewable materials and ultimately increasing the supply of renewable materials in the marketplace through efficient recycling. To achieve an environmentally sustainable and green campus, staff and students must have information that allows them to have adequate knowledge about the effect of their actions on the environment and its consequences. There are many reasons for choosing to create or use green campaign strategies of different types to educate individuals on the effects of waste on the environment and protect the planet.

i. Reduced Paper Usage - As the world is going paperless, HEIs should reduce paper usage by carrying on most of their activities virtually through CBT, online communication among staff for directives. This can be done by organising e-learning and online resources for students, using digital tools for administrative tasks, and encouraging students to submit assignments online. By reducing paper usage, Federal Colleges of Education can conserve trees, reduce waste generation, and promote a clean environment.

ii. Eco-Friendly Products - Encouraging the use of eco-friendly products on campus, such as biodegradable bags, recycled paper products, and reusable water bottles, can also promote sustainable waste management. This can be done by partnering with vendors who offer such products or by providing incentives for students and staff to use them[122]. The University of Port Harcourt has implemented a waste-to-wealth program that involves producing eco-friendly products.

iii. **Green Transportation** - Encouraging students and staff to use green transportation such as bicycles, tricycles, and public transportation, can help reduce the carbon footprint of waste in the school environment. Colleges of education can provide bike racks to encourage the use of

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bicycles, carpooling rather than personal vehicles, etc. The Federal University of Technology, Akure, has implemented a green transportation initiative that involves providing shuttle buses, promoting carpooling as against personal driving, and encouraging the use of bicycles[75]. This reduces the amount of gaseous emissions, smoke, and fume pollution from vehicular traffic as such vehicles are drastically reduced from plying the roads.

iv. Resource Conservation: These campaigns encompassing eco-awareness programs, policy advocacy, and behavioural change communication highlight the environmental and economic benefits of reducing, reusing, and recycling resources. Through the implementation of green campaigns, HEIs can significantly reduce the volume of waste generated by promoting responsible consumption patterns and minimising dependence on disposable products. For example, campaigns that encourage the use of reusable water bottles, electronic rather than paper-based documentation, or eco-friendly packaging contribute to reducing waste at the source and conserving raw materials[124]. As a result, fewer resources are extracted and processed, leading to lower carbon emissions and a more efficient use of natural capital.

Furthermore, waste separation at source also enhances material recovery, which is essential for resource conservation. By promoting the separation of organic waste, plastics, paper, metals, and electronic waste through clear labelling, signage, and education, these institutions can facilitate recycling and composting processes more effectively. The reprocessing of materials such as paper and plastic not only reduces the need for virgin resources but also saves energy and mitigates environmental degradation[125].

v. Experiential Learning Platforms: Additionally, green campaigns in Federal Colleges of Education can serve as experiential learning platforms where students are actively involved in resource conservation efforts. Projects like campus clean-ups, zero-waste days, and

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sustainability-themed initiatives inculcate environmental ethics and empower youth to innovative solutions that enhance resource efficiency[126]. Student-led initiatives supported by institutional green policies significantly contribute to reducing ecological footprints while reinforcing academic knowledge with practical skills. When educational institutions incorporated green campaigns into their academic curricula and governance structures, they not only ensured compliance with environmental regulations but also cultivated a new generation of environmentally conscious citizens and leaders.

vi. Sustainable Environmental Practices: This involves the responsible handling, reduction, reuse, recycling, and disposal of waste materials to minimise their negative impact on the environment and maximise the recovery of valuable resources[127]. Effective resource conservation requires a multi-faceted approach involving individuals, businesses, governments, and communities to be conscious about the impact of waste on the environment and to adopt best practices for achieving sustainability goals. Educational stakeholders should explore the potential of waste as a resource by investing in waste recycling facilities to address the mounting volume of the non-biodegradable components in MSW, while equally seizing the opportunity of the high organic component to set up waste composting facilities[117]. Green campaign strategies for waste management in FCEs serve as critical instruments for promoting resource conservation by fostering a culture of sustainability among students, staff, and administrators. Resource conservation can be achieved maximally through the following practices, among others:

vii. Establishing Recycling Initiatives: To promote sustainable waste management and conserve environmental resources, it is essential to educate and training the public on the importance of waste recycling. This involves not only raising awareness but also providing accessible and convenient recycling bins and centres to encourage participation. Recycling

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initiatives should also be extended to the reuse and recycling of construction and demolition waste, including materials such as concrete, wood, and metal, which often litter most school environments. This will also facilitate efficient collection and processing waste materials like paper, cardboard, plastics, glass, and metals can significantly reduce the volume of waste directed to landfills, conserve natural resources, and lessen environmental pollution.

Furthermore, promoting sustainable lifestyles among businesses and individuals plays a critical role in advancing waste reduction. Encouraging the use of reusable containers, reducing reliance on single-use plastics, and supporting the principles of the circular economy can lead to more responsible consumption patterns. Composting organic waste such as food scraps and yard waste offers an environmentally friendly alternative to disposal, enriching soil and supporting agricultural productivity. Additionally, e-waste recycling must be emphasised through public education on the safe disposal of electronic devices. By salvaging valuable components and properly managing hazardous substances, the environmental impact of discarded electronics can be minimised, contributing to a cleaner and safer environment.

Ultimately, adopting green campaigns on waste reduction strategies is vital for conserving resources and protecting the environment. Through sustained public education, the promotion of sustainable practices, and the establishment of efficient recycling systems, FCEs can significantly reduce environmental degradation and foster a culture of responsibility. These efforts not only safeguard natural resources but also support long-term ecological and economic sustainability.

i. Green Campaigns Influence on Plastic Waste

Plastic waste has become one of the most pressing environmental challenges of the 21st century due to its long-lasting nature, widespread presence and harmful effects on the environment. On

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university and college campuses, plastic waste is primarily generated from single-use items such as table water bottles, food wrappers, disposable cutlery, and packaging materials. These materials often end up littering school grounds, clogging drainage systems, or being improperly disposed of, posing threats to both human health and the environment[128]. Effective management of plastic waste within educational institutions is essential for promoting a clean, sustainable, and health-conscious academic environment. To tackle the threat of plastic overwhelming the world, every hand has to be on board to convert the old plastics items to new functional products (See Appendix 4). The public as well as private sectors must be involved and be willing to work together. Plastics may be an environmental challenge, but they are equally a path to immense opportunities in job creation, and they are capable of being reused as raw materials for the production of other goods. Notably, several potential solutions can be explored, from plastic recycling to curb the menace of plastic (PET) waste and converting it to material resource optimisation.

Green campaigns have increasingly gained recognition as instrumental approaches in addressing the plastic waste problem on campuses through many of their coordinated initiatives designed to raise awareness, influence behaviour and mobilise collective action among students and staff within the campus environment. Green campaigns on campuses typically involve workshops and poster exhibitions on the conversion of recyclable plastics to monumental artistic objects, and other new functional products can greatly reduce the menace of plastic waste[129].

Most importantly, the campaigns for the promotion of the principles of the circular economy, specifically the "Reduce, Reuse, Recycle" (3Rs) framework, are fundamental in encouraging students to minimise plastic use, replace single-use plastics with reusable alternatives, and participate in campus-wide recycling initiatives[96]. The provision of labelled waste bins,

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improved recycling infrastructure, more recycling centres, implementing effective collection systems, and creating markets for recycled PET will make plastic recycling a lucrative business for waste management and economic development[129].

In partnership with external recycling firms, NGOs, manufacturing companies and governmental agencies can organise and implement measures towards effective collection and processing of plastic waste[53]. There are many plastic recycling plants in Nigeria, such as Wecycler, reportedly eight (8) completed plastic waste recycling plants in Nigeria, with 18 others at various stages of completion[130]. Examples of pioneering circular plastics companies include Lagos-based Salubata, which produces shoes from recycled plastics waste (this company was also the recent winner of African Innovation Week (2020)[131].

Government and other stakeholders should encourage the establishment of plastic recycling companies to convert the abundant plastic waste into wealth through green production.

Furthermore, green campaigns can serve as platforms for institutional change and environmental policy advocacy. Engaging stakeholders through campaigns allows students and staff to push for sustainable procurement policies, such as restrictions on plastic packaging, institutional support for refillable stations, adherence to plastic reduction strategies, or the integration of sustainability into curriculum design.

The integration of plastic waste management with green campaigns not only addresses immediate environmental concerns on campus but also plays a transformative role in shaping sustainable behaviours. When students are actively engaged in green initiatives, they develop a sense of environmental stewardship that often extends beyond the academic setting. Green campaigns thus become a catalyst for broader ecological consciousness and long-term behavioural change, which is essential for combating plastic pollution and fostering a resilient,

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circular economy. These measures not only reduce waste volumes but also promote eco-conscious values and sustainable living habits among the student population and the society at large.

ii. Green Campaigns Influence on Metal Recycling

Metal recycling, also known as metal reprocessing, is a vital green practice that reduces the need for extracting and processing virgin materials, conserving finite resources like iron, copper, and aluminium. Metals are valuable materials that can be recycled repeatedly without losing their intrinsic properties, making metal recycling an important component of sustainable waste management and resource conservation[133]. By collecting, processing, and reusing metals, this process minimises environmental impacts from mining in the form of pollution and water contamination, while significantly cutting energy consumption. Metals' ability to be recycled repeatedly without losing their properties makes them a cornerstone of sustainable waste management, supporting industries like construction, automotive, and manufacturing with cost-effective, high-quality materials while reducing greenhouse gas emissions and landfill waste. These items are refurbished to meet the demand of the populace in iron and steel manufacturing.

The global scrap metal industry drives economic and social benefits, particularly in regions like Nigeria, from the 2015 Central Bank ban on foreign exchange for steel imports which spurred growth in local recycling, boosting non-oil sectors and creating income for informal collectors, and subsequently increasing the contribution of mining and steel production to the country's gross domestic product[134]. Scavengers gather metals from dumpsites, households, and workshops, selling them to intermediaries who supply recycling companies, transforming scrap into products like vehicle parts, pipes, and household goods[29]. This not only fosters a circular economy but also supports livelihoods, with recycled metals meeting high demand in local

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manufacturing, thereby enhancing economic growth and reducing reliance on imported materials (See Appendix 4).

Metal reprocessing opportunities, especially within the informal sector, have led to the collection of used metals such as copper, lithium, and aluminium from dumpsites, household items, industries, and mechanic workshops by scavengers. These individuals, who may not fully grasp the reasons behind the increasing demand for certain substances, collect these and sell them to intermediaries, who in turn engage directly with recycling companies to maximise profits. The items are melted and transformed into various local products, including vehicle body parts, iron pipes, cooking stoves, farm implements, local pots and pans, and buckets.

Despite its benefits, metal recycling faces challenges, including contamination, inefficient collection and sorting, and fluctuating market prices. Governments worldwide are addressing these through regulations, curbside pickups, recycling centres, and incentives to protect informal collectors and ensure efficient recycling processes. By promoting continuous material reuse, metal recycling aligns with circular economy principles, minimising industrial environmental footprints. For higher education institutions (HEIs), integrating metal recycling into green campaign strategies can enhance sustainability efforts, reduce waste, and educate communities on resource conservation, reinforcing the role of recycling in sustainable development.

iii. Green Campaigns Influence on Energy Recovery

Nigeria possesses a great opportunity to generate energy from the vast quantities of waste produced by its rapidly growing population, thereby positioning Waste-to-Energy (WtE) technology as a vital component of the country's sustainable development plan. Waste-to-Energy (WtE), widely referred to as Energy Recovery, is a pivotal green strategy that transforms non-recyclable waste into valuable energy forms such as electricity, heat, or biogas, offering a

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sustainable solution to waste management challenges. In Nigeria, where rapid population growth generates significant waste, and yet no access to regular electricity supply, WtE presents an untapped opportunity to address the persistent energy deficits, reduce greenhouse gas emissions, and promote sustainable development[136]. The potential energy yield from different waste streams, combined with economic viability, environmental benefits, and social impacts, demonstrates the importance of WtE technology for the country. A study noted that the lower heating value of municipal solid waste and agricultural residue significantly affects energy yield, and that incineration of 27.36 million tons of organic waste annually, while using relevant technology with energy recovery, could generate between 14.52 and 23.08 TWh of electricity per annum[137].

By integrating WtE technologies like incineration, gasification, and anaerobic digestion into waste management systems, higher education institutions including FCEs can lead the charge in fostering sustainable campus environments. Green campaigns in colleges can play a critical role in raising awareness, educating students and staff, and advocating for the adoption of WtE practices, aligning with circular economy principles to minimise landfill dependency and conserve depleting natural resources for future generations.

Incineration burns waste at high temperatures to produce heat and electricity, while gasification converts waste into syngas for energy generation; these are cheaper alternatives for heat generation for various uses at the domestic or industrial level. Anaerobic digestion, particularly suitable for Nigeria's warm climate (10°C–35°C), biologically processes organic waste into biogas, which can be used for cooking, heating, or power generation, serving as a clean development mechanism to mitigate global warming[138].

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Despite Nigeria's abundant waste and favourable conditions for WtE, the adoption remains limited due to challenges such as insufficient technical expertise, financial constraints, weak regulatory frameworks, and low public awareness. Green campaigns in HEIs can address these barriers by promoting efficient recycling, waste to energy education, advocating for zero-waste campus, and fostering collaborations with federal governments for funding of necessary infrastructure. To fully attain the potential for waste-to-energy in Nigeria, the government and other stakeholders must take more proactive measures in promoting and regulating the energy industry. These could include providing tax incentives for waste-to-energy companies, streamlining the permitting process, and investing in education and outreach programmes to raise awareness of the benefits of converting waste to energy and conserving the depleting natural resources for future generations.

2.1.11 Factors Affecting Green Campaign Strategies

Green campaign initiatives aimed at promoting environmental sustainability, efficient waste management, including Waste-to-Energy (WtE) technologies, in Higher Education Institutions (HEIs) face several barriers that impede their effective implementation. These challenges are particularly pronounced in developing countries like Nigeria, where limited resources and structural inefficiencies worsen the difficulties.

i. **Limited Financial Resources and High Initial Costs** - The implementation and sustainability of green campaign strategies are often impeded by inadequate funding in tertiary institutions. Developing and maintaining initiatives such as eco-labelling programs, incentive-based schemes, colour-coded bin systems, and environmental advertising requires substantial financial investment, which many colleges cannot afford. Moreover, financial limitations affect students' capacity to participate actively in green practices, such as

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recycling or digital advocacy, especially when such activities require a high initial cost and additional costs for maintenance[139]. Without sustainable funding from government, private sector partnerships, or institutional budgets, most green campaigns would not be effective and thus thereby limiting their long-term impact on students' waste management attitudes and behaviours.

ii. **Lack of Technical Expertise and Trained Personnel -** Despite the potential of digital tools to enhance green campaign strategies, the uneven access to advanced technologies and digital infrastructure remains a significant limitation, particularly in developing nations like Nigeria. Many Federal Colleges of Education lack the requisite digital facilities, such as smart waste monitoring systems, social media analytics tools, and interactive learning platforms, which are essential for promoting sustainable behaviours among students[140]. This technological gap limits the ability of the college community to participate in sustainable waste management for tracking and awareness. Moreover, students often lack the technical literacy required to engage meaningfully with tech-driven sustainability initiatives. The shortage of technical expertise and skilled labour for the operation and maintenance of WtE plants is a significant barrier[137]. There is an urgent need for investment in research and development, training Initiatives, and technology transfer to produce well-trained technicians and professors in practical waste management.

iii. **Inadequate Policy and Legal Frameworks -** Weak or absent regulatory frameworks at the institutional and national levels pose significant obstacles to efficient waste management in Nigeria. In Nigeria, the lack of clear policies supporting WtE and sustainable waste management limits institutional accountability and hinders the integration of green campaign practices into campus waste operations[75]. For example, the absence of streamlined permitting

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processes for WtE facilities discourages investment and adoption. A 2022 review of waste management in Sub-Saharan Africa emphasises the need for enforced environmental sanitation regulations to support sustainable practices, a gap that affects HEIs[137]. Furthermore, the 2024 Global Waste Management Outlook underscores the importance of robust policy interventions to address waste management challenges, noting that global waste management services are often ill-equipped without such frameworks[63].

iv. **Low Awareness and Resistance to Change** - Many HEI stakeholders, including students, faculty, and administrators, lack awareness of the benefits of sustainable waste management practices with green campaign strategies such as environmental advertising, colour-coded bins and eco-labelling for sustainable waste management. Cultural and behavioural barriers, such as indifference from senior management or a lack of student commitment, further complicate efforts to foster sustainability. Public awareness campaigns should be launched to inform citizens about the advantages of green technologies for environmental protection, energy generation, and economic opportunities. Students and staff should be co-opted in the planning and decision-making processes on green initiatives to motivate them and increase trust[137].

v. **Inadequate Infrastructure and Logistics -** The lack of appropriate infrastructure, such as waste sorting facilities, anaerobic digesters, or recycling centres, hinders the practical implementation of green campaign initiatives in HEIs. In developing countries, logistical challenges, including inefficient waste collection and transportation systems, exacerbate these issues. For instance, a 2022 study on solid waste management in the Global South notes that unsustainable practices, such as mixing household and hazardous waste, complicate waste processing due to inadequate infrastructure. In Nigeria, the absence of modern waste

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management facilities on campuses limits the feasibility of WtE projects, as highlighted in a 2024 analysis of WtE potential[137].

vi. **Limited Stakeholder Engagement and Collaboration** - Effective green campaigns require active participation from all campus stakeholders, students, faculty, administrators, and external partners like local governments and industries. However, achieving this level of engagement is challenging due to a lack of institutional interest, coordination, or incentives. Lack of proper motivation for students and staff to engage in sustainable practices by the environmental stewardship representatives and institutional leadership hinders the sustainability efforts of green campaign strategies in HEIs[141].

vii. **Monitoring and Reporting -** An essential but often neglected component of green campaign strategies is the systematic monitoring and reporting of outcomes. Without effective mechanisms to track campaign coverage, waste reduction metrics, and changes in student attitudes, it is difficult to assess its impact. Most institutions do not have structured monitoring systems or the human resources to collect and analyse data on environmental practices[142]. Inadequate reporting reduces accountability and hinders transparency, weakening institutional learning and continuous improvement, making the students perceive the campaigns as irrelevant, thus discouraging them from active participation[143].

viii. **Inadequate Orientation and Misuse** - Lack of consistency in waste management awareness campaigns often prevents their full adoption in federal colleges of education. For instance, colour-coded bins are often misunderstood or misused due to a lack of student sensitisation and proper environmental education, thereby undermining sorting effectiveness[144].

Overcoming these challenges demands a steadfast commitment from college leadership to environmental sustainability initiatives to enhance waste management practices. This includes

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fostering a culture of environmental responsibility among students, faculty, and staff through regular environmental awareness campaigns and educational Initiatives. Additionally, campus management must stay proactive in aligning with evolving environmental regulations and seek. stakeholder support from the government, in particular, to effectively integrate Waste Recycling, Waste-to-Energy (WtE), and other sustainable waste management initiatives in the campus.

2.1.12 Students' Attitude

Students' attitude refers to the collective beliefs, perceptions, feelings, and behavioural tendencies that students hold toward environmental practices. Students' attitudes towards waste management refer to students' favourable or unfavourable feelings regarding certain characteristics or occurrences in their physical environment[21]. This includes their level of concern for environmental issues, their willingness to participate in keeping the campus clean, engaging in green initiatives such as recycling or proper waste segregation, and their sense of responsibility toward maintaining a sustainable campus environment.

Waste generation in higher education institutions (HEIs) continues to grow due to increasing enrolments, consumption patterns and urbanised lifestyles. HEIs, as knowledge centres, are strategically positioned to shape future leaders' perspectives and behaviours regarding environmental sustainability. However, the extent to which students internalise and practice sustainable waste management remains underexplored in Nigerian colleges of education. Understanding and enhancing students' attitudes towards waste management is crucial in fostering a culture of sustainability within and beyond college campus boundaries. Waste management should be a critical component of environmental sustainability, particularly within all HEIs that function as microcosms of broader society.

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Every school generates waste from routine activities such as classwork, compound sweeping, serving food, and bush cutting. Educational interventions are therefore essential to ensure students have the required knowledge and understanding, as well as positive attitudes towards waste management on campus through environmental education, scientific training in environmental sustainability initiatives such as waste reuse and recycling. It is expected that, as part of the learning process, waste management activities in schools should involve students by building the right attitudes toward waste management[145].

Students' attitudes toward waste management in Higher Education Institutions play a critical role in achieving sustainability. Positive students' attitudes, marked by environmental awareness, implementation of coloured waste bins at strategic points and participation in recycling practices would greatly lead to a reduction HEIs' environmental impact. Environmental education is vital for shaping students' attitudes toward effective waste management in HEIs. Research in developed countries, indicates that environmental advertising, social media campaigns and eco-labelling initiatives, among others, highlighting waste mismanagement consequences, foster sustainable behaviours, yet in developing countries, insufficient practical training hinders students' ability to act on their awareness[146]. Incorporating sustainable waste management practices through educational training and workshops, social media platforms, and the use informative flyers and signage, are essential to bridge this gap.

There is a significant relationship in the level of awareness and attitudes of students to waste management in Federal Colleges of Education in the South-West Geo-Political Zone of Nigeria; the study confirmed that students had a high level of knowledge regarding society waste management. Most students in Malaysia were reported to have become aware of the importance of waste separation through social media[99]. The use of Instagram to enlighten students about

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waste management was considered an effective initiative to achieve sustainable waste behaviour[126].

HEIs can enhance the impact of students' positive attitudes through education, infrastructure, and incentives. Programmes like composting workshops and recycling campaigns promote practical engagement, while incentives like cash and non-cash rewards motivate participation. These strategies foster a culture of environmental stewardship.

In public establishments like Federal Colleges of Education, indiscriminate waste disposal has always be a major challenge. The widespread use of non-biodegradable materials such as plastic and polythene packaging has worsened waste management challenges on campuses. Poorly managed waste dumpsites beside hostels, offices, and classrooms attract pests and disease vectors, posing serious health risks. The rapid increase in students' enrolment in many institutions often worsen this issue, as waste generation outpaces disposal capacities by the maintenance units in most institutions. In essence, evaluating students' attitudes and behaviours toward waste management is vital for the development of impactful educational programmes and policies that support sustainable development goals within school environments.

Waste management activities in schools should involve building the right attitudes in the students toward proper waste management. Individuals, particularly youth, should be taught with a positive attitude toward SWM, through environmental education, which will teach them to respect the environment and its resources[21]. This will have consequences for the environmental sustainability level to be achieved in the entire country, as youth have the tendency to influence the overall behaviour of adults in the society.

A study conducted on environmental knowledge and attitudes shows that students can develop high levels of understanding and positive attitudes through reading studies and information

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regarding the environment[21]. Most recent studies that explored various factors that influence students' attitudes toward waste management with emphasis on how knowledge, perceptions and belief, behaviours, intentions and actual actions, as well as social and environmental factors contribute to waste management practices among students; affirmed that students' attitudes greatly affect their waste management practices.

This study seeks to assess how attitudes, knowledge, perception, beliefs and behaviour of students in FCEs affect their solid waste management system, as well as their awareness of the health risks linked to poor waste management. This is necessary to properly address several key issues that relate to waste management within the institution and identify areas where education and awareness are lacking.

2.1.12.1 Students' Knowledge

Students' knowledge and attitude toward waste management are fundamental determinants of how effectively sustainable environmental practices are implemented within educational institutions and communities. These two factors, knowledge and attitude, are interrelated yet distinct: knowledge pertains to what students know about waste and its handling, while attitude reflects students' disposition and their willingness to act is based on the knowledge. The students' knowledge and awareness about waste separation significantly influenced their attitudes and behaviours toward waste management[118]. Educational interventions are essential to ensure students have the required knowledge and understanding, as well as positive attitudes towards waste separation on campus, such as environmental education[147]. The research highlighted that students with higher awareness of waste types and disposal methods are more likely to engage in proper waste separation practices. In terms of waste separation knowledge, it

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was also justified that knowledge and attitude, as well as acceptance of waste education, significantly affect college students' willingness to separate waste[117].

Students generally exhibit moderate levels of knowledge about waste management, depending on education level, curriculum exposure, geographic region and based on the key elements of waste management knowledge they possess such as waste types (biodegradable vs. non-biodegradable, hazardous vs. non-hazardous), waste handling methods (reduce, reuse, recycle, composting, etc.; awareness of environmental and health implications of improper waste disposal [146]. Students will also demonstrate a moderate understanding of waste management basic concepts, such as waste segregation and the environmental impacts of improper disposal. However, this knowledge tends to be superficial as most students are not thoroughly enlightened on areas like hazardous waste handling, composting techniques, and the intricacies of recycling processes. Full understanding of these areas will translate to efficient waste management that is centred mostly on waste separation and recycling.

2.1.12.2 Students' Perception and Beliefs

Perception refers to the way students interpret information related to waste and its impact on health, the environment, and society. It influences whether they view waste as a personal responsibility or a systemic issue beyond their control, while beliefs include the convictions students hold about the effectiveness of waste management, their role in the process, and the perceived benefits or consequences of action or inaction. Students' perception and beliefs are often shaped by cultural, religious, familial, and peer influences. Students' perception and beliefs significantly shape their waste management behaviours by mediating how knowledge is internalised and translated into practical action. While knowledge

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provides information, perception and belief systems determine motivation, values, and the emotional drivers behind environmental actions[145].

A study among Chinese university students revealed that personal norms and environmental knowledge significantly influenced their waste management behaviors, but most students often disengaged from waste sorting because they believed the waste was ultimately not properly managed by authorities, suggesting that fostering a sense of personal responsibility and efficacy is crucial in evolving students' participation in waste management[148]. Consequently, students who believe that waste management is a civic duty are more likely to engage in positive behaviours such as waste sorting, reuse, and participation in clean-up initiatives because they perceive themselves as key agents of environmental change and are more likely to engage in sustainable waste practices[152].

2.1.12.3 Students' Behavioural Intentions

Behavioural intention is the willingness to participate in an action. Behavioural intention of students to waste management is the willing of students to engage in waste management initiatives, it includes their intention to properly dispose of waste even when no one is watching, readiness to educate peers about waste management, adopting sustainable consumption habits (e.g., using reusable items) and willingness to report improper waste disposal by others. These activities are a strong predictor of actual behaviour. A study assessing students' awareness and practices toward solid waste management found that while students exhibited a positive attitude and willingness to participate in waste separation, there was room for improvement in both knowledge and practices[146]. This underscores the importance of strengthening students' behavioural intentions through targeted educational interventions.

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Educational institutions serve not only as centres of learning but also as platforms for cultivating environmentally responsible behaviour among students and staff. Targeted efforts must be put in place by the school authority to bridge the gap between students' knowledge of proper waste management and their actual behavior[145]. As future change agents, students possess the capacity to influence public attitudes and propagate sustainable waste management practices within their communities. When adequate knowledge and awareness initiatives are communicated to the students, they will be enlightened about health hazards that are linked to improper waste management in order to promote appropriate behaviours that safeguard public and individual health[147]. Moreover, students' attitudes serve as indicators of future societal behaviour, affirming the role of HEIs in shaping national values. While, considering the reports from some HEIs on students' waste management based on their students' responses, it was noted that students are more likely to engage in actions and behaviour that have a positive impact on sustainable urban development and suggested that environmental education should be taught in the university and in more engaging and practical ways[149].

2.1.12.4 Students' Actual Behaviour

Students' actual behaviour significantly impacts waste management in academic settings. Actual waste management behaviours among students are influenced by various factors, including knowledge, attitudes, environmental awareness, social norms, peer influence and convenience[148]. Students who are more environmentally aware and witness their peers practising sustainable waste management are more likely to adopt these practices themselves. This strongly confirms that peer influence is a crucial factor in motivating students. Additionally, the availability and accessibility of waste management infrastructure within the school premises will also contribute to shaping students' behaviour towards waste management.

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Schools play a crucial role in enhancing students' awareness of recycling and motivating their engagement in household waste management practices. This is so because habitual practices are often displayed anywhere the person finds himself; thus, efficient waste management practices acquired in school will be transferred to the community at large. Regrettably, a study on college students' attitudes toward waste separation and recovery on campus found that while students generally had a positive attitude toward waste separation, their actual practices were not always consistent with their attitudes[118]. This discrepancy highlights the need for practical interventions and provision of adequate waste management infrastructure that will facilitate the translation of positive attitudes into consistent behaviours[150]. Educational institutions must take a holistic approach that integrates cognitive, affective, and behavioural learning outcomes to transform awareness into sustained environmental actions. This will not only improve campus cleanliness but also prepare students to be responsible environmental stewards in their communities.

Students' actual behaviour in proper waste disposal (using colour-coded bins), participation in school clean-up activities either in hostels or lecture rooms, personal efforts in waste minimization e.g., reducing paper or plastic use and making efforts in recycling practices through waste and reusing of materials will have significant positive effects on waste management on campus and by extension in the homes and the society at large. To achieve a successful waste management programmes in educational institutions, a published waste management plan should be developed to include clear periods for awareness-raising and behavioural change activities, as well as provision of infrastructural facilities, such as e.g. sufficient availability of bins across the campus[151]. Strategies to promote sustainable waste management behaviour, such as incorporating environmental education into the curriculum, developing convenient waste management infrastructure, and implementing social marketing campaigns, are crucial for environmental

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sustainability on campuses. By adopting these strategies, educational institutions can encourage students to develop sustainable waste management practices that benefit the environment.

2.1.13 Factors Affecting Students' Positive Attitudes

The mounting problem of solid waste has placed immense pressure on environmental systems globally. Institutions of learning, particularly tertiary institutions play a critical role in shaping sustainable behaviours among future leaders. Unfortunately, despite the evident necessity of responsible waste handling, inadequate environmental education, lack of modern infrastructure, technological and financial limitations, poor policy implementation, as well as students' negative or indifferent attitudes toward waste management practices are some of the factors hindering effective student involvement in waste management [146]. When these factors are undermined, the likelihood of sustained environmentally friendly practices diminishes.

Inadequate Environmental Education - Environmental education (EE) has not been included in the academic curriculum for tertiary institutions across many developing and developed nations. EE is a learning process that aims to increase awareness, knowledge, and skills to solve environmental problems and promote sustainable development. Environmental education plays a vital role in efficient waste management, particularly in developing countries, for raising awareness, changing attitudes, and promoting sustainable practices among individuals, especially the youth and it can also evolving their positive attitudes towards waste separation on campus[152]. However, most institutions are yet to include this vital subject in their curricula. Students often lack foundational knowledge about the environmental impact of waste and the importance of proper waste separation, recycling, composting, and disposal. Even where students are taught waste management, it is often theoretical and devoid of practical engagement; "Without

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structured and action-oriented environmental education, students remain ill-equipped to participate meaningfully in sustainable waste initiatives[152]".

Poor Waste Management Infrastructure - The absence of adequate bins, recycling centres, and waste segregation mechanisms in schools discourages students from participating actively in efficient waste management behaviours. In many campuses, students are confronted with overfilled bins, a lack of composting facilities, and poor collection systems[153]coupled with indiscipline among the maintenance staff who often leave the overfilled bins unattended. The installation of colour-coded waste bins will encourage students to separate their waste while disposing of them.

Cultural perceptions about cleanliness, gendered expectations of environmental care, and peer influence shape students' attitudes. In some contexts, waste management is wrongly associated with low-status labour who are often stigmatised due to the nature of the job thus causing students to distance themselves from engaging in waste management practices[154].

Policy and Institutional Gaps - Many educational institutions lack explicit policies or mechanisms guiding student participation in waste management, even where they exist, enforcement is often weak or inconsistently applied as a result of human factors. The lack of institutional accountability reduces students' motivation to act responsibly. Considering the deleterious health effects of improper waste management, strict enforcement of policy is necessary on campuses to encourage proper waste management by all occupants, be students or staff.

Lack of Incentives and Student Engagement - Students are often not actively involved in the planning or execution of the waste management programmes due to the non-availability of incentives as motivators. The absence of reward systems or gamified approaches also reduces

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students' enthusiasm for participation in efficient waste management[155]. For instance, incentives in the form of deposit systems, where students return empty containers like bottles or cans to designated collection points and receive a refund on their deposit, is a financial reward to motivate responsible waste disposal behaviour among students.

Technological Limitations - In the digital age, students are highly responsive to media and mobile technologies. However, there is often a lack of innovative tools such as waste management apps, digital reminders, or interactive waste tracking platforms in school settings. Additionally, environmental campaigns are poorly communicated in the campuses as well as in our communities.

Waste management system in societies requires accurate planning and cooperation of all residents. In particular, successful waste management initiatives for Federal Colleges of Education as a large community need the commitment and effective participation of students who form the larger percentage of residents in the college. They are the most important part of college community residents, and their attitude and participation in campus waste management practices play a key role in the successful implementation of college waste management projects. Therefore, a better understanding of the attitudes of students toward waste management generally and the factors influencing their behaviors are greatly significant to contribute to the promotion of efficient waste management system in campuses.

2.2 Theoretical Review

This theoretical review explores the synergistic relationship between green campaign strategies, students' attitudes and waste management practices. It examines the role of eco-conscious approaches in mitigating environmental impacts, specifically focusing on waste reduction, recycling and sustainable consumption patterns. Recent scholarly contributions are integrated to

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provide a comprehensive overview of the evolving landscape of green campaign strategies, students' attitudes and their influence on waste management. The theoretical foundation of this study is anchored on four interrelated frameworks that explain how green campaign strategies, students' attitudes and waste management interact within higher education contexts.

2.2.1 Theory of Planned Behaviour (TPB)

The Theory of Planned Behaviour (TPB) was developed by Icek Ajzen in 1991, as an extension of the Theory of Reasoned Action (TRA) originally formulated by Fishbein and Ajzen (1975). In the original model of TRA, intention plays the central role in determining a planned behaviour; this variable is influenced by two critical factors, including subjective norms and attitudes toward behaviour[156.] TPB incorporated an additional construct: perceived behavioural control, to account for factors outside the individual's control that influence behavioural execution. The model postulates that the intention to perform a particular behaviour is an outcome of the three conceptually independent determinants - attitudes, subjective norms and perceived behavioural control - over the behaviour in question. Ajzen concluded that a person who has a positive attitude towards a particular behaviour has a greater intention to engage in this behaviour[155]. Over the years, the TPB has been used in many research fields to understand behaviour. It is applicable in the study of human health, water conservation, energy depletion, food choice and waste recycling.

In the context of waste management, the TPB is applied to show the relationships between attitude, social pressures, and perceived control over the act of recycling, as determinants of intention to recycle as well as recycling behavior[155]. The Theory of Planned Behaviour (TPB) explains the reasons for waste management behaviour by emphasizing the three core components: attitude, subjective norms, and perceived behavioural control. It states that a

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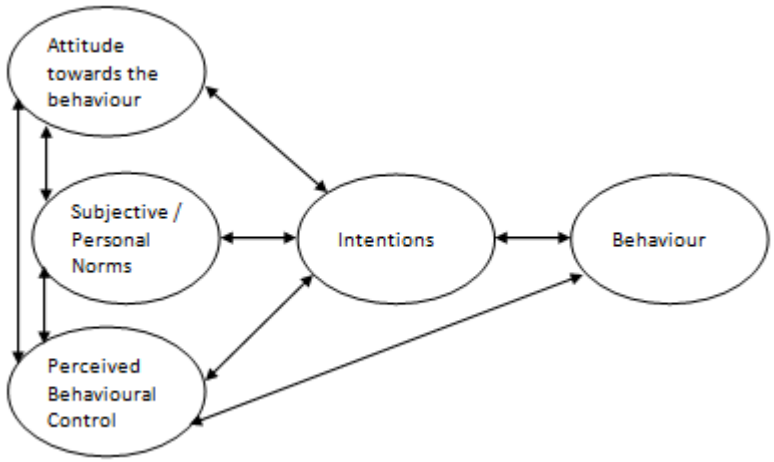
positive attitude toward proper waste disposal and recycling fosters a willingness to engage in sustainable practices. Social pressure from peers, educators, and institutional policies further strengthens students' intention, to conform to environmental expectations of cleanliness. Additionally, the perceived ease or difficulty of carrying out waste management activities such as access to recycling bins, awareness campaigns, and supportive infrastructure will directly affect the students' participation. The availability of these contextual factors will promote effective waste management behaviours in educational institutions.

Several wealth of empirical data supports and contributes to the popularity of the TPB in predicting both intention to recycle and recycling behaviour, such as [156, 157, 159]. A study carried out to determine the effect of applying the theory of planned behavior to recycling behaviour of students in South Africa, confirmed that the TPB remains a useful model for examining the variables that affects recycling behavior. It revealed that while intention to recycle matters, a person's perceived control or belief in their ability to recycle is a stronger influence. This suggests that empowering individuals' confidence in their recycling actions can significantly motivate better waste management.[156]. This indicates that the planned behaviour of individual in recycling would greatly affect their recycling ability, and hence a motivating factor in waste management in campuses.

Another study titled "Understanding Waste Management Behavior among University Students in China: Environmental Knowledge, Personal Norms, and the Theory of Planned Behavior" discovered that personal norms represent an altruistic perspective to understand pro-environmental behavior, thus personal norm has been added to the variables in the TPB to predict both intention to recycle and recycling behavior[159]. A significant effect of personal norms was found on the waste management behaviour of university students. This suggests that moral

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concern would be an essential factor driving waste management behaviour in general. These studies affirm that the TPB remains a relevant framework for analysing behaviours related to waste and recycling, particularly when extended to include variables such as moral norms, environmental knowledge, and emotional influences.



The Theory of Planned Behaviour (TPB) of Ajzen (1991)[159]

While the Theory of Planned Behavior (TPB) offers valuable insights into behavioural intentions, it has notable limitations when applied to waste management. One key issue is the intention-behaviour gap, the assumption that intentions always lead to action. In reality, students may plan to dispose of waste properly but fail to do so due to external constraints such as inadequate infrastructure, weak enforcement, or peer pressure[158]. Additionally, the TPB is more suited to deliberate, planned behaviours and less effective in explaining habitual or unconscious actions, which are common in daily waste disposal practices. Furthermore, the model excludes moral and emotional factors such as personal values, guilt, or social responsibility, which often influence environmentally responsible behaviours in campus and community settings.

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2.2.2 Protection Motivation Theory (PMT)

The Protection Motivation Theory (PMT) was developed by Rogers in 1975 to explain how individuals engage in protective behaviours in response to perceived threat. PMT assumes that individuals' decision to participate in risk-preventative behaviours is made based on their motivation to protect themselves from threats of natural disasters, global climate change, and nuclear explosion[160]. Since the waste disposal process potentially yields environmental and health risks and also affects global climate change, it is possible that an individual's threat appraisal and coping appraisal, as indicated in PMT, will influence their engagement in waste management behaviours.

The coping appraisal for PMT includes self-efficacy and response efficacy. PMT posits that individuals assess threats (severity and vulnerability) and their ability to cope (self-efficacy and response efficacy) when deciding whether to adopt protective behaviours. In the context of waste management, individuals are more likely to engage in environmentally responsible actions when they perceive the risks of poor waste disposal as serious and believe in their capacity to mitigate those risks[161]. PMT further explores how individuals' SWMBs are influenced by their perceived threats caused by environmental contamination from waste disposal and their perceived coping capability as seen in their engagement in efficient waste management in order to eliminate or reduce environmental and health risks associated with waste indiscriminate disposal.

A study testing the role of self-efficacy in SWM behaviour stressed that an office worker's perceived self-efficacy as a significant influence on his or her motivation to engage in all types of solid waste management behaviours (SWMBs) and that communicating information increases and motivates workers' intention in SWMBs[161]. The study concludes that workers should be given information on various types of environmental action strategies and the seriousness of

waste disposal problems, so that they realise the importance of taking actions that minimise the risk of waste mismanagement.

The limitation of the Protection Motivation Theory lies in its excessive reliance on fear-based messages. This may cause psychological discomfort, apathy, or defensive avoidance rather than engagement in such behaviour. For instance, the implementing PMT in green campaigns may lead to apathy, denial, or anxiety among students, rather than constructive actions to enable them participate in waste management. Furthermore, the theory did not fully address positive reinforcement or community-based motivations on environmental sustainable actions which are often more effective in waste management campaigns in educational institutions.

2.2.3 Social Marketing Theory (SMT)

The Theory of Social Marketing was formally introduced by Kotler and Zaltman in 1971 as the application of commercial marketing principles to influence voluntary behaviour change for the benefit of individuals and society. The theory of social marketing posits that voluntary behaviour change can be achieved by applying commercial marketing principles to promote socially beneficial ideas or practices. In the context of green campaign strategies in Federal Colleges of Education, social marketing offers a framework for designing targeted interventions that encourage environmentally responsible behaviours among students such as motivation or rewards. A study observed that segmenting the student population, understanding their values and motivations, and crafting persuasive messages through tools of environmental advertising (signage, posters, flyers), social media campaigns, eco-labelling, and incentive-based initiatives, green campaigns can effectively promote waste reduction, reuse, and recycling in campuses[162].

Furthermore, students' attitudes, shaped by their environmental knowledge, social perceptions, and beliefs, are central to achieving behavioural change. Social marketing seeks to influence

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these attitudes by highlighting the personal and collective benefits of proper waste management, such as cleaner campus environments, improved health, and enhanced institutional reputation[163]. Through repeated exposure to green messages, active participation in sustainability initiatives, and recognition of positive behaviours with financial and non-financial incentives students can be effectively encouraged to engage in responsible waste management practices.

Although, social marketing aims to influence voluntary behaviour using conventional marketing strategies, its effectiveness in educational settings is often constrained by limited financial and human resources for implementing green campaigns and monitoring waste management behaviours. Additionally, its emphasis on individual behaviour change may neglect broader institutional barriers, such as inadequate waste disposal infrastructure and a lack of administrative support, which are critical to the success of environmental initiatives.

2.2.4 Waste Management Theory

Waste Management Theory (WMT) was first articulated in the early 2000s, notably by Eva Pongrácz, Paul S. Phillips, and Riitta L. Keiski**,** (2004)**,** particularly in their 2004 work "Evolving the Theory of Waste Management: Defining Key Concepts". Waste Management Theory (WMT) emerged from a need to provide a comprehensive and conceptual understanding of what constitute waste and its governance. This theory contains conceptual analyses of what constitutes waste, the activity leading to waste generation, and a holistic view of the functions and goals of waste management.

A key insight of the theory is that assigning a label of "waste" to materials automatically channels them into discard pathways, potentially undermining preventive or recovery efforts[164]. When material is assigned the label of 'waste', it will be treated as such; consequently, despite its explicit wish for waste prevention[2]. WMT is founded on the expectation that waste management

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is to prevent waste from causing harm to human health and to contribute greatly to achieving the goals of resource conservation and environmental protection.

In the context of this study, green campaign strategies such as environmental advertising and the use of social media platforms are practical tools drawn from WMT. These strategies aim to enhance environmental sustainability through educational and communicative efforts to challenge the traditional "use-and-dispose" approach to waste and to promote a more sustainable environment and circular economy. When applied to higher education institutions, Waste Management Theory offers a useful framework for understanding how students' attitudes toward the environment relate to the school's policies and awareness campaigns that influence their waste-related behaviours. This is especially pertinent in developing countries, like Nigeria, where infrastructure gaps and weak enforcement limit the effectiveness of traditional waste management systems.

Waste Management Theory, though useful, has some key limitations in that there is never a definite definition of waste. The meaning of waste varies across contexts, which can lead to confusion in policy interpretation and hinder effective implementation. While the theory encourages a shift from throwing things away to reusing them, it does not always provide clear steps or tools to make this happen in real-life situations. This is especially challenging in developing countries where waste systems are still weak.

2.3 Review of Empirical Studies

There are a number of studies that have discussed green campaigns, students' attitudes and waste management from different perspectives and contents. This section provides an empirical review of the studies of the above contents in higher educational institutions in both developed and developing nations, including Nigeria.

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Environmental Advertising and Waste Management

A study titled Knowledge, Attitudes, and Practices on Solid Waste Management among Undergraduate Students in a Philippine State University which assessed the knowledge, attitude, and practices (KAP) of undergraduate students at Laguna State Polytechnic University regarding solid waste management, revealed that while most students demonstrated satisfactory knowledge (73.4%) and attitude (71.0%) toward waste management, less than half (43.1%) practiced appropriate waste management behaviors. The significant gap between knowledge/attitude and practice suggests challenges in translating awareness into action. The findings highlight the need to incorporate solid waste management topics into the university curriculum to improve students' environmental practices and sustainability awareness[168]. The strategic alignment of environmental education and awareness on campuses would significantly influence the waste management methods adopted by undergraduate students.

Another study titled Environmental Education and Waste Management Behavior Among Undergraduate Students of the University of Calabar, Nigeria, investigated the influence of Environmental Education on the waste management behavior of undergraduate students in the Department of Environmental Education at the University of Calabar. Using a survey design, with data collected via a structured questionnaire and analyzed through simple percentages and Pearson Product Moment Correlation, the findings revealed a significant positive correlation Environmental Education and improved waste management behavior, indicating that Environmental Education can effectively promote better waste disposal practices. The study concluded that Environmental Education plays a crucial role in fostering positive environmental

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attitudes and behaviors, recommending its integration into school curricula at all levels to enhance sustainable waste management awareness and practices in the university[167.]

A systematic review of studies from 2010 to 2019 titled, Raising Awareness on Solid Waste Management through Formal Education for Sustainability: A Developing Countries Evidence Review, shows that while students generally have positive environmental attitudes and awareness, their practical knowledge and application of SWM are limited due to inadequate teacher training and weak environmental curricula. The review emphasizes the critical need to integrate comprehensive environmental sustainability education at all school levels to bridge this knowledge gap and promote sustainable waste management practices in developing countries[21]. This confirms that addressing the challenges of solid waste management in developing countries requires a holistic approach that prioritizes environmental education across all educational levels with enhanced practical environmental curricula.

It further noted that waste management is carried out by several processes, many of which are closely interrelated and have a melting point where the methods adopted are interwoven with other methods. The author negates the idea of picking one method of waste management system as it would not make an effective waste management, but a combination of methods could bring a better result.

The distribution of environmental flyers and posters across various departments in a university resulted to increase in the use of designated recycle bins[111]. An investigation on the impact of environmental signage and waste-sorting behaviour in educational institutions shows that integrated communication using signage, posters, and outdoor advertisements, like colourful and strategically mounted billboards within the institution, led to a great reduction in waste-related violations on campus[109].

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Another study reiterated that papers be reused to save resources incurred the purchase of new items and also that organic wastes be decomposed through anaerobic digestion and composting for bioenergy generation and organic fertilizer production respectively[37]. The role of the visual appeal of posters containing images, infographics, and emotive language makes them persuasive tools, drawing students' attention to the conveyed environmental messages[177]. These can only be achieved through regular campaigns, sensitisation and education of the community on the best practices concerning proper solid waste management.

Conversely, the lack of adequate environmental education and awareness in many HEIs in developing countries as a result of fragilities in practical environmental curricula and the teachers' limited capacity to address contemporary environmental issues in school environment, negatively affect the students' contribution to sustainable development[23].

A study reiterated that regular awareness through educational initiatives such as campus newsletter and social media, incentives and rewards, competitions and film shows, and the use of colour-coded waste bins and signage at strategic locations will promote proper waste management practices among students, staff, and other community[171].

In another study at Covenant University to explore the health and economic impacts of waste recycling and the need to educate communities in Nigeria on the benefits of waste recycling for sustainability; it was discovered that effective methods of bridging the communication gaps through efficient information dissemination, intensive awareness outreach and use of educational blogs and poems help ensure that communities are adequately educated and efficient in their task of waste recycling for sustainability in the country, and also stressed that the task of waste recycling would be easy if various institutions in Nigeria can be placing labeled containers in the

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open for public use, or providing bins for home and business owners for strategic waste disposal and waste collection for recycling[95].

Social Media Platforms and Waste Management

A study title, The Waste Management and the Environmental Campaign "KangPisMan" to Awareness of the Environmental Sustainability's Importance, considered the effect of the KangPisMan (popularly known as Instagram) in Indonesia social media environmental campaign on its followers' waste management attitude, focusing on two main aspects of the campaign message, content and structure. The study used a quantitative approach provided by survey method of questionnaire. It discovered that attractive campaign messages with good content and structure delivered by instagram generated positive followers' responses and attitude on managing their wastes. The study further reveals that an Instagram account used for environmental campaign purpose needs serious management efforts, a clear program description, creativity, attractive image visualisation, communicative and easy-to-understand messages[115].

Another study carried out to determine the Effects of Different Marketing and Awareness Strategies on Recycling and Waste Minimization in the Residence Halls in University of Wisconsin, it was confirmed that analysis of Passive Programming such as social media is effective in both increasing the percentage of green campaign on recycling relative to the total amount of waste and contributing to an increase in recycling behavior of the students and decrease in trash[169]. This means that the change in recycling behaviour of students can be modified, where social media, TikTok and other educational blogs can be used to enlighten individuals about waste management. It was also observed that creating an Eco-Rep sustainability ambassador among students positively affects the percentage of recycling relative

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to the total amount of waste. This shows that behavioural modification can be achieved through peer group influence.

Eco-Label and Waste Management

The potential and success of eco-labels in promoting sustainable waste practices in universities is limited by low awareness and inconsistent standard[172]. Consistent use and spreading of eco-label elements such as labeled recycling bins, sustainability certifications, and green curricula into broader waste management and circular economy strategies is necessary to enhance waste management.

A study noted that there is wide spread inclusion of eco-label elements such as labeled recycling bins, sustainability certifications, and green curricula into broader waste management and circular economy strategies, however, it noted that despite its potential as tools for promoting sustainable waste practices in universities, their success is limited by low awareness and inconsistent standards[171]. Investigation on the impact of strategic implementation of colour-coded waste separation bins, where specific colours were assigned to different waste types, significantly enhanced waste segregation at source did not only facilitated the ease of recycling but also promoted responsible waste disposal behaviour among the university community[75].

Incentive-Based Initiatives and Waste Management

A study titled Greening of a campus through waste management initiatives; experience from a higher education institution in Thailand, revealed that Incentive measures showed a greater positive effect on waste reduction to landfills. It increases the overall campus recycling[173].

The institution of a "prize" as a reward, in addition to the provision of storage facilities to participating households, was identified as the most cost-effective incentive option that generated the highest amounts of separated material resources at a relatively lower cost. Again, the study

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showed that the cost-effectiveness of the schemes depended on the incentive type and the service zones where the schemes were instituted[174].

Students' Attitudes and Waste Management

A study with the title, Knowledge of Sustainable Waste Management Practices in Ilorin, Nigeria: Implication on Attainment of Sustainable Development Goals" carried out to determine the impact of knowledge of waste management practices on sustainable development goals among residents, including students, in Ilorin. The data was analyzed using frequency count, percentage, mean and Pearson Product Moment Correlation (PPMC). The result indicated that the participants recognised the environmental hazards of practices like open burning, but there was a significant gap in understanding sustainable waste management techniques such as composting and recycling. The study concluded that there is need for targeted educational initiatives to enlighten students and the campus community on efficient waste management system with modern technologies[146]. This will reduce the hazard of open dumping and burning.

Another empirical study titled, "College Students' Attitude towards Waste Separation and Recovery on Campus", which aims to verify the variable relationship, influence path, and regulating factors of college students' attitudes and behavior toward waste separation on college students' attitudes toward waste separation and recovery. The SPSS software v23.0 was used to carry out the statistical analysis of the collected data by applying multiple analyses. The finding revealed that female students demonstrated more positive attitudes and responsiveness to waste-related issues than their male counterparts. Moreover, the study found a positive correlation between students' knowledge of waste management and their propensity to engage in environmentally responsible behaviours, and thus concludes that understanding students'

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attitudes and their environment can help schools and policymakers create better waste management systems on campus[117].

Students' knowledge and attitude were positively correlated with their level of practice on solid waste management practice, and the tendency for the students to minimise the use of materials is highly associated with satisfactory knowledge and attitude ratings. It is therefore recommended that environmental education in educational institutions[169].

While investigating students' perceptions on recycling to determine whether a university's strategy helped or hindered student recycling behavior in residence halls; it was discovered that student recycling rates were even lower than the average reached in the country, and therefore recommended a holistic approach that includes peer influence, education and information for improving students' attitudes and motivations, along with improving physical recycling structures[149].

A research investigated the predictors of recycling intentions among the youth in India, addressing the escalating challenge of municipal waste management in the country revealed that that rising urban population and high consumption lifestyles contribute to the challenge of municipal waste management, exacerbated by India having the world's highest number of young people aged 10–24[175]. Findings from the study showed that social factors significantly influence the recycling intentions of Indian youth. The study emphasises the importance of policymakers promoting recycling as a social trend and ensuring the provision of adequate facilities to facilitate public participation in recycling activities without encountering difficulties, and that schools play a crucial role in enhancing students' awareness of recycling and motivating them towards proper household waste management practices.

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However, a study on college students' attitudes toward waste separation and recovery on campus revealed that while students generally had a positive attitude toward waste separation but their actual practices were not always consistent with their attitudes[117].

Similarly, a study in Beijing, China, assessed the knowledge, attitudes, and practices (KAP) of university students regarding waste sorting. The findings revealed that although students had a positive attitude toward waste separation, their knowledge was insufficient, leading to weak practical performance. The study emphasised the need for educational interventions to improve students' understanding and practices related to waste management[169].

A study on awareness and attitude of students towards municipal waste management reveals that although students have knowledge and awareness about waste management but they lack motivation for waste segregation and composting, and have limited knowledge of sustainable development and the SDGs[4]. The study also identified a lack of proper waste disposal facilities and the inconvenience of sorting waste as other barriers inhibiting efficient waste management among students. This highlights the urgent need to enhance youth sensitisation and channel their potential towards sustainable waste management practices in preparation for the effective implementation of SDGs come 2030.

Waste Management

A study titled "Ensuring Sustainable Environment and Development: A Study of Solid Waste Management in the University of Lagos, Nigeria, carried out on solid waste management with the 3Rs (reuse, reduce and recycle) using a self-explanatory bottle-shaped bin to determine the level of waste sorting at source at the University of Lagos, reiterated that the principle of the 3Rs could be adhered to within the University environment to achieve efficient waste management[89]. The study postulates that the University environment should be a role model and leaders in

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enforcing proper waste management to achieve environmental sustainability and economic development by creating employment opportunities in the long run.

A related research study titled, Solid waste recycling within higher education in developing countries: a case study of the University of Lagos" carried out at the University of Lagos to evaluate the level of recycling performance in the institution shows that the level of contamination across colored waste bins remains a big challenge despite the university's recycling policy and efforts to provide recycling facilities across the campus. Results indicate that material recovery of organic waste, mixed plastic, and mixed paper could be maximised through efficient waste management with proper waste sorting on source to prevent contamination of the waste to achieve more economic importance from the waste streams[44].

Similarly, while examining the knowledge and attitudes of university undergraduates toward waste management, it was discovered that 66% of respondents are aware of waste management and that improper waste disposal poses a health risk. However, it was further discovered that the knowledge of students is at an intermediate level, but their attitude towards waste disposal is insufficient, as students still drop garbage in a car or throw it out of the window, or just dump it in a neighbouring bush or drainage. It therefore recommends integrating relevant topics on environmental awareness and practical experiences into the undergraduate curriculum for enhanced awareness and a better attitude towards waste management[136].

In another study that explores how the positive feeling associated with recycling, known as the warm glow, can paradoxically lead to improved waste behaviour. Findings indicated that when individuals are presented with alternatives such as transforming plastic packaging into clothing or repurposing unused bread into beer, which have gained widespread popularity among the populace may psychologically perceive their waste creation as a positive contribution to the

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collective good, generating a sense of personal satisfaction (referred to as a warm-glow effect[176]. The study concluded that these potential 'wasteful contribution' effects should be taken into account when evaluating the sustainability benefits of specific recycling initiatives where ‘waste’ materials are repurposed or recycled to useful items.

Empirical evidence from Nigerian higher education institutions underscores the evolving practices and interventions in sustainable solid waste management, particularly within higher education institution campuses, as they offer critical insights into the operationalisation of waste management strategies aligned with the principles of the 3Rs: reduce, reuse, and recycle. The introduction of the bottle shape as waste bins for the collection of empty bottles was adopted to encourage proper sorting of garbage at source at the University of Lagos[89]. This design served as a behavioural prompt for users, thereby reinforcing the 3Rs by encouraging source-level sorting. The study demonstrated that aesthetically and functionally designed waste bins could effectively increase awareness and participation in environmentally responsible practices among students and staff. Results indicate that material recovery of organic waste, mixed plastic, and mixed paper could be maximised through efficient waste management, indicating more opportunity from the waste streams[44]. The study claims that the university environment should be a role model and leaders in enforcing proper waste management to achieve environmental sustainability and economic development by creating employment opportunities in the long run[177].

Study conducted on analysis of solid waste composition the University of Nsukka, reveals that weighted average percentage of the waste fractions for university of Nigeria Nsukka Campus is 37.66%, 20.23%, 6.65%, 24.86%, 3.33% and 7.28% for paper, plastic, metal, organic, glass and others respectively, out of which 28.35% is compostable while 64.49 % is recyclable. It then

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concluded that the recovery of resources and recycling call for segregation of waste at the source to remove the recyclables using separate waste containers for different waste types to maximise the recycling potentials[3].

A study on sustainable integrated solid waste management in a university campus, using the Federal University of Technology Akure (FUTA), Nigeria, as a case study, affirmed that the introduction of colour-coded waste separation bins, and assigning different colours to specific waste types, can promote proper waste separation and disposal, thus facilitating recycling[75].

A research investigated the predictors of recycling intentions among the youth in India, addressing the escalating challenge of municipal waste management in the country revealed that that rising urban population and high consumption lifestyles contribute to the challenge of municipal waste management, exacerbated by India having the world's highest number of young people aged 10–24[174]. Findings from the study showed that social factors significantly influence the recycling intentions of Indian youth. The study emphasises the importance of policymakers promoting recycling as a social trend and ensuring the provision of adequate facilities to facilitate public participation in recycling activities without encountering difficulties, and that schools play a crucial role in enhancing students' awareness of recycling and motivating them towards proper household waste management practices.

In contrast, a broader environmental health study that examined the detrimental effects of indiscriminate solid waste disposal in urban and institutional contexts across Nigeria, revealed that uncontrolled waste dumping practices have worsen the occurrence of a range of environmental hazards, including climate change, global warming, and the incidence of extreme weather events[95]. The study emphasised that ineffective waste management systems as generally

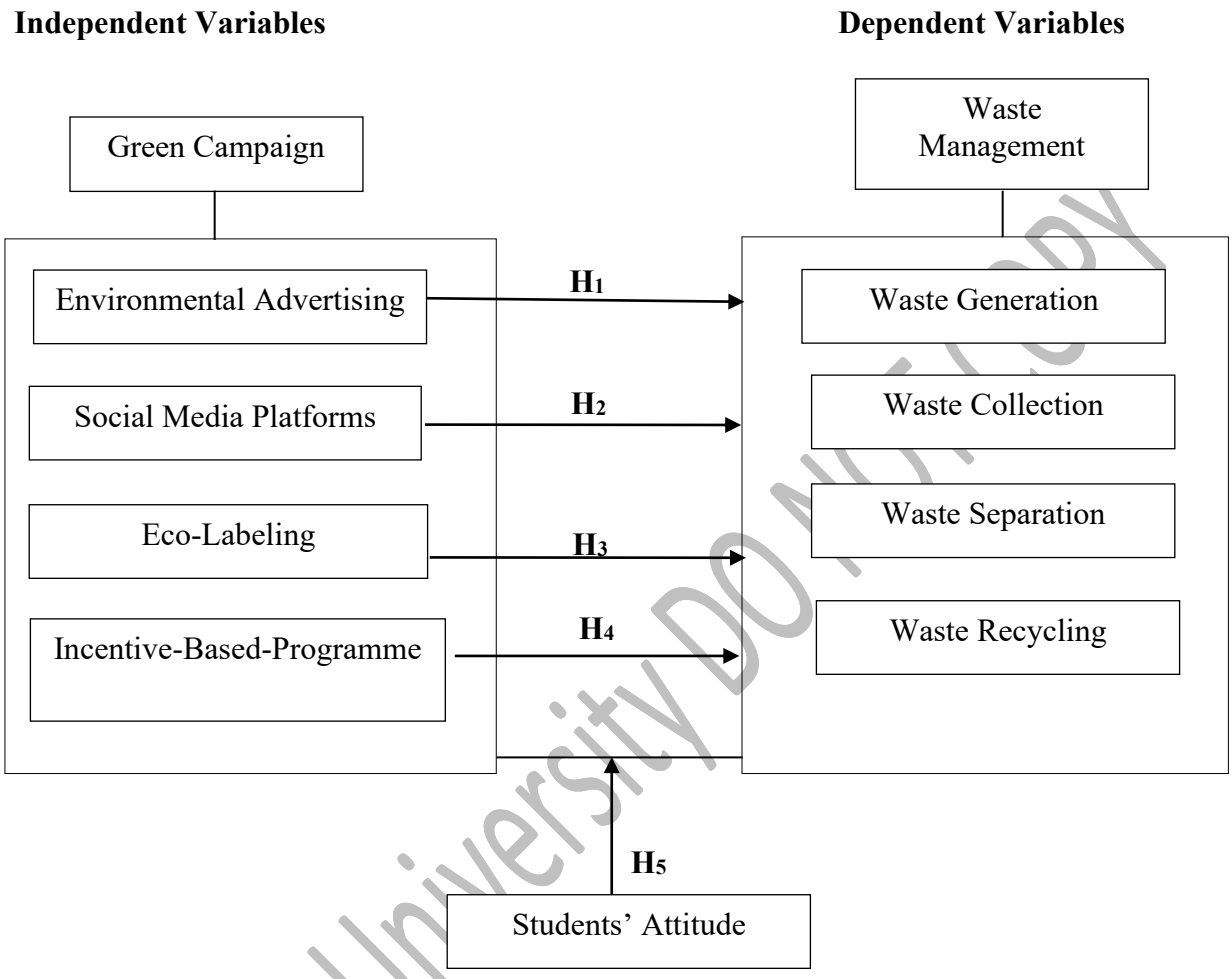
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practices in many developing countries not only pose health risks but also contribute significantly to environmental degradation and global ecological crises.

Collectively, these empirical investigations highlight the necessity of sustainable and strategic waste management solutions that combine environmental awareness, infrastructural innovation with behavioural interventions. The deployment of targeted, user-friendly waste management technologies, coupled with inclusion of environmental education in educational institutions curricula, is critical to achieving long-term sustainability in Nigerian tertiary institutions. There is a pressing need for similar studies to be embarked on in other institutions of learning, particularly in Federal Colleges of Education in Nigeria, as a means of enlightening the campus communities on the importance of solid waste management for a sustainable and conducive learning environment.

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2.4 Conceptual Framework



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Operationalisation of the Research Variables

This study is based on two major variables; namely green campaign strategies and waste management practices, that is Y = f(X), where Y = waste management practices (dependent variables) and X = green campaign strategies (independent variables), while the moderating variable is Students' Attitude which is represented by Z.

Y = f(X)

Substituting for Y and X

Y = Waste Management (WM)

X = Green Campaign Strategies (GCS)

Z = Students' Attitudes

That is,

Waste Management = f (Green Campaign Strategies, Students' Attitudes)

Waste Management (Y) is represented by y_1, y_2, y_3, y_4, where;

Y_1 = waste generation (WG)

Y_2 = waste collection (WC)

Y_3 = waste separation (WSs)

Y_4 = waste recycling (WR)

Green Campaign Strategies (X) is represented by x_1, x_2, x_3, x_4, where;

X_1 = environmental advertising (EA), (where EA = signage, billboard and flyers)

X_2 = Social Media Platforms (SMP), (where SMP = Instagram, Facebook and education blog)

X_3 = Eco-labeling (EL), (where EL = colour-coded waste bins, Institutional Policies)

X_4 = Incentive-based-Initiatives (IBP), (where IBP = cash and non-cash incentives)

Students' Attitude (Z) is represented by Z_1, Z_2, Z_3, Z_4

Z_1 = Knowledge and awareness (KA)

Z_2 = Perception and beliefs (PB)

Z_3, = Behavioural intentions (BI)

Z_4 = Actual behaviour (AB)

2.5 Summary of Gaps in Literature

2.5.1 Summary of Reviewed Literature

The conceptual, empirical and theoretical reviews done indicates several gaps which lends legitimacy to this research, such as; most previous studies investigated the effect of solid waste

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management in universities in developed countries, and the application of green campaign strategies to waste management in higher education institutions in developing countries has not been explored, hence efficient waste management in Federal Colleges of Education using green campaign strategies is the lacuna which the study intend to fills. Results of some of the studies that focused on waste management in HEIs have shown that a higher percentage of waste generated in HEIs is often organic waste, mixed plastics and paper and recyclables[16,44,89,92].

Several conceptual, theoretical, and empirical studies have been conducted to explore the dynamics of waste management within higher education institutions (HEIs), particularly in developing countries. These studies often emphasize the characterization of solid waste and highlight the predominance of organic materials, plastics, and paper as the most common waste categories, but, despite the existence of recycling policies and infrastructure, large percentage of the wastes still ended up in landfills due to low adherence to waste segregation practices such as the use of colour-coded bins.

At the national level, Nigeria produces over 32 million tons of solid waste annually, of which only 20-30% is effectively collected. This inefficiency contributes significantly to environmental degradation. To address this, integrated waste management Initiatives have been introduced, particularly in Lagos State through the Lagos State Waste Management Authority[14]. The students' population density and waste generation levels have necessitated partnerships with private waste firms and informal waste collectors. Scholars have noted the potential role of HEIs in advancing waste management through the adoption of green campaign strategies.

Furthermore, the evolution of green marketing since the early 1990s has emphasised environmental sustainability as a core organisational value, particularly among manufacturing industries. The adoption of green campaign strategies such as environmental advertising, social

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media, eco-labelling, and incentive-based initiatives has proven effective in reducing environmental harm from waste. It is suggested that similar strategies be applied within colleges of education to promote responsible environmental behaviour among students and staff.

The integration of sustainable solid waste management (SWM) into the core operations of Federal Colleges of Education (FCEs) is increasingly advocated. These institutions play a vital role in shaping the attitudes of future educators. Embedding green campaign strategies in their waste management practices through environmental education would not only enhance environmental sustainability but also model appropriate behaviour to students and staff, who are instrumental in transferring these values to the larger society.

2.5.2 Summary of Gaps in Literature

Empirical Gap: A few empirical studies have investigated the impact of green campaign strategies and students' attitudes on actual behaviour of students in waste management within Federal Colleges of Education in developing countries, particularly Nigeria. This shows that there is a gap in measurable evidence on students' actual behaviour designed to foster behavioural change. Most prior studies have predominantly focused on universities in developed countries, with limited attention given to the application of green campaign strategies in waste management within the colleges of education in developing nations.

Contextual Gap: Much of the existing literature has explored waste management in universities, which often have different administrative structures, resources, and student dynamics compared to Federal Colleges of Education (COEs)**.** These colleges operate under different academic and cultural environments that may affect how students perceive and respond to green campaigns. Therefore, the lack of research tailored to Federal Colleges of Education (FCEs) fails to capture the unique challenges and opportunities within this educational context.

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Geographical Gap: The majority of prior studies on waste management and green campaigns are based in developed countries**,** where environmental awareness, funding, and infrastructure are relatively advanced. Very few studies have focused on sub-Saharan Africa, and even fewer on Southwest Nigeria**,** a region with its own cultural, institutional, and environmental dynamics. Thus, the absence of region-specific investigations in Federal Colleges of Education in Southwest Nigeria creates a significant geographical gap, necessitating localized studies that reflect the realities of waste management in the FCEs**.**

Practical Gap: Although several theoretical frameworks support the use of green campaigns and students' attitudes for environmental sustainability behaviour, however, there is limited practical evidence showing how these methods are implemented and evaluated in Nigerian colleges. For example, the observed low compliance with colour-coded waste bins, despite the provision of infrastructure and awareness initiative, suggests that existing interventions may not be effectively engaging the student population. This highlights the need for practical implementation of efficient waste management practices in academic environments.

Implementing modern green campaign strategies for waste management within FCEs will serve as a practical demonstration of responsible waste handling and disposal. This, in turn, will foster a culture of environmental responsibility among students and staff who will be better equipped to instil positive behavioural changes in waste management practices among the college community and the society in general.

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Chapter Three

Methodology

This chapter describes the procedures, methods and instruments that the researcher adopted in the conduct of the study. These procedures are research design, population of the study, sample and sampling techniques, description of research instruments, validity of research instruments, reliability of research instruments, data collection, data analysis, and ethical approval.

3.1 Research Design

A descriptive research design was used for the research work. Descriptive survey design is a quantitative research approach used to collect data that provides an accurate account of characteristics, opinions, or behaviors of a population, as they exist in their natural setting, without researcher interference[1].

3.2 Population of the Study

The study population comprised eleven thousand, three hundred and twenty (11,320) full-time NCE students in Years 1 to 3 across the four Federal Colleges of Education (FCEs) in Southwest Nigeria during the 2023/2024 academic session. The selected institutions are FCE (Technical), Akoka, Yaba, Lagos State, FCE, Osiele – Abeokuta, Ogun State, FCE (Special), Oyo (SPED), Oyo State, and FCE, Iwo, Osun State. The actual student population figures for each college were obtained from the Office of the Dean of Student Affairs (DSA) of the College, which is responsible for maintaining comprehensive records of both on-campus and off-campus students. The figures are presented in the table 3.1

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Table 3.1 - Population of the students in the selected FCEs (2023/2024 Academic session)

S/N	Institution	Location	Students Population
1.	Federal College of Education (Technical)	Akoka, Yaba, Lagos State. (1967)	1,347
2.	Federal College of Education (Special)	Oyo (SPED), Oyo State (1977)	4,055
3.	Federal College of Education, Abeokuta	Abeokuta, Ogun State (1976)	3,998
4.	Federal College of Education, Iwo	Iwo, Osun State. (2020)	1,920
	TOTAL		**11,320**

3.3 Sample and Sampling Techniques.

The targeted population for this study comprises all students in the four Federal Colleges of Education in South-West, Nigeria. A simple random sampling technique was used to select the respondents among the students from the common areas in the campuses, such as canteens, lecture rooms and halls of residents. The sample size was determined from the eleven thousand, three hundred and twenty using Taro Yamane's sampling size determination formula[3] as follows:

$$n = \frac{N}{1+N\,(e)2}$$

where;

n = sample size

N = finite population size which is

e = maximum acceptable error margin which is 5%

1 = unit (a constant value)

Substitute N = 11,320 and e = 0.05:

n = (11,320 / (1 + 11,320 * 0.05^2)

n = (11,320 / (1 + 12440 * 0.0025)

n = (11,320 / (1 + 31.1)

n = (11,320 / 32.1)

n = 11,320 / 32.1

n ≈ 386.45 = 386 respondents

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Table 3.2 – Summary of Sample Size for Students

S/N	Institutions	Population per College of students	Proportionate sample size of Students
1.	Federal College of Education (Technical), Akoka	1,347	46
2.	Federal College of Education (Special), Oyo	4,055	140
3.	Federal College of Education, Abeokuta	3,998	137
4.	Federal College of Education, Iwo	1,920	63
	Total	**11,320**	**386**

3.4. Description of the Research Instrument

The researcher used structured questionnaire as the major technique for collecting primary data from the respondents. This is because the research study requires first-hand information that can only be gathered by questioning the target respondents who are representatives of the study population. The questionnaire was divided into four sections. Section A, covers the demographic characteristics of the respondents such as gender, age, year of study, Section B consists of question items from research questions on green campaign strategies, Section C have questions from research questions on Students' attitudes, while Section D consists of questions on Waste Management variables. Four-point Likert summated rating scale format was used with the following set of scale indicators: Strongly Agree (SD) = 4 points, Agree (A) = 3, Disagree (D) = 2, Strongly Disagree (SD) = 1 point.

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Measurement of Research Constructs

Variables	Construct	References
Waste Management	Waste Generation	4, 5, 6,
	Waste Collection	8, 9, 10
	Waste Separation	5, 11, 12
	Waste Recycling	5, 13, 14
Green Campaign	Environmental Advertising	15, 16,, 17, 18, 19
	Social media awareness	20, 21, 16
	Eco-labelling	15, 22,23, 11
	Incentives / Rewards	24, 25
Students' Attitudes	Knowledge and Awareness	18, 26, 27, 28

3.5 Validity of Research Instrument

The instrument was validated using the Average Variance Extracted (AVE) and Fornell-Lacker criterion to assess convergent validity. All constructs recorded AVE values of 0.5 and above, meaning at least half of the variance in the indicators was explained by their respective constructs. This confirms that the items were well-correlated and effectively represented their intended concepts, providing a strong basis for further analysis.

Table 3.6: Validity Test of Research Instrument

Description	AVE	Fornell-Lacker
Green Marketing Campaign	0.543	0.731
Environmental Advertising	0.559	0.678
Social Media Platform	0.549	0.784
Eco-Labeling	0.510	0.608
Incentive-Based Labeling	0.541	0.701
Waste Management	0.546	0.768
Waste Collection	0.559	0.648
Waste Generation	0.584	0.731
Waste Recycling	0.519	0.623
Waste Separation	0.547	0.739
Students' Attitude	0.552	0.741

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3.6 Reliability of the Research Instrument

The reliability of the study was confirmed through an evaluation of the measurement model. This involved examining factor loadings, composite reliability, and Cronbach's alpha values, all of which confirmed that each construct consistently measured its intended concept. Notably, Cronbach's alpha values exceeded the recommended threshold of 0.70, indicating strong internal consistency.

Table 3.7: Reliability Test of Research Instrument

Description	Items	Factor Loadings	Cronbach's Alpha	Composite Reliability (CR)
Green Marketing Campaign			0.871	0.712
Environmental Advertising			0.754	0.769
	EA1	0.785		
	EA2	0.722		
	EA3	0.631		
	EA4	0.547		
Social Media Platform			0.800	0.798
	SMP1	0.547		
	SMP2	0.571		
	SMP3	0.584		
	SMP4	0.544		
	SMP5	0.566		
Eco-Labeling			0.803	0.700
	EL1	0.633		
	EL2	0.674		
	EL3	0.593		
	EL4	0.523		
Incentive-Based Programme				0.701
	IBP4	0.800		
	IBP5	0.665		
Waste Management			0.873	0.707

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Waste Collection	WC1	0.642	0.800	0.784
	WC2	0.691		
	WC3	0.607		
Wasye Generation	WG1	0.658		0.807
	WG2	0.663		
	WG3	0.682	0.827	0.822
Waste Recycling	WR1	0.817		
	WR3	0.652		
Waste Separation	WS1	0.615	0.710	0.819
	WS2	0.582		
	WS3	0.660		
Student Attitude			0.873	0.731

3.7. Data Collection

The researcher personally administered the questionnaire to the respondents in the selected institutions, and the completed questionnaires were retrieved upon completion with the help of research assistants at each of the Colleges.

3.8 Data Analysis

The research study used both descriptive and inferential statistics to analyse the findings of the study. The descriptive statistics, frequency and percentage were used to analyse the demographic information of respondents; mean and standard deviation for research questions. The hypotheses were tested with Structural Equation Model (SEM). Data were analyzed with Statistical Package for Social Sciences (SPSS) version 26 and Smart PLS software.

3.9 Ethical Approval

Ethical approval represents a fundamental component of this study by emphasizing strict compliance with core research ethics such as anonymity, confidentiality, conflict of interest, and proper referencing of all sources. The researcher ensured the confidentiality of respondents and also obtained formal permission from the appropriate authorities before administering the

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questionnaire. Furthermore, objectivity was maintained throughout the study by avoiding any potential conflict of interest that could compromise the integrity or objectives of the research.

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Chapter Four

Results and Discussion of Findings

The chapter provides description of the socio-demographic, research questions. The chapter also presents a discussion of findings based on the research questions and the hypotheses that were tested.

4.1 Demographic Data Analysis

A total of three hundred and eighty-five (385) questionnaires were administered, and three hundred and seventy (370) copies were returned. After sorting the questionnaire, only three hundred and sixty-three (363) copies were confirmed to be useful for data analysis. The questionnaire represented 94% of the responses.

Table 4.1 Response Rate

Responses	Frequency	Percent
Usable Questionnaire	363	94%
Returned and disqualified questionnaire	22	6%
Total	385	100

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Demographics Profile of the Respondents

Table 4.2: Demographics Profile of the Respondents

Variables	Category	Frequency	Percent
Institutions	Federal College of Education, Akoka	43	11.6
	Federal College of Education, Iwo	60	16.6
	Federal College of Education, Abeokuta	129	35.6
	Federal College of Education, Special, Oyo	131	36.2
	Total	363	100.0
Gender	Male	175	48.3
	Female	188	51.7
	Total	363	100.0
Age	less than 16 years	9	2.5
	16-20 years	175	48.3
	20 years and above	179	49.2
	Total	363	100.0
Year of Study	100level	97	26.8
	200level	228	63.0
	300level	37	10.2
	Total	363	100.0

Table 4.2 shows the responses from the four Federal Colleges of Education in Southwest Nigeria. Among the 363 total respondents: FCE Special, Oyo had the highest respondents, 131 (36.2%), followed by FCE Abeokuta, 129 (35.6%), FCE Iwo had 60 respondents (16.6%), while FCE Akoka had the least, with 43 respondents (11.6%). The high responses from FCE Special, Oyo, and FCE Abeokuta show that these campuses are more accessible or engaged.

Gender

The responses from the respondents show that the majority of the respondents were females. Out of the total respondents, 188 (51.7%) were females, 175 (48.3%) were males.

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Age

Responses from the age brackets show that the majority of the respondents were above 20 years, 179 (49.2%). The respondents less than 16 years were 9 (2.5%), and those between 16–20 years were 175 (48.3%).

Year of Study

Responses from students show that the majority were 200 Level, 228 (63.0%). The 100 level students were 97 (26.8%) while the 300 Level students were 37 (10.2%). This shows that the 200-level students were accessible within the study's scope.

4.2 Presentation of Data

4.2.1 Research Questions

4.2.1.1 Descriptive Analysis on Green Campaign Strategies

Table 4.3 presents an analysis of green campaign strategies. The analysis, which is in the form of mean and standard deviation, focuses on the sub-variables including: environmental advertising, social media platform, eco-labelling and incentive-based Initiatives.

Table 4.3: Descriptive Analysis of Responses on Environmental Advertising

Environmental advertising	Mean	Std. Deviation
My college signage provides information about waste	2.29	1.005
The information on the board in my college is clear and helpful	2.68	.904
My college distributes fliers to educate students on the zero-waste campaign	2.45	.938
Information on my College billboards is displayed with colourful photos and infographics	2.58	.956
The information on the signage board displays recycling symbols.	2.61	.884

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From Table 4.3, it is shown that the respondents had a moderate response to the items measuring environmental advertising. That is, my college signage provides information about waste; the information on the board in my college is clear and helpful; my college distributes fliers to educate students on the zero-waste campaign; information on my college billboards are displayed with colourful photos and infographics, and the information on the signage board displays recycling symbols. Amongst the items, students mildly agreed and gave more attention to the item that says that the information on the board is clear and helpful. The respondents gave a low response to the items that say their college distributes flyers to educate students on the zero-waste campaign. Although the advertising method used by the colleges isn't effective based on their responses, however, the students feel that information via billboard tends to make an impact in the colleges.

Table 4.4: Descriptive Analysis of Responses on Social Media Platform

Social Media Platform	Mean	Std. Deviation
I frequently see green campaign messages on my College's social media platforms (Instagram and Facebook)	2.48	.942
My college uses social media platforms to communicate and educate us on environmental issues.	2.63	.866
My college's social media platforms' content (visuals and audio-visuals) is easy to understand.	2.63	.913
Illustrative drawings and materials are displayed on my school's blog to educate students.	2.73	.882
I acquired my knowledge and preference for a clean environment through my college's blog.	2.46	.959

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From Table 4.4, it is shown that the respondents had a moderate response to the items measuring the social media platform. That is, I frequently see green campaign messages on my College's social media platforms (instagram and facebook); My college uses social media platforms to communicate and educate us on environmental issues; My college's social media platforms' content (visuals and audio-visuals) are easy to understand; Illustrative drawings and materials are displayed on my school's blog to educate students and I acquire my knowledge and preference for a clean environment through my college's blog. Amongst the items, students agreed and gave more attention to the item that says that illustrative drawings and materials displayed on their school's blog educate students. The respondents gave a low response to the items that said they acquired their knowledge and preference for a clean environment through their college's blog. Although the social media platform used by the colleges is seen to be effective based on their responses, however, the students feel that their knowledge and preference for a clean environment are not conveyed through their college's blog.

Table 4.5: Descriptive Analysis of Responses on Eco-Labelling

Eco-Labelling	Mean	Std. Deviation
I see and recognise recycling symbols on waste bins.	2.52	.936
My college has colour-coded bins for proper waste sorting.	2.58	.862
My college has facilities to support the disposal of eco-labelled products after use.	2.56	.909
My College has colour-coded bins at strategic places.	2.56	.857
Colour-coded bins allow me to separate recyclable and non-recyclable waste.	2.56	.943

From Table 4.5, it is shown that the respondents had a moderate response to the items measuring the eco-labelling. That is, I see and recognise recycling symbols on waste bins; My College has colour-coded bins for proper waste sorting; My College has facilities to support the disposal of

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eco-labelled products after use; My College has colour-coded bins at strategic places, and Colour-coded bins allow me to separate recyclable and non-recyclable waste. Amongst the items, students mildly agreed and gave more attention to the item that says that their college has colour-coded bins for proper waste sorting. The respondents gave a low response to the items that said they see and recognise recycling symbols on waste bins. Although students recognise the presence of colour-coded bins within their college; however, the recognition of symbols needs to be improved for easy recognition by students.

Table 4.6: Descriptive Analysis of Responses on Incentive-Based Initiatives

Incentive-based Initiatives	Mean	Std. Deviation
Selling of recyclables is available within my college	2.56	.914
Students earn extra income by using trash to create meaningful artworks	2.53	.921
My college organises awards (in hostels, departments and units) to promote cleanliness.	2.57	.957
My college gives cafeteria vouchers, credit cards) in exchange for recyclable items	2.57	.925
Clean environment improves healthy living and reduces the money spent on medications.	2.72	.874

From Table 4.6, it is shown that the respondents had a moderate response to the items measuring the incentive-based Initiatives. That is, the selling of recyclables is available within my college; students earn extra income by using trash to create meaningful artworks; my college organises awards (in hostels, departments and units) to promote cleanliness; my college gives cafeteria vouchers, credit cards) in exchange for recyclable items; clean environment improves healthy living and reduces money spent on medications. Amongst the items, students agreed and gave more attention to the item that says that a clean environment improves healthy living and reduces money spent on medications. The respondents gave a low response to the items that said they earn extra income by using trash to create meaningful artworks. Although the incentive-based

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initiatives exist, such as selling recyclables, art from trash, awards, and vouchers. However, the perceived incentive is seen as not highly impactful, publicised, or a driving force for recycling as their responses are moderate.

4.2.1.2 Descriptive Analysis on Students' Attitude

Table 4.7 presents an analysis of students' attitudes. The analysis, which is in the form of mean and standard deviation, focuses on the sub-variables including: knowledge and awareness, and behavioural intentions.

Table 4.7: Descriptive Analysis on Students' Attitude

Knowledge and awareness	Mean	Std. Deviation
There is enough awareness on environmental cleanliness in my campus.	2.61	.942
Recycling education is part of the orientation Initiatives in my college.	2.60	.944
Attractive campaign messages on signposts motivate my positive response to clean environment.	2.57	.885
I have a good level of knowledge about solid waste management.	2.62	.908
I know where to take my recyclable items to for reprocessing.	2.74	.868
Behavioural Intention		
I take initiative to promote cleanliness around me.	2.69	.893
I use reusable bags and containers to carry my items of food and drinks.	2.67	.908
I separate waste based on the colour-coded bins provided.	2.68	.916
I always take reusable bags and containers along for my shopping.	2.66	.929
I volunteer to clean up trash in the School environment.	2.67	.928

From Table 4.7, it is shown that the respondents had a high response to the items measuring knowledge and awareness, which is a sub-variable of students' attitude. That is, there is enough awareness of environmental cleanliness on my campus; recycling education is part of the orientation programmes in my college; Attractive campaign messages on signposts motivate my

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positive response to a clean environment; I have a good level of knowledge about solid waste management; I know where to take my recyclable items to for reprocessing. Amongst the items, students agreed and gave more attention to the item that says that they know where to take their recyclable items for reprocessing. The respondents gave a low response to the items that said attractive campaign messages on signposts motivate my positive response to a clean environment. Although the knowledge awareness level is low within the campus, however, the students know where to take recyclables for reprocessing.

From Table 4.7, it is shown that the respondents had a high response to the items measuring the behavioural intention, which is a sub-variable of students' attitude. That is, I take initiative to promote cleanliness around me; recycling education is part of the orientation Initiatives in my college; I separate waste based on the colour-coded bins provided; I always take re
usable bags and containers along for my shopping; I volunteer to clean up trash in the School environment. Amongst the items, students agreed and gave more attention to the item that says that they take initiative to promote cleanliness around them. The respondents gave a low response to the items that said they volunteer to clean up trash in the school environment and use reusable bags and containers to carry their items of food and drink. Based on the findings, the students adopt sustainable means to promote cleanliness and waste management behaviour.

4.2.1.3 Descriptive Analysis on Waste Management

The table 4.8 reveals an analysis of waste management. The analysis, which is in the form of mean and standard deviation, focuses on the sub-variables including: waste generation, waste collection, waste separation and waste recycling.

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Table 4.8: Descriptive Analysis of Waste Management

	Mean	Std. Deviation
Waste Generation		
Poor waste management spread of diseases and environmental pollution.	2.72	.875
Unregulated lifestyles among students increase the waste in my college.	2.60	.905
The waste generated in my hostel is mostly food waste.	2.74	.895
Waste Collection		
Waste collection points are inadequate in my college	2.58	.877
The maintenance workers in my college are not adequate to handle the waste issues.	2.57	.848
My college partners with external stakeholders to address the waste issue.	2.59	.872
Waste Separation		
Separating waste to recover reusable items reduces the consumption of materials.	2.67	.882
I separate waste into recyclable and non-recyclable items on campus.	2.61	.896
Inadequate bins in my college prevent the proper sorting of waste	2.64	.841
Waste Recycle		
Waste reuse and recycling reduce the volume and cost of waste	2.74	.847
My college organises regular awareness Initiatives on waste recycling	2.30	.720
I always remove potentially useful material from waste before disposal	3.06	.662

From Table 4.8, it is shown that the respondents had a high response to the items measuring waste generation, which is a sub-variable of waste management. That is, poor waste management spread of diseases and environmental pollution; unregulated lifestyles among students increase the waste in my college, and the waste generated in my hostel is mostly food waste. The respondents gave a low response to the items that said unregulated lifestyles among students increase the waste in my college. This implies that students are aware of the detrimental effects

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of poor waste management and agree on the prevalence of food waste in hostels, as well as the student lifestyles in waste generation.

From the table results, it is shown that the respondents had a moderate response to the items measuring waste collection, which is a sub-variable of waste management. That is, waste collection points are inadequate in my college; the maintenance workers in my college are not adequate to handle the waste issues and my college partners with external stakeholders to address the waste issue. Amongst the items, students agreed and gave more attention to the item that says that the waste generated in my hostel is mostly food waste. The respondents gave a low response to the items that said the maintenance workers in my college are not adequate to handle the waste issues. Although the students perceived inadequacies in both waste collection points and maintenance workers, however, they recognised the external partnerships with the college.

From the table results, it is shown that the respondents had a moderate response to the items measuring waste separation, which is a sub-variable of waste management. That is, separating waste to recover reusable items reduces the consumption of materials; I separate waste into recyclable and non-recyclable items on campus and Inadequate bins in my college prevent the proper sorting of waste. Amongst the items, students agreed and gave more attention to the item that says that separating waste to recover reusable items reduces the consumption of materials. The respondents gave a low response to the items that said they separate waste into recyclable and non-recyclable items on campus. Although the students understand the importance of waste separation, however, the inadequacy of bins limits them from separating the waste.

From the table results, it is shown that the respondents had a moderate response to the items measuring waste recycling, which is a sub-variable of waste management. That is, waste reuse and recycling reduce the volume and cost of waste; my college organises regular awareness

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Initiatives on waste recycling, and I always remove potentially useful material from waste before disposal. Amongst the items, students agreed and gave more attention to the item that says I always remove potentially useful material from waste before disposal. The respondents gave a low response to the items that said my College organises regular awareness programmes on waste recycling. This implies that students understand the benefits of recycling and remove useful materials from waste; however, there is a lack of regular awareness regarding waste recycling.

4.2.2 Hypotheses

A two-step data analysis procedure was employed to investigate the relationships among the constructs in the proposed model. In the first step, the measurement model was evaluated to assess the reliability and validity of the constructs. This involved examining key indicators such as factor loadings, composite reliability, average variance extracted (AVE), discriminant validity, and common method bias.

In the second step, the structural model was analysed to test the hypothesised relationships between the independent and dependent variables. The evaluation criteria included collinearity statistics (VIF), path coefficients, coefficient of determination (R^2), effect size (f^2), t-values, p-values, and predictive relevance (Q^2).

4.2.2.1 Hypothesis One: Environmental advertising has no significant impact on waste management in Federal Colleges of Education, Southwest, Nigeria.

I. Reflective Measurement Model Assessment

This study employed a reflective measurement model to evaluate the factor loadings of environmental advertising and waste management. The analysis used 5 items for environmental

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advertising and 12 items for waste management. Factor loadings ranged from 0.50 to 0.80, with values above 0.50 deemed acceptable and those above 0.70 considered preferred and recommended. Based on the results, item 5 from the environmental advertising construct was removed due to a loading below 0.50. Similarly, item 2 was removed from the waste management construct (see Table 4.9).

Table 4.9: Factor Loading of Environmental Advertising and Waste Management

	Environmental Advertising	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
EA1	0.785				
EA2	0.722				
EA3	0.631				
EA4	0.547				
WC1		0.642			
WC2		0.691			
WC3		0.607			
WG1			0.658		
WG2			0.663		
WG3			0.682		
WR1				0.817	
WR3				0.652	
WS1					0.615
WS2					0.582
WS3					0.660

Note: Environmental Advertising (EA); Waste Collection (WC); Waste Separation (WS); Waste Recycling (WR); Waste Separation (WS)

Table 4.10: Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion)

	AVE	CR	EA	WC	WM	WR	WS
Environmental Advertising	0.559	0.769	**0.678**				
Waste Collection	0.549	0.784	0.291	**0.648**			
Waste Management	0.546	0.707	0.298	0.249	**0.668**		
Waste Recycling	0.519	0.703	0.429	0.563	0.613	**0.623**	
Waste Separation	0.546	0.704	0.244	0.191	0.190	0.557	**0.739**
Waste generation	0.584	0.751	0.247	0.181	0.216	0.588	0.186

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Note: Average Variance Extracted (AVE); Composite Reliability (CR); Environmental Advertising (EA); Waste Collection (WC); Waste Management (WM); Waste Recycling (WR); Waste Separation (WS)

The composite reliability was assessed to ensure that the environmental advertising and waste management measures are similar. The analysis revealed that the composite reliability for the study was within the acceptable threshold of 0.70 and 0.90. Values from 0.70 to 0.90 are considered good, but values above 0.95 are considered problematic. This shows that the composite reliability is adequate for the study. Furthermore, environmental advertising had the highest composite reliability among others.

The convergent validity was employed in the study, and average variance extract (AVE) was carried out to know how much of the indicator variance can be explained by the latent variable. The First-order latent variable was constructed to identify the values of the AVE, which include: environmental advertising (0.559), waste collection (0.549), waste management (0.546), waste recycling (0.519), waste separation (0.546) and waste generation (0.584). From the analysis, all the variables are above 0.50, which is the acceptable threshold. This shows that the convergent validity for the study is adequate, and 50% or more of the variance of the items makes up the construct (See Table 4.9).

Discriminant validity was assessed using the Fornell-Lacker criterion, heterotrait-monotrait (HTMT) and cross loadings. The Fornell-Lacker criterion proposed that the square root of the construct AVE should be greater than its correlation with other variables. The constructs AVE are all greater than other inter-construct correlations, which satisfied the discriminant validity (See Table 4.9).

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Table 4.11: Cross-Loading for Discriminant Validity

	Environmental Advertising	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
EA1	0.785	0.234	0.259	0.229	0.177
EA2	0.722	0.227	0.194	0.163	0.210
EA3	0.631	0.173	0.174	0.175	0.149
EA4	0.547	0.139	0.171	0.059	0.125
WC1	0.250	0.642	0.203	0.191	0.010
WC2	0.170	0.691	0.132	0.070	0.162
WC3	0.144	0.607	0.148	0.109	0.182
WG1	0.205	0.133	0.658	0.137	0.169
WG2	0.183	0.161	0.663	0.126	0.139
WG3	0.208	0.204	0.682	0.118	0.126
WR1	0.212	0.200	0.178	0.817	0.091
WR3	0.142	0.066	0.093	0.652	0.201
WS1	0.176	0.054	0.171	0.153	0.615
WS2	0.174	0.119	0.078	0.117	0.582
WS3	0.114	0.162	0.146	0.077	0.660

Note: Environmental Advertising (EA); Waste Collection (WC); Waste Separation (WS); Waste Recycling (WR); Waste Separation (WS)

Cross-loading items are higher than the items in the row and column of the table, which supports discriminant validity (see Table 4.10). The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 per cent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.50 and 0.70, which makes the discriminant validity acceptable (see Table 4.10).

Table 4.12: Discriminant Validity (Heterotriat-Monotriat-HTMT)

		CONFIDENCE INTERVAL	
	Waste Management	2.5%	97.5%
Environmental Advertising	0.736	0.590	0.882

The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 per cent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.40 and 0.70, which makes the discriminant validity acceptable.

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Table 4.13: Common Method Bias: Latent Variable Correlation

	Environmental Advertising	Waste Collection	Waste Generation	Waste Management	Waste Recycling	Waste Separation
Environmental Advertising	1.000					
Waste Collection	0.291	1.000				
Waste Generation	0.298	0.249	1.000			
Waste Management	0.429	0.663	0.713	1.000		
Waste Recycling	0.244	0.291	0.290	0.557	1.000	
Waste Separation	0.247	0.281	0.216	0.588	0.286	1.000

Common method bias was assessed in this study using the correlation matrix procedure[3]. The latent variables are between 0.20 and 0.70 and are not found to exceed 0.90 between constructs. This shows that the issue of common method bias was not found in the study (see Table 4.12).

Table 4.14: Collinearity Statistic (VIF)

	VIF Values
Environmental Advertising	**1.100**

Environmental advertising was tested for collinearity (see Table 4.13). The result revealed that the variable is 1.100, which is less than 3.3. This indicates that VIF values are within the threshold value[1]. It also implies that there are no collinearity issues between the constructs and are free from common method bias.

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Table 4.15: Structural Model Result of Environmental Advertising and Waste Management

		Path Coefficient	Standard Deviation	T-Value	P-Value	Decision
	Environmental Advertising -> Waste Collection	0.284	0.041	7.008	0.000	
	Environmental Advertising -> Waste Generation	0.306	0.039	7.800	0.000	
	Environmental Advertising -> Waste Recycling	0.239	0.040	5.987	0.000	
	Environmental Advertising -> Waste Separation	0.252	0.038	6.454	0.000	
	Waste Management -> Waste Collection	0.663	0.055	11.977	0.000	
	Waste Management -> Waste Generation	0.713	0.044	16.238	0.000	
	Waste Management -> Waste Recycling	0.557	0.066	8.476	0.000	
	Waste Management -> Waste Separation	0.588	0.066	8.906	0.000	
H1	**Environmental Advertising -> Waste Management**	**0.429**	**0.046**	**9.287**	**0.000**	**Supported**
	R^2	0.184				
	R^2 Adjusted	0.182				
	F^2	0.35				
	SRMR	0.171				

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The indirect effect of path coefficient and T-value for the relationship between environmental advertising and waste collection is (β= 0.284, t-value = 7.008, P-value= 0.00), environmental advertising and waste generation is (β= 0.306, t-value = 7.800, P-value= 0.00), environmental advertising and waste separation is (β=0.239, t-value = 5.987, P-value= 0.00), and environmental

advertising and waste recycling is (β=0.239, t-value = 5.987, P-value= 0.00). This analysis shows that waste generation is the highest contributing factor to explaining the impact of environmental advertising on waste management (see Figures 4.2 & 4.3).

The direct effect of the path coefficient and T-value for the overall construct include environmental advertising and waste management (β = 0.429, t-value = 9.287, P-value = 0.00) (See Figures 4.2 and 4.3). This implies that environmental advertising has a significant effect on waste management among students in colleges. The result further revealed that an increase in environmental advertising will increase waste management by 0.046 standard deviation. The SRMR for the model is 0.171, which is within the acceptable threshold; thus, the model is considered a good fit (see Table 4.13).

The F^2 result indicates that the relationship between environmental advertising and waste management (0.35) is high. This implies that the presence of environmental advertising on waste management is high (see Table 4.13).

The coefficient of determination (R^2) is used to measure the level of variance in waste management that can be explained by environmental advertising. The analysis revealed that the R^2 for waste management is small at R^2= 0.184, which implies that 18.4 % variance of waste management is explained by environmental advertising (see Table 4.13).

The result shows that the t-value = 9.287 is more than 1.96, and its significance level, p 0.000, is less than 0.05. This implies that the null hypothesis, which states that environmental advertising does not have a significant effect on waste management, is rejected. Therefore, the alternative hypothesis, which states that environmental advertising does have a significant effect on waste management, is **accepted**.

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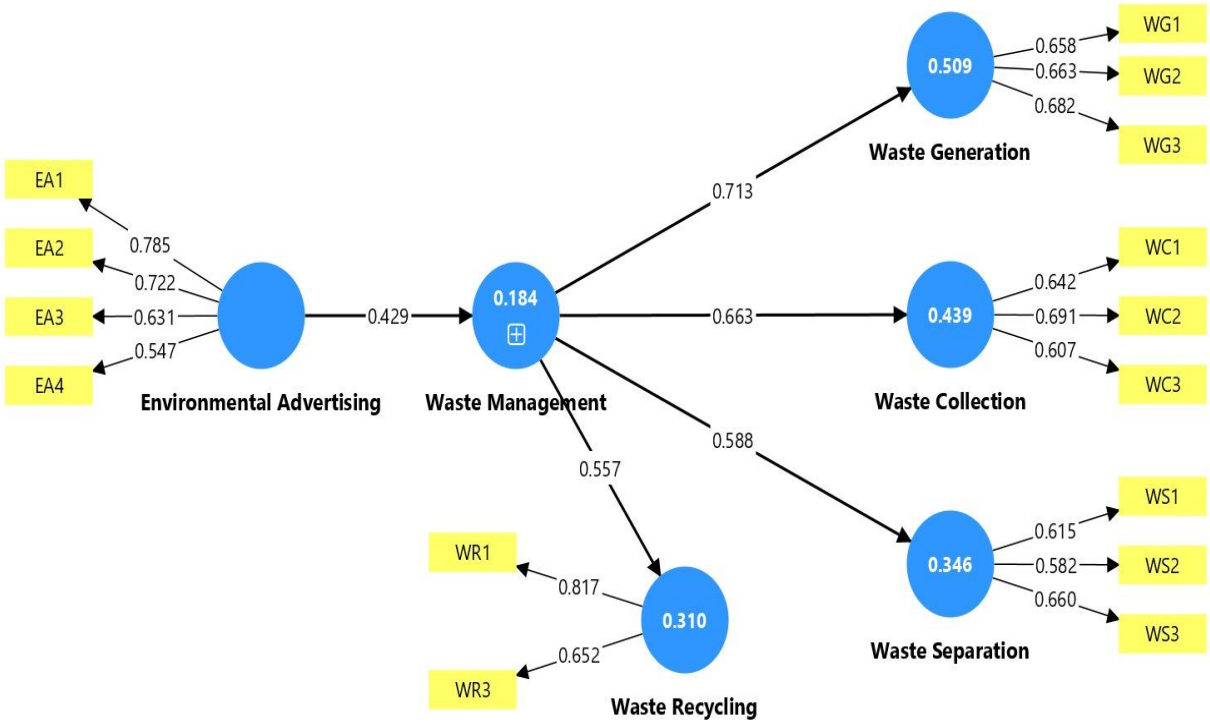


Figure 4.1: Structural Model of the Relationship between Environmental Advertising and Waste Management

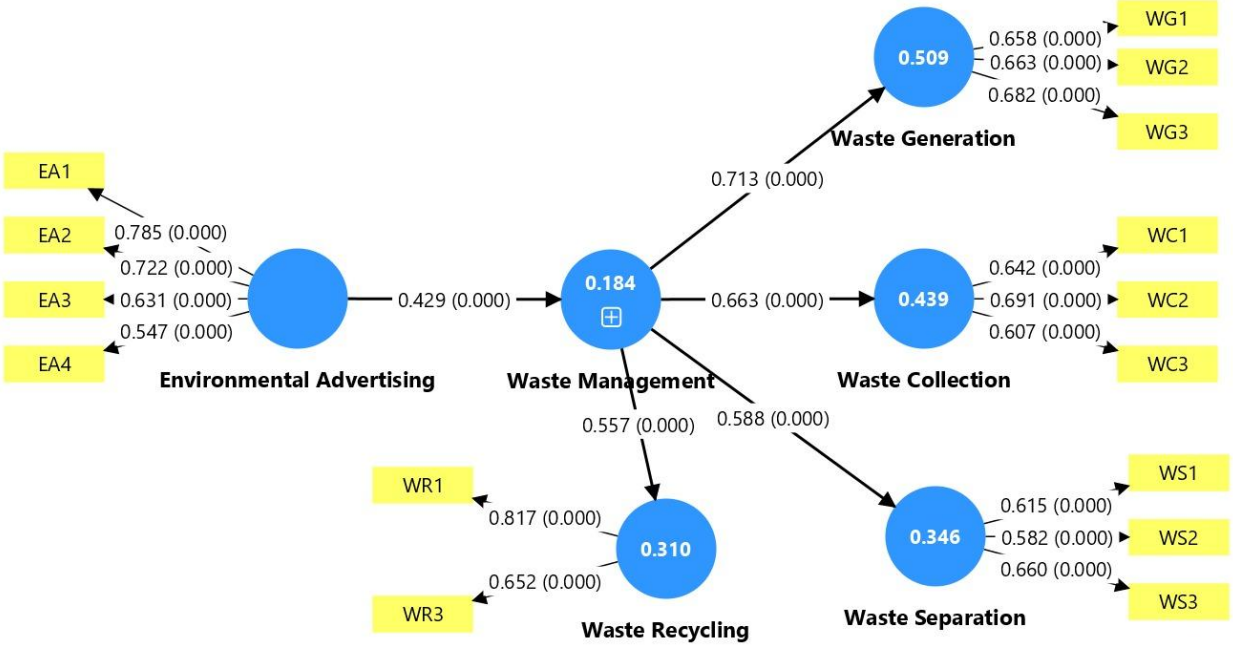


Figure 4.2: Bootstrapping of the P-value of the Relationship between Environmental Advertising and Waste Management

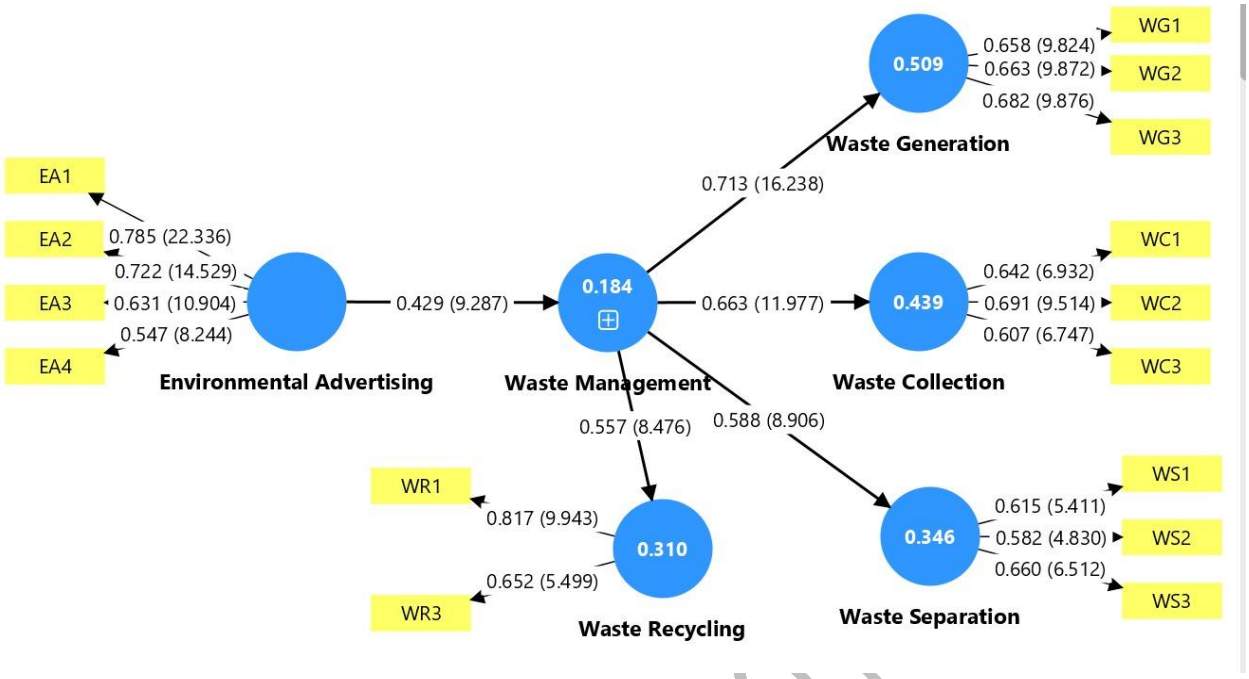


Figure 4.3: Bootstrapping of the T-value of the Relationship between Environmental Advertising and Waste Management

4.2.2.2 Hypothesis Two: Social media platform does not significantly influence waste management in Federal Colleges of Education, Southwest, Nigeria.

i. Reflective Measurement Model Assessment

This study employed a reflective measurement model to evaluate the factor loadings of social media platforms and waste management. The analysis used 5 items for the social media platform and 12 items for waste management. Factor loadings ranged from 0.50 to 0.80, with values above 0.50 deemed acceptable and those above 0.70 considered preferred and recommended. Based on the results, item 2 was removed from the waste management construct (see Table 4.15).

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Table 4.16: Factor Loading of Social Media Platform and Waste Management

	Social Media Platform	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
SMP1	0.547				
SMP2	0.571				
SMP3	0.584				
SMP4	0.544				
SMP5	0.566				
WC1		0.618			
WC2		0.698			
WC3		0.623			
WG1			0.660		
WG2			0.665		
WG3			0.678		
WR1				0.811	
WR3				0.660	
WS1					0.611
WS2					0.571
WS3					0.673

Note: Social Media Platform (SMP); Waste Collection (WC); Waste Separation (WG); Waste Recycling (WR); Waste Separation (WS)

Table 4.17: Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion)

	AVE	CR	SMP	WC	WM	WR	WS	WG
Social Media Platform	0.517	0.798	**0.663**					
Waste Collection	0.519	0.784	0.271	**0.748**				
Waste Management	0.546	0.707	0.287	0.247	**0.768**			
Waste Recycling	0.579	0.703	0.423	0.660	0.710	**0.623**		
Waste Separation	0.547	0.705	0.185	0.187	0.189	0.545	**0.739**	
Waste generation	0.584	0.751	0.318	0.186	0.216	0.605	0.186	0.620

Note: Average Variance Extracted (AVE); Composite Reliability (CR); Social Media Platform (SMP); Waste Collection (WC); Waste Management (WM); Waste Recycling (WR); Waste Separation (WS)

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The composite reliability was assessed to ensure that the social media platform and waste management measures are similar. The analysis revealed that the composite reliability for the study was within the acceptable threshold of 0.70. Values from 0.70 to 0.90 are considered good, but values above 0.95 are considered problematic. This shows that the composite reliability is adequate for the study. Furthermore, social media platform had the highest composite reliability amongst others.

The convergent validity was employed in the study, and average variance extract (AVE) was carried out to determine how much of the indicator variance can be explained by the latent variable. The First-order latent variable was constructed to identify the values of the AVE, which include: social media platform (0.517), waste collection (0.149), waste management (0.546), waste recycling (0.579), waste separation (0.547) and waste generation (0.584). From the analysis, all the variables are above 0.50, which is the acceptable threshold. This shows that the convergent validity for the study is adequate, and 50% or more of the variance of the items make up the construct (See Table 4.16).

Discriminant validity was assessed using the Fornell-Lacker criterion, heterotrait-monotrait (HTMT) and cross loadings. The Fornell-Lacker criterion proposed that the square root of the construct AVE should be greater than its correlation with other variables. The constructs AVE are all greater than other inter-construct correlations, which satisfied the discriminant validity (See Table 4.16).

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Table 4.18: Cross-Loading for Discriminant Validity

	Social Media Platform	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
SMP1	0.547	0.180	0.131	0.092	0.200
SMP2	0.571	0.192	0.168	0.132	0.176
SMP3	0.584	0.127	0.202	0.088	0.169
SMP4	0.544	0.153	0.140	0.077	0.157
SMP5	0.566	0.104	0.162	0.128	0.192
WC1	0.102	0.618	0.203	0.190	0.010
WC2	0.208	0.698	0.132	0.070	0.164
WC3	0.212	0.623	0.148	0.108	0.181
WG1	0.204	0.133	0.660	0.137	0.168
WG2	0.196	0.160	0.665	0.126	0.139
WG3	0.175	0.202	0.678	0.117	0.127
WR1	0.148	0.198	0.178	0.811	0.091
WR3	0.125	0.065	0.094	0.660	0.199
WS1	0.212	0.055	0.172	0.154	0.611
WS2	0.134	0.122	0.078	0.118	0.571
WS3	0.237	0.165	0.146	0.078	0.673

Note: Environmental Advertising (EA); Waste Collection (WC); Waste Management (WM); Waste Recycling (WR); Waste Separation (WS)

Cross-loading items are higher than the items in the row and column of the table, which supports discriminant validity (see Table 4.17). The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 percent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.50 and 0.70, which makes the discriminant validity acceptable (see Table 4.17).

Table 4.19: Discriminant Validity (Heterotriat-Monotriat-HTMT)

		CONFIDENCE INTERVAL	
	Waste Management	2.5%	97.5%
Social Media Platform	0.851	0.438	0.718

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The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 per cent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.40 and 0.70, which makes the discriminant validity acceptable.

Table 4.20: Common Method Bias: Latent Variable Correlation

	Social Media Platform	Waste Collection	Waste Generation	Waste Management	Waste Recycling	Waste Separation
Social Media Platform	1.000					
Waste Collection	0.271	1.000				
Waste Generation	0.287	0.747	1.000			
Waste Management	0.423	0.660	0.710	1.000		
Waste Recycling	0.185	0.187	0.189	0.545	1.000	
Waste Separation	0.318	0.286	0.216	0.605	0.286	1.000

Common method bias was assessed in this study using the correlation matrix procedure[3]. The latent variables are between 0.20 and 0.70 and are not found to exceed 0.90 between constructs. This shows that the issue of common method bias was not found in the study (see Table 4.19).

Table 4.21: Collinearity Statistic (VIF)

	VIF Values
Environmental Advertising	**1.105**

Social Media Platform was tested for collinearity (see Table 4.20). The result revealed that the variable is 1.1, which is less than 3.3. This indicates that VIF values are within the threshold value[1]. It also implies that there are no collinearity issues between the constructs and are free from common method bias.

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Table 4.22: Structural Model Result of Social Media Platform and Waste Management

		Path Coefficient	Standard Deviation	T-Value	P-Value	Decision
	Social Media Platform -> Waste Collection	0.279	0.041	6.980	0.000	
	Social Media Platform -> Waste Generation	0.300	0.038	7.857	0.000	
	Social Media Platform -> Waste Recycling	0.230	0.038	6.108	0.000	
	Social Media Platform -> Waste Separation	0.256	0.043	5.884	0.000	
	Waste Management -> Waste Collection	0.660	0.056	11.836	0.000	
	Waste Management -> Waste Generation	0.710	0.045	15.723	0.000	
	Waste Management -> Waste Recycling	0.545	0.068	8.015	0.000	
	Waste Management -> Waste Separation	0.605	0.064	9.504	0.000	
H2	**Social Media Platform -> Waste Management**	**0.423**	**0.046**	**9.184**	**0.000**	**Supported**
	R^2	0.179				
	R^2 Adjusted	0.176				
	F^2	0.217				
	SRMR	0.167				

The indirect effect of path coefficient and T-value for the relationship between social media platform and waste collection is (β= 0.279, t-value = 6.980, P-value= 0.00), social media platform and waste generation is (β= 0.300, t-value = 7.857, P-value= 0.00) social media platform and waste separation is (β=0.256, t-value= 5.884, P-value= 0.00), and social media platform and waste recycling is (β=0.230, t-value= 6.108, P-value= 0.00). This analysis shows

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that waste collection is the highest contributing factor to explaining the impact of social media platforms on waste management (see Figures 4.5 & 4.6).

The direct effect of the path coefficient and T-value for the overall construct include social media platform and waste management (β = 0.423, t-value = , P-value = 0.00) (See Figures 4.2 and 4.3). This implies that social media platform has a significant effect on waste management among students in colleges. The result further revealed that an increase in social media platforms will increase waste management by 0.046 standard deviation. The SRMR for the model is 0.167, which is within the acceptable threshold; thus, the model is considered a good fit (see Table 4.21).

The F^2 result indicates that the relationship between social media platform and waste management (0.217) is moderate. This implies that the presence of social media platforms on waste management is moderate (see Table 4.21).

The coefficient of determination (R^2) is used to measure the level of variance in waste management that can be explained by social media platform. The analysis revealed that the R^2 for waste management is small at R^2= 0.179, which implies that 17.9% variance of waste management is explained by social media platform (see Table 4.21).

The result shows that the t-value = 9.184 is more than 1.96, and its significance level, p 0.000, is less than 0.05. This implies that the null hypothesis, which states that social media platform does not have a significant effect on waste management, is rejected. Therefore, the alternative hypothesis, which states that social media platform has a significant effect on waste management, is **accepted**.

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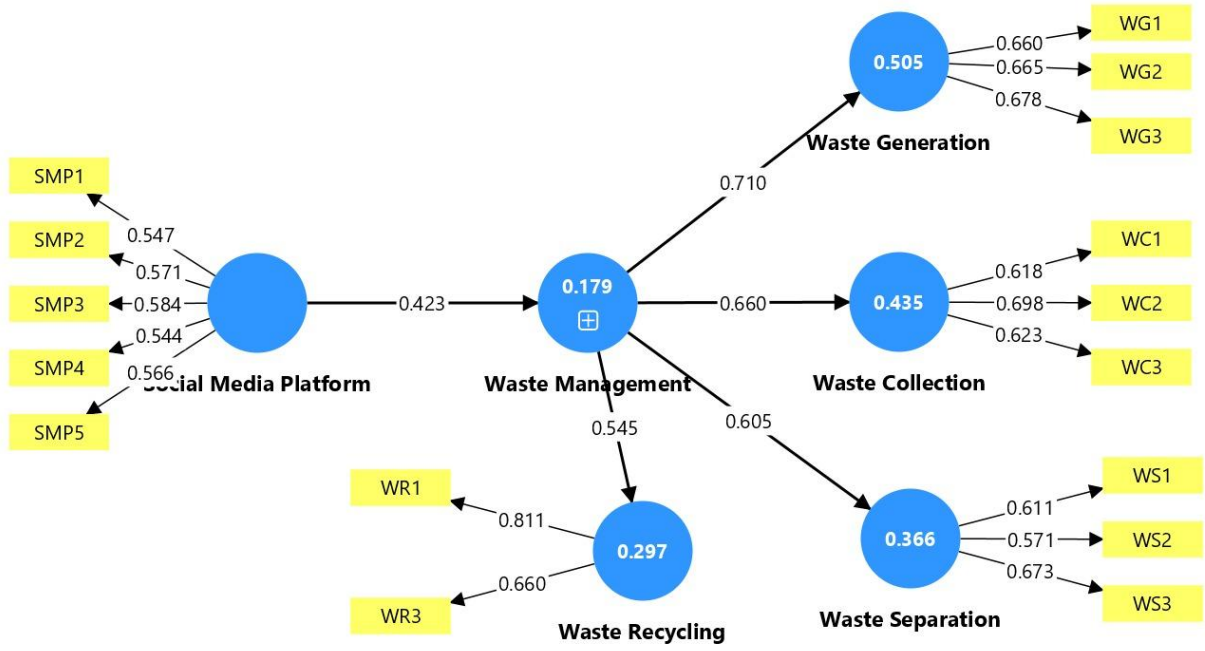


Figure 4.4: Structural Model of the Relationship between Social Media Platform and Waste Management

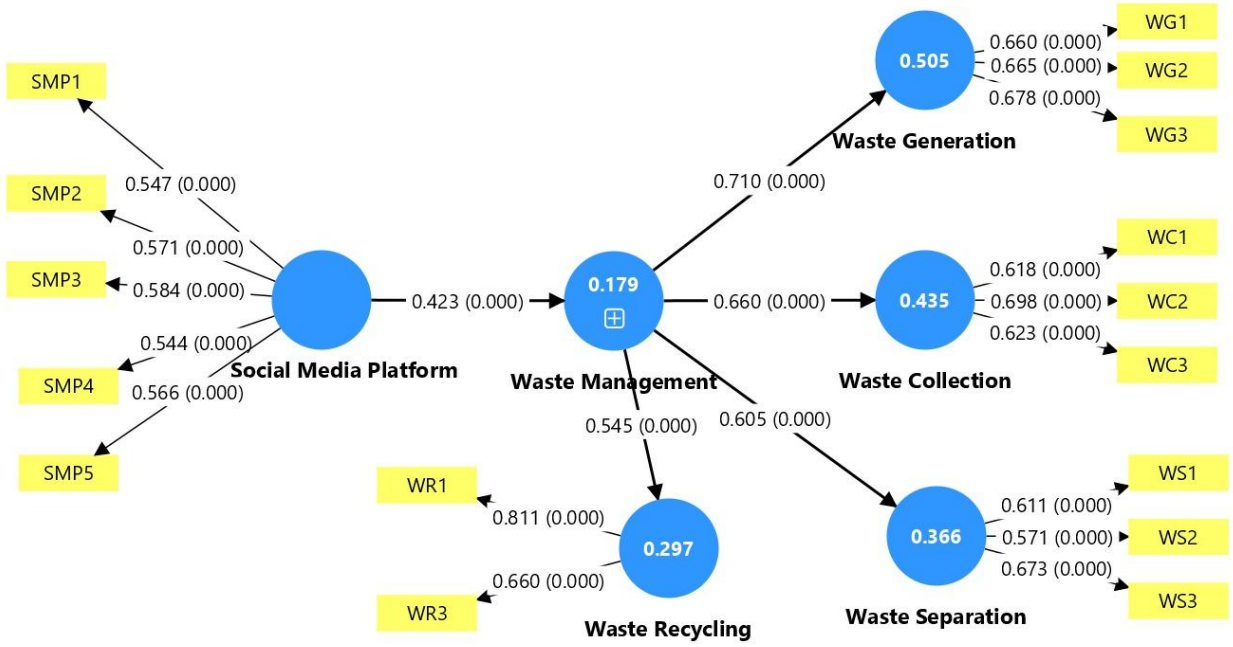


Figure 4.5: Bootstrapping of the P-value of the Relationship between Social Media Platform and Waste Management

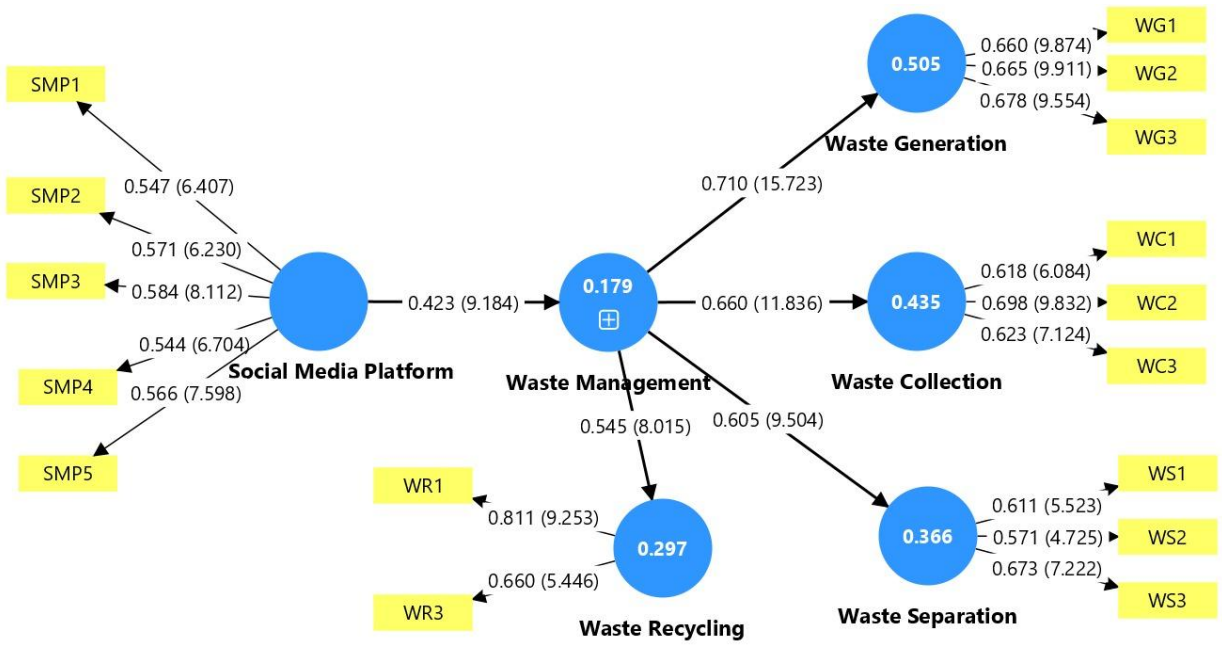


Figure 4.6: Bootstrapping of the T-value of the Relationship between Social Media Platform and Waste Management

4.2.2.3 Hypothesis Three: Eco-labeling does not have any significant effect waste management in Federal Colleges of Education, Southwest, Nigeria.

I. Reflective Measurement Model Assessment

This study employed a reflective measurement model to evaluate the factor loadings of eco-labelling and waste management. The analysis used 5 items for eco-labelling and 12 items for waste management. Factor loadings ranged from 0.50 to 0.80, with values above 0.50 deemed acceptable and those above 0.70 considered preferred and recommended. Based on the results, item 5 was removed from eco-labelling and item 2 was removed from the waste management construct (see Table 4.22).

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Table 4.23: Factor Loading of Eco-Labelling and Waste Management

	Eco-Labeling	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
EL1	0.633				
EL2	0.674				
EL3	0.593				
EL4	0.523				
WC1		0.627			
WC2		0.700			
WC3		0.613			
WG1			0.651		
WG2			0.669		
WG3			0.683		
WR1				0.816	
WR3				0.653	
WS1					0.605
WS2					0.564
WS3					0.684

Note: Eco-Labelling (EL); Waste Collection (WC); Waste Separation (WG); Waste Recycling (WR); Waste Separation (WS)

Table 4.24: Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion)

	AVE	CR	EL	WC	WM	WR	WS	WG
Eco-Labeling	0.510	0.700	0.608					
Waste Collection	0.520	0.684	0.289	0.648				
Waste Management	0.546	0.707	0.286	0.248	0.768			
Waste Recycling	0.579	0.703	0.404	0.667	0.713	0.423		
Waste Separation	0.546	0.704	0.148	0.189	0.190	0.541	0.739	
Waste generation	0.584	0.650	0.276	0.185	0.216	0.597	0.184	0.620

Note: Average Variance Extracted (AVE); Composite Reliability (CR); Eco-Labelling (EL); Waste Collection (WC); Waste Management (WM); Waste Recycling (WR); Waste Separation (WS)

The composite reliability was assessed to ensure that the eco-labelling and waste management measures are similar. The analysis revealed that the composite reliability for the study was within the acceptable threshold of 0.70. Values from 0.70 to 0.90 are considered good, but values above 0.95 are considered problematic. This shows that the composite reliability is adequate for the study. Furthermore, eco-labelling had the highest composite reliability amongst others.

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The convergent validity was employed in the study, and average variance extract (AVE) was carried out to know how much of the indicator variance can be explained by the latent variable. The First-order latent variable was constructed to identify the values of the AVE, which include: eco-labelling (0.510), waste collection (0.520), waste management (0.546), waste recycling (0.579), waste separation (0.546) and waste generation (0.584). From the analysis, all the variables are above 0.50, which is the acceptable threshold. This shows that the convergent validity for the study is adequate, and 50% or more of the variance of the items make up the construct (See Table 4.23).

Discriminant validity was assessed using the Fornell-Lacker criterion, heterotrait-monotrait (HTMT) and cross loadings. The Fornell-Lacker criterion proposed that the square root of the construct AVE should be greater than its correlation with other variables. The constructs AVE are all greater than other inter-construct correlations, which satisfied the discriminant validity (See Table 4.23).

Table 4.25: Cross-Loading for Discriminant Validity

	Eco-Labeling	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
EL1	0.633	0.119	0.214	0.130	0.165
EL2	0.674	0.246	0.188	0.104	0.175
EL3	0.593	0.210	0.142	0.067	0.150
EL4	0.523	0.114	0.146	0.050	0.188
WC1	0.154	0.627	0.203	0.191	0.010
WC2	0.229	0.700	0.132	0.070	0.166
WC3	0.177	0.613	0.148	0.109	0.180
WG1	0.128	0.133	0.651	0.137	0.168
WG2	0.233	0.160	0.669	0.126	0.139
WG3	0.210	0.202	0.683	0.118	0.127
WR1	0.128	0.198	0.178	0.816	0.090
WR3	0.088	0.066	0.093	0.653	0.199
WS1	0.165	0.055	0.171	0.154	0.605
WS2	0.078	0.121	0.078	0.118	0.564
WS3	0.252	0.165	0.146	0.077	0.684

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Note: Eco-labelling (EL); Waste Collection (WC); Waste Management (WM); Waste Recycling (WR); Waste Separation (WS)

Cross-loading items are higher than the items in the row and column of the table, which supports discriminant validity (see Table 4.24). The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 percent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.50 and 0.70, which makes the discriminant validity acceptable (see Table 4.24).

Table 4.26: Discriminant Validity (Heterotriat-Monotriat-HTMT)

		CONFIDENCE INTERVAL	
	Waste Management	2.5%	97.5%
Eco-Labeling	0.851	0.438	0.718

The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 percent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.40 and 0.70, which makes the discriminant validity acceptable.

Table 4.27: Common Method Bias: Latent Variable Correlation

	Eco-Labeling	Waste Collection	Waste Generation	Waste Management	Waste Recycling	Waste Separation
Eco-Labeling	1.000					
Waste Collection	0.289	1.000				
Waste Generation	0.286	0.248	1.000			
Waste Management	0.404	0.667	0.713	1.000		
Waste Recycling	0.148	0.189	0.190	0.541	1.000	
Waste Separation	0.276	0.185	0.216	0.597	0.184	1.000

Common method bias was assessed in this study using the correlation matrix procedure[3]. The latent variables are between 0.20 and 0.70 and are not found to exceed 0.90 between constructs. This shows that the issue of common method bias was not found in the study (see Table 4.19).

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Table 4.28: Collinearity Statistic (VIF)

	VIF Values
Eco-Labeling	**1.100**

Eco-Labelling was tested for collinearity (see Table 4.27). The result revealed that the variable is 1.1, which is less than 3.3. This indicates that VIF values are within the threshold value[1]. It also implies that there are no collinearity issues between the constructs and are free from common method bias.

Table 4.29: Structural Model Result of Incentive-Based Initiatives and Waste Management

		Path Coefficient	Standard Deviation	T-Value	P-Value	Decision
	Eco-Labeling -> Waste Collection	0.269	0.041	6.527	0.000	
	Eco-Labeling -> Waste Generation	0.288	0.040	7.270	0.000	
	Eco-Labeling -> Waste Recycling	0.218	0.034	6.368	0.000	
	Eco-Labeling -> Waste Separation	0.241	0.041	5.906	0.000	
	Waste Management -> Waste Collection	0.667	0.056	11.981	0.000	
	Waste Management -> Waste Generation	0.713	0.045	16.009	0.000	
	Waste Management -> Waste Recycling	0.541	0.069	7.801	0.000	
	Waste Management -> Waste Separation	0.597	0.064	9.275	0.000	
H3	**Eco-Labeling -> Waste Management**	**0.404**	**0.047**	**8.680**	**0.000**	**Supported**
	R^2	0.163				
	R^2 Adjusted	0.161				
	F^2	0.217				
	SRMR	0.167				

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The indirect effect of path coefficient and T-value for the relationship between eco-labelling and waste collection is (β= 0.269 t-value = 6.980, P-value= 0.00), eco-labelling and waste generation is (β= 0.288, t-value = 7.270, P-value= 0.00), eco-labelling and waste separation is (β=0.241, t-value = 5.906, P-value= 0.00), and eco-labelling and waste recycling is (β=0.218, t-value = 6.368, P-value= 0.00). This analysis shows that waste collection is the highest contributing factor to explaining the impact of eco-labelling on waste management (see Figures 4.8 & 4.9).

The direct effect of the path coefficient and T-value for the overall construct for eco-labelling and waste management (β = 0.404, t-value = 8.680, P-value = 0.00) (See Figures 4.8 and 4.9). This implies that eco-labelling has a significant effect on waste management among students in colleges. The result further revealed that an increase in eco-labelling will increase waste management by 0.047 standard deviation. The SRMR for the model is 0.167, which is within the acceptable threshold; thus, the model is considered a good fit (see Table 4.28).

The F^2 result indicates that the relationship between eco-labelling and waste management (0.217) is moderate. This implies that the presence of eco-labelling on waste management is moderate (see Table 4.28).

The coefficient of determination (R^2) is used to measure the level of variance in waste management that can be explained by eco-labelling. The analysis revealed that the R^2 for waste management is small at R^2= 0.163, which implies that 16.3% variance of waste management is explained by eco-labelling (see Table 4.28).

The result shows that the t-value = 8.680 is more than 1.96, and its significance level, p 0.000, is less than 0.05. This implies that the null hypothesis, which states that eco-labelling does not have a significant effect on waste management, is rejected. Therefore, the alternative hypothesis, which states that eco-labelling does have a significant effect on waste management, is **accepted**.

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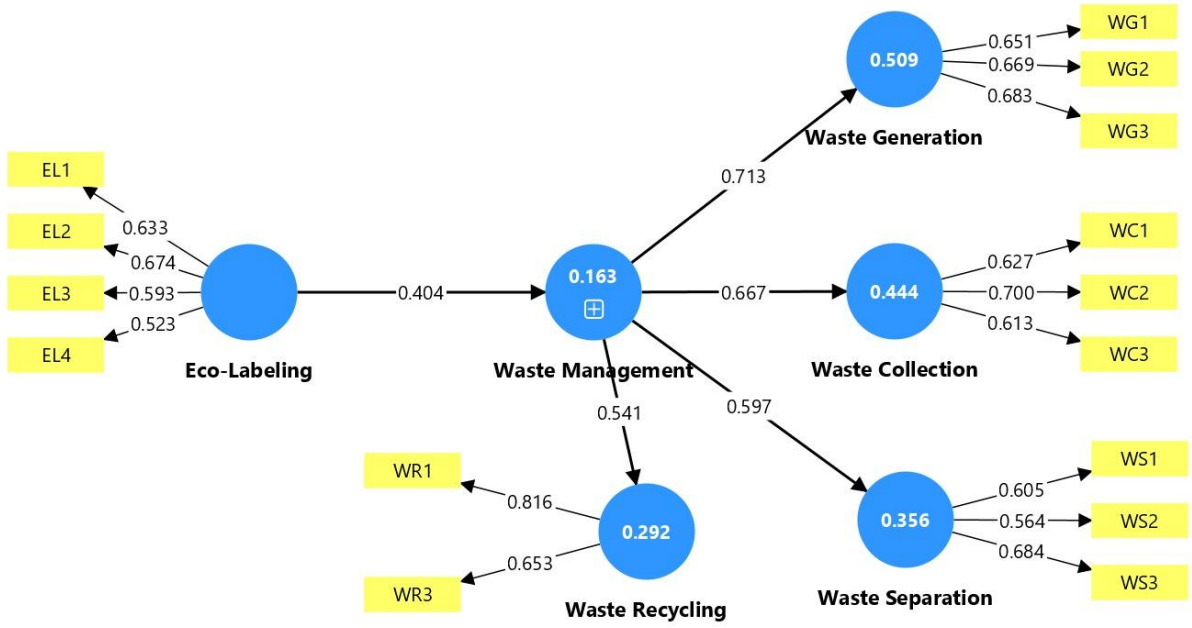


Figure 4.7: Structural Model of the Relationship between Eco-labelling and Waste Management

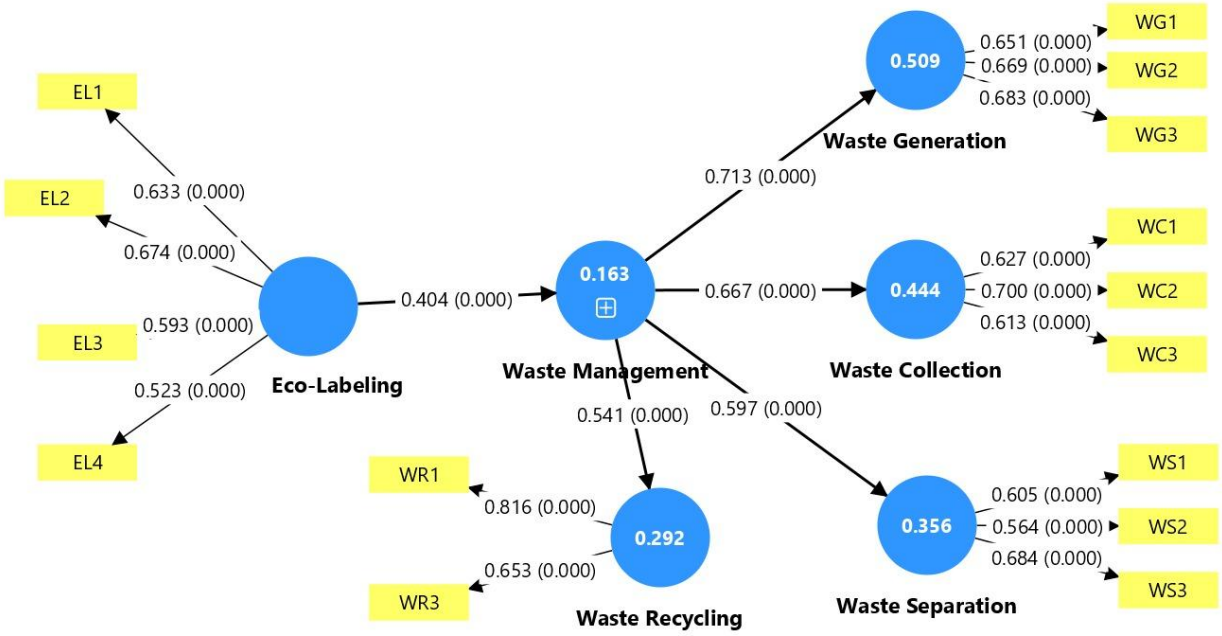


Figure 4.8: Bootstrapping of the P-value of the Relationship between Eco-labelling and Waste Management

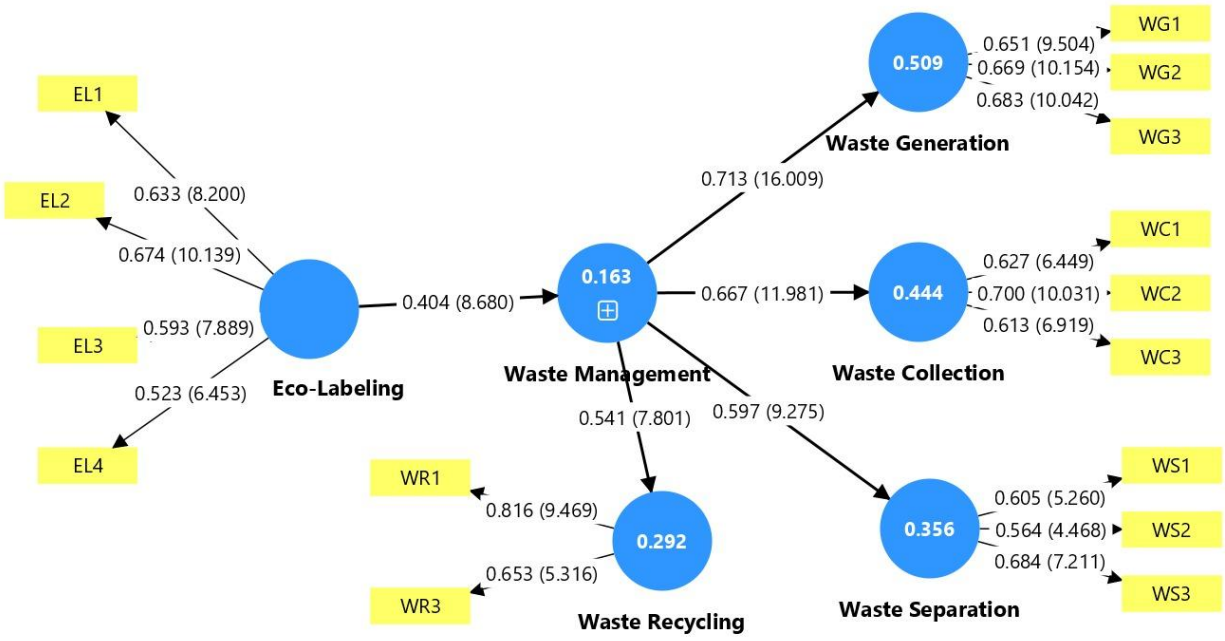


Figure 4.9: Bootstrapping of the t-value of the Relationship between Eco-labelling and Waste Management

4.2.2.4 Hypothesis Four: Incentive-based initiatives do not have a significant impact on waste management in Federal Colleges of Education, Southwest, Nigeria.

I. Reflective Measurement Model Assessment

This study employed a reflective measurement model to evaluate the factor loadings of incentive-based Initiatives and waste management. The analysis used 5 items for eco-labelling and 12 items for waste management. Factor loadings ranged from 0.50 to 0.80, with values above 0.50 deemed acceptable and those above 0.70 considered preferred and recommended. Based on the results, items 1,2,3 were removed from the incentive-based initiative and item 2 was removed from the waste management construct (see Table 4.29).

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Table 4.30: Factor Loading of Incentive-Based Initiatives and Waste Management

	Incentive-based Initiatives	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
IBP4	0.800				
IBP5	0.665				
WC1		0.631			
WC2		0.695			
WC3		0.614			
WG1			0.655		
WG2			0.669		
WG3			0.679		
WR1				0.805	
WR3				0.668	
WS1					0.601
WS2					0.583
WS3					0.672

Note: Incentive-based Initiatives (ICP); Waste Collection (WC); Waste Separation (WG); Waste Recycling (WR); Waste Separation (WS)

Table 4.31: Composite Reliability, Convergent and Discriminant Validity (Fornell-Lacker Criterion)

	AVE	CR	IBP	WC	WM	WR	WS	WG
Incentive -Based Initiatives	0.541	0.701	**0.736**					
Waste Collection	0.519	0.684	0.183	**0.648**				
Waste Management	0.546	0.707	0.207	0.249	**0.768**			
Waste Recycling	0.579	0.703	0.297	0.660	0.711	**0.623**		
Waste Separation	0.547	0.705	0.169	0.188	0.189	0.554	**0.739**	
Waste generation	0.584	0.651	0.191	0.184	0.215	0.596	0.187	0.620

Note: Average Variance Extracted (AVE); Composite Reliability (CR); Incentive-based Initiatives (ICP); Waste Collection (WC); Waste Management (WM); Waste Recycling (WR); Waste Separation (WS)

The composite reliability was assessed to ensure that the incentive-based Initiatives and waste management measures are similar. The analysis revealed that the composite reliability for the study was within the acceptable threshold of 0.70. Values from 0.70 to 0.90 are considered good, but values above 0.95 are considered problematic. This shows that the composite reliability is

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adequate for the study. Furthermore, waste management had the highest composite reliability among others.

The convergent validity was employed in the study, and average variance extract (AVE) was carried out to determine how much of the indicator variance can be explained by the latent variable. The First-order latent variable was constructed to identify the values of the AVE, which include: incentive-based Initiatives (0.541), waste collection (0.519), waste management (0.546), waste recycling (0.579), waste separation (0.547) and waste generation (0.584). From the analysis, all the variables are above 0.50, which is the acceptable threshold. This shows that the convergent validity for the study is adequate, and 50% or more of the variance of the items make up the construct (See Table 4.30).

Discriminant validity was assessed using the Fornell-Lacker criterion, heterotrait-monotrait (HTMT) and cross loadings. The Fornell-Lacker criterion proposed that the square root of the construct AVE should be greater than its correlation with other variables. The constructs AVE are all greater than other inter-construct correlations, which satisfied the discriminant validity (See Table 4.30).

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Table 4.32: Cross-Loading for Discriminant Validity

	Incentive-based Initiatives	Waste Collection	Waste Generation	Waste Recycling	Waste Separation
IBP4	0.800	0.177	0.143	0.155	0.139
IBP5	0.665	0.083	0.167	0.088	0.144
WC1	0.127	0.631	0.203	0.189	0.010
WC2	0.118	0.695	0.132	0.070	0.165
WC3	0.110	0.614	0.148	0.107	0.182
WG1	0.111	0.133	0.655	0.137	0.167
WG2	0.182	0.161	0.669	0.126	0.139
WG3	0.123	0.203	0.679	0.116	0.126
WR1	0.082	0.199	0.178	0.805	0.090
WR3	0.180	0.066	0.093	0.668	0.200
WS1	0.061	0.055	0.171	0.155	0.601
WS2	0.142	0.120	0.078	0.119	0.583
WS3	0.152	0.164	0.146	0.078	0.672

Note: Incentive-based Initiatives (ICP); Waste Collection (WC); Waste Management (WM); Waste Recycling (WR); Waste Separation (WS)

Cross-loading items are higher than the items in the row and column of the table, which supports discriminant validity (see Table 4.31). The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 percent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.50 and 0.70, which makes the discriminant validity acceptable (see Table 4.31).

Table 4.33: Discriminant Validity (Heterotriat-Monotriat-HTMT)

		CONFIDENCE INTERVAL	
	Waste Management	2.5%	97.5%
Incentive-based Initiatives	0.851	0.438	0.718

The Heterotriat-Monotriat-HTMT explains that the upper bound of the 95 percent confidence interval of HTMT should be lower than 0.90; thus, the confidence interval within this study is within 0.40 and 0.70, which makes the discriminant validity acceptable.

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Table 4.34: Common Method Bias: Latent Variable Correlation

	Incentive-based Initiatives	Waste Collection	Waste Generation	Waste Management	Waste Recycling	Waste Separation
Incentive-based Initiatives	1.000					
Waste Collection	0.183	1.000				
Waste Generation	0.207	0.249	1.000			
Waste Management	0.297	0.660	0.711	1.000		
Waste Recycling	0.169	0.188	0.189	0.554	1.000	
Waste Separation	0.191	0.184	0.215	0.596	0.187	1.000

Common method bias was assessed in this study using the correlation matrix procedure[3]. The latent variables are between 0.20 and 0.70 and are not found to exceed 0.90 between constructs. This shows that the issue of common method bias was not found in the study (see Table 4.33).

Table 4.35: Collinearity Statistic (VIF)

	VIF Values
Incentive-based Initiatives	**1.005**

Incentive-based initiative was tested for collinearity (see Table 4.34). The result revealed that the variable is 1.1, which is less than 3.3. This indicates that VIF values are within the threshold value[1]. It also implies that there are no collinearity issues between the construct and are free from common method bias.

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Table 4.36: Structural Model Result of Incentive-Based Initiatives and Waste Management

		Path Coefficient	Standard Deviation	T-Value	P-Value	Decision
	Incentive-based Initiatives -> Waste Collection	0.196	0.039	5.055	0.000	
	Incentive-based Initiatives -> Waste Generation	0.211	0.037	5.673	0.000	
	Incentive-based Initiatives -> Waste Recycling	0.165	0.036	4.543	0.000	
	Incentive-based Initiatives -> Waste Separation	0.177	0.040	4.410	0.000	
	Waste Management -> Waste Collection	0.660	0.057	11.539	0.000	
	Waste Management -> Waste Generation	0.711	0.046	15.619	0.000	
	Waste Management -> Waste Recycling	0.544	0.067	8.241	0.000	
	Waste Management -> Waste Separation	0.596	0.066	8.975	0.000	
H4	**Incentive-based Initiatives -> Waste Management**	**0.297**	**0.052**	**5.744**	**0.000**	**Supported**
	R^2	0.088				
	R^2 Adjusted	0.086				
	F^2	0.097				
	SRMR	0.185				

The indirect effect of path coefficient and T-value for the relationship between incentive-based Initiatives and waste collection is (β= 0.196 t-value = 5.055, P-value= 0.00), incentive-based Initiatives and waste generation is (β= 0.211, t-value = 5.673, P-value= 0.00) incentive-based Initiatives and waste separation is (β=0.165, t-value = 4.543, P-value= 0.00), and incentive-based Initiatives and waste recycling is (β=0.177, t-value = 4.410, P-value= 0.00). This analysis shows that waste generation has the highest contributing factor to explaining the impact of incentive-based Initiatives on waste management (see Figures 4.11 & 4.12).

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The direct effect of the path coefficient and T-value for the overall construct include incentive-based Initiatives and waste management (β = 0.297, t-value = 5.744, P-value = 0.00) (See Figures 4.11 and 4.12). This implies that incentive-based Initiatives has a significant effect on waste management among students in colleges. The result further revealed that an increase in incentive-based initiative will increase waste management by 0.052 standard deviation. The SRMR for the model is 0.185, which is within the acceptable threshold; thus, the model is considered a good fit (see Table 4.35).

The F^2 result indicates that the relationship between incentive-based Initiatives and waste management (0.097) is low. This implies that the presence of incentive-based Initiatives on waste management is moderate (see Table 4.35).

The coefficient of determination (R^2) is used to measure the level of variance in waste management that can be explained by incentive-based Initiatives. The analysis revealed that the R^2 for waste management is small at R^2= 0.088, which implies that 8.8% variance of waste management is explained by eco-labelling (see Table 4.35).

The result shows that the t-value = 5.744 is more than 1.96, and its significance level, p 0.000, is less than 0.05. This implies that the null hypothesis, which states that incentive-based Initiatives does not have a significant effect on waste management, is rejected. Therefore, the alternative hypothesis, which states that incentive-based Initiatives does have a significant effect on waste management, is **accepted**.

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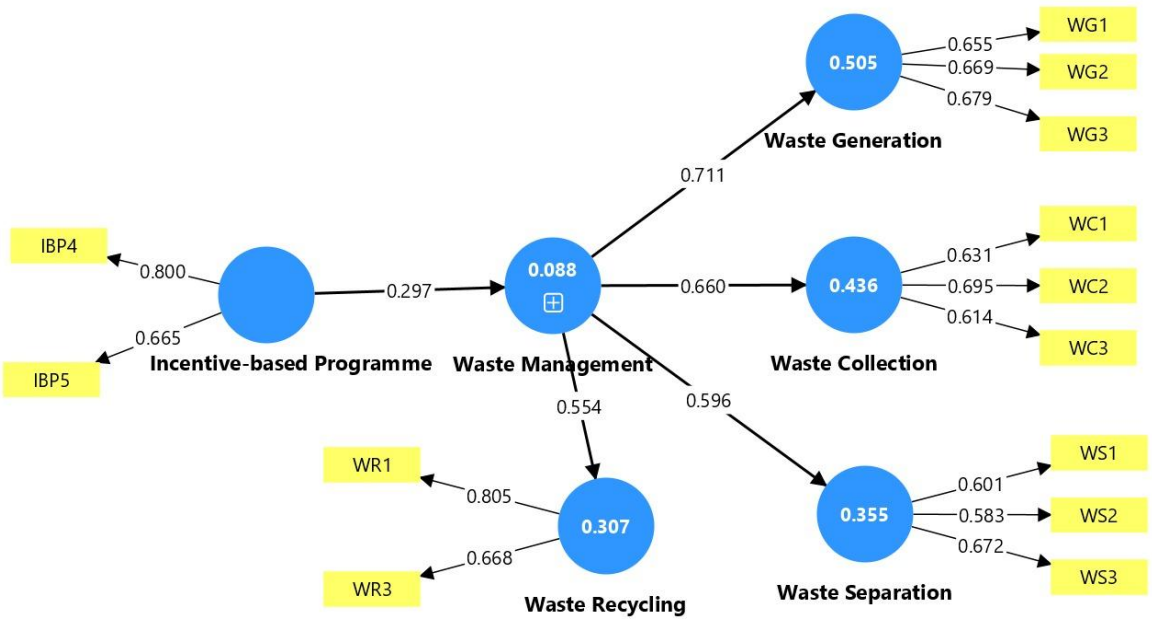


Figure 4.10: Structural Model of the Relationship between Incentive-based Initiatives and Waste Management

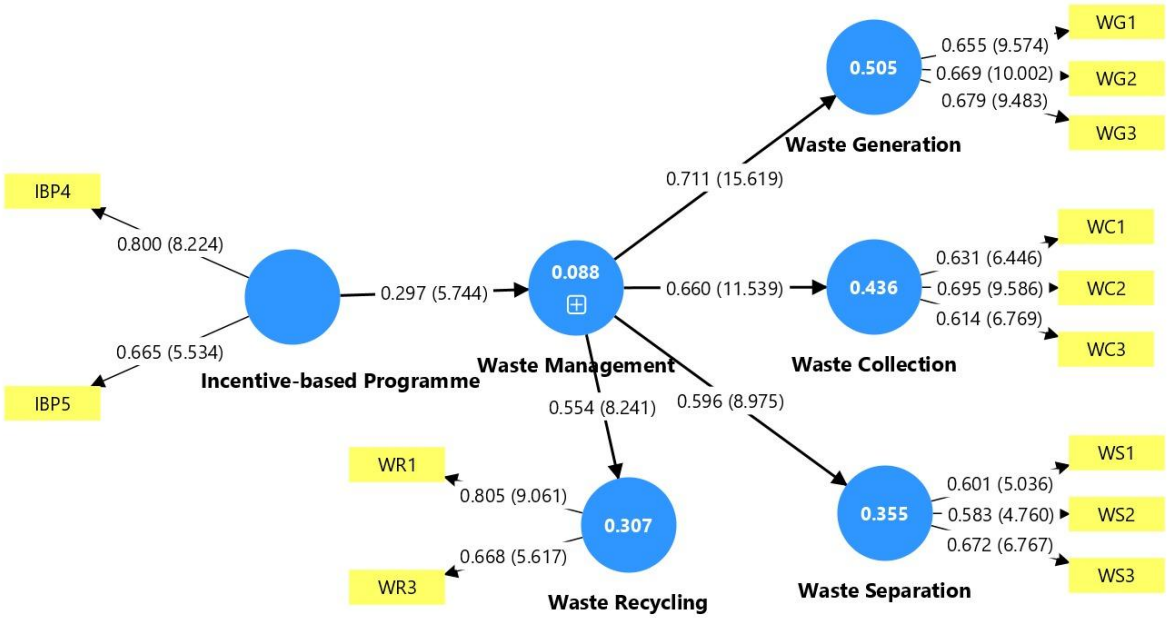


Figure 4.11: Bootstrapping of the t-value of the Relationship between Incentive-based Initiatives and Waste Management

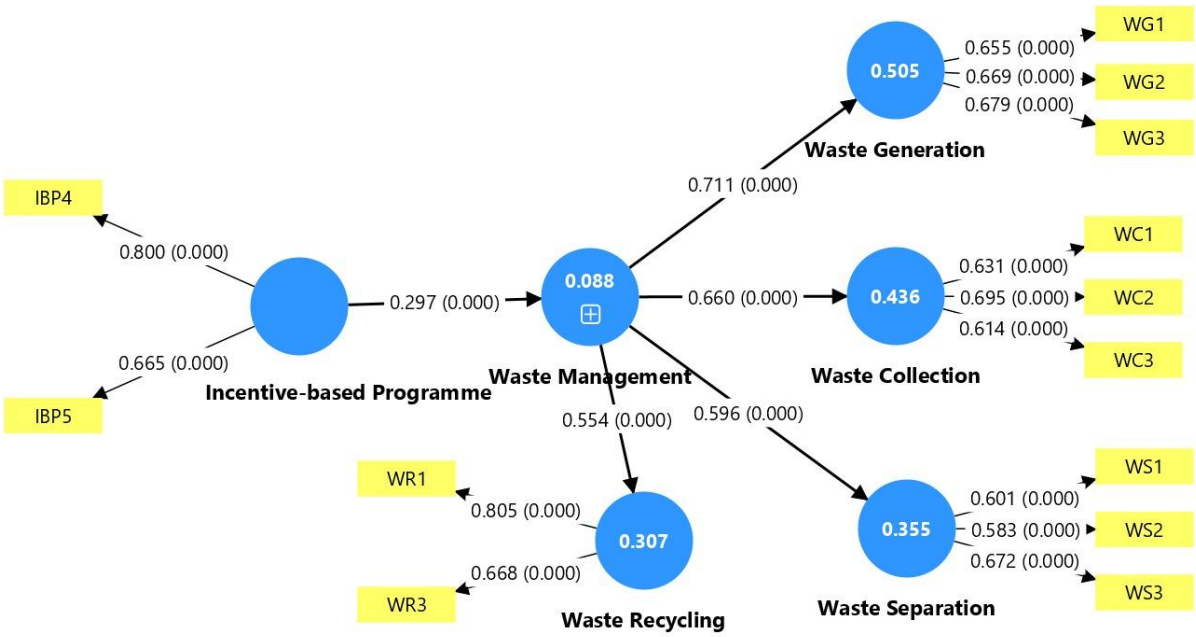


Figure 4.12: Bootstrapping of the p-value of the Relationship between Incentive-based Initiatives and Waste Management

4.2.2.5 Hypothesis Five: Students' attitudes do not play a significant moderating role in the relationship between green campaign strategies and waste management in Federal Colleges of Education, Southwest, Nigeria.

Table 4.38: Structural Model Result of Green Campaign Strategies, Student Attitudes and Waste Management

		Path Coefficient	Standard Deviation	T-Value	P-Value	Decision
	Students' Attitude -> Waste Management	0.296	0.060	4.935	0.000	
H6	**Students' Attitude x Green Campaign Strategies -> Waste Management**	**-0.006**	**0.035**	**0.167**	**0.867**	**Not Supported**
	R^2	0.357				
	R^2 Adjusted	0.352				
	F^2	0.003				
	SRMR	0.105				

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The F^2 result revealed that the relationship between students' attitude, green campaign strategies and waste management (0.003) is low. This implies that the presence of students' attitude, green campaign strategies on waste management is low (see Table 4.37).

The coefficient of determinant (R^2) is assessed to measure the predictive power of the model. The analysis revealed the coefficient of determinant (R^2) for waste management (0.304), which implies that 35.7% variance of waste management is explained by students' attitude and green campaigns, which include: environmental advertising, social media platform, eco-labelling and incentive-based Initiatives (See Figure 4.15). It also implies that there are other variables that can influence waste management in colleges.

The total effect of path coefficient and T-value for the overall construct include: students' attitude, green campaign strategies and waste management (β= -0.006, t= 0.167, P-value= 0.867) (see Table 4.37). This result revealed that a change in students' attitudes cannot affect the relationship between green campaign strategies and waste management. That is, there is no significant evidence that students' attitudes can moderate the relationship between green campaign strategies and waste management. Whether the students have a positive or negative attitude, the impact of green campaign strategies on waste management remains the same.

The SRMR for the model is 0.128, which is within the acceptable threshold. The model is considered a good fit.

The overall result shows that the t-value is more than 1.96 and its significant level is 0.00, which is less than 0.05; thus, the null which states that students' attitude do not moderate the relationship between green campaign strategies and waste management is **accepted** and the alternative hypothesis which states that students' attitude moderate the relationship between green campaign strategies and waste management is therefore rejected.

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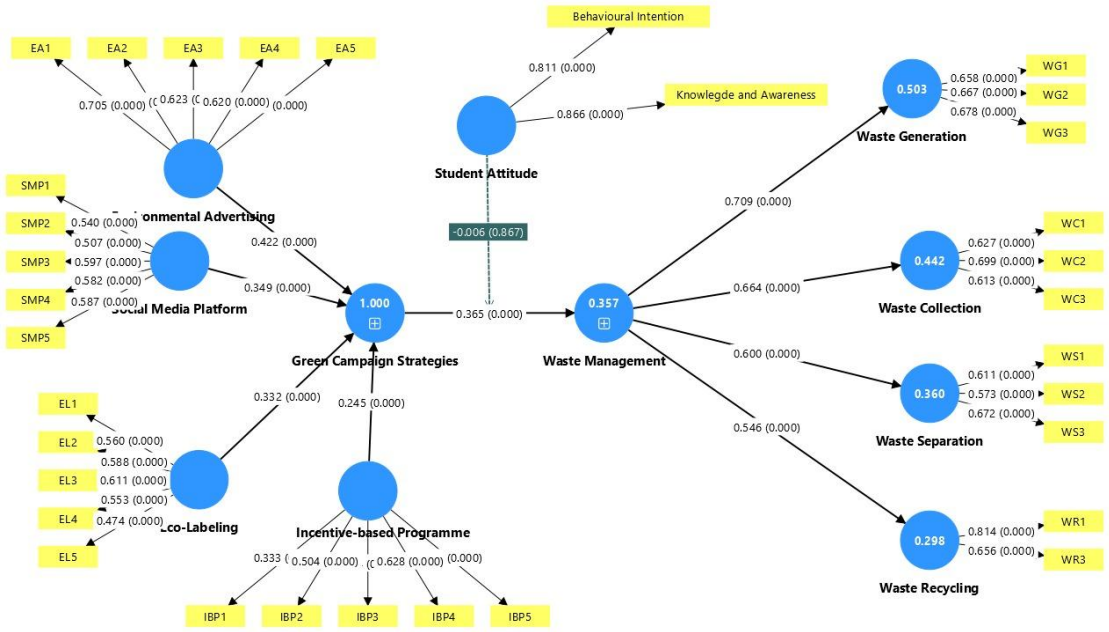


Figure 4.15: Bootstrapping of the t-value of the Relationship between Students' Attitude, Green Campaign Strategies and Waste Management

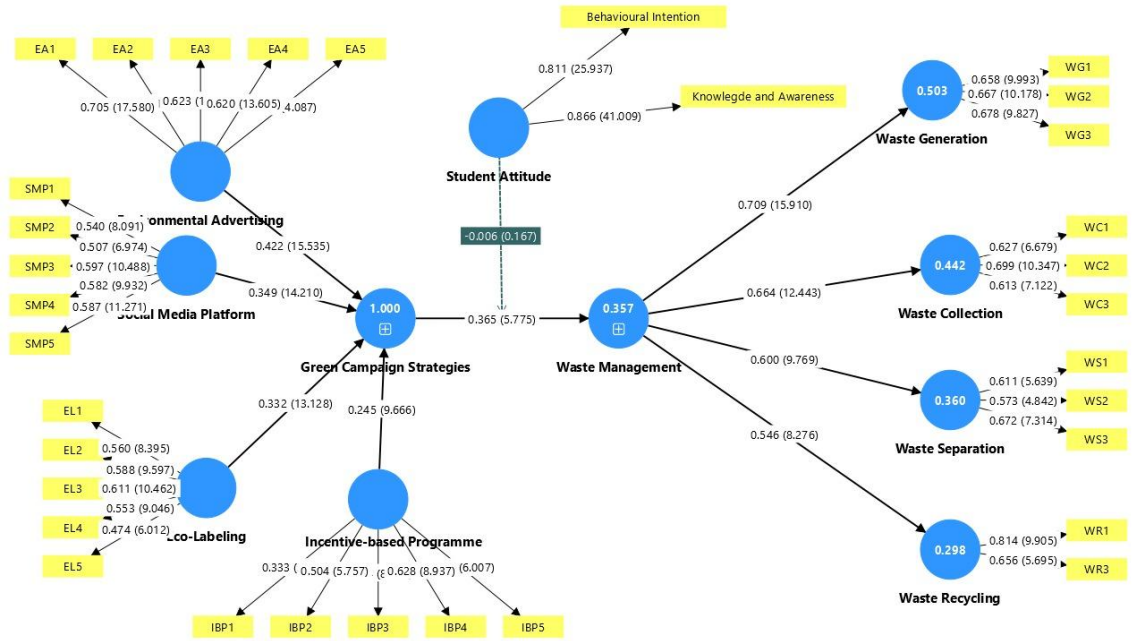


Figure 4.16: Bootstrapping of the p-value of the Relationship between Students' Attitude, Green Campaign Strategies and Waste Management

4.3 Discussion of Findings

Environmental advertising and waste management in Federal Colleges of Education, Southwest, Nigeria

The hypothesis proposed that environmental advertising does not significantly affect waste management. The results ($\beta = 0.429$, $t = 9.287$, $p = 0.000$) reject the null hypothesis, indicating that environmental advertising has a significant positive effect on waste management among students in Federal Colleges of Education, Southwest Nigeria. The path co-efficient ($\beta = 0.429$) is moderate, demonstrating that the use of signage and billboards is effective in significantly enhancing waste management. However, the relatively low R-square ($R^2=0.184$) suggests that current environmental advertising efforts may not be fully tailored to students' preferences leading to waste management. This implies that other factors constitute 80% of the variance in waste management.

Respondents showed a moderate agreement with items measuring environmental advertising (e.g., college signage, clear information, flyers, billboards, signage). While students mildly agreed that information on boards was clear and helpful (Mean=2.68, Std. Deviation=0.904), they gave low responses to colleges distributing fliers for zero-waste campaigns (Mean=2.45, Std. Deviation=0.938). This suggests that existing advertising methods are not fully effective, although students perceive billboard information as potentially impactful.

These findings align with previous researchers whose study in Sweden demonstrated that well-placed environmental signage reduced waste violations by 60%, emphasising the potential of targeted visual campaigns. They further explained that integrated communication using signage, posters, and strategically mounted billboards can ensure effective waste management[1, 2]. Similarly, another scholar opines that the effectiveness depends on visual appeal and content

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clarity, suggesting that colleges must move beyond mere placement to strategic design and messaging[3].

While environmental advertising does enhance waste management, descriptive responses suggest that current implementation strategies in Federal Colleges of Education may lack engagement. The implication is that institutions need to have strategic and engaging advertising content is necessary to impact waste management. Also, the need to be creative in the advertisement, especially with the use of localised messages and infographics, is shown to increase compliance with waste management[12].

Social media platform and waste management in Federal Colleges of Education, Southwest, Nigeria.

This hypothesis tested the influence of social media on waste management. The results (β = 0.423, t = 9.184, p = 0.000) indicate a significant and positive influence. The null hypothesis was rejected, indicating that social media platform has a significant positive effect on waste management among students. Social media platforms explain 17.9% of the variance in waste management (R^2=0.179). It further implies that social media alone is insufficient to influence waste management of colleges due to limited interactivity or engagement with institutional content like school blogs from students.

Respondents showed a moderate agreement regarding their college's social media platforms. Students agreed that illustrative drawings and materials on their school's blog educated them (Mean=2.73, Std. Deviation=0.882). However, they gave a low response to acquiring their knowledge and preference for a clean environment directly through their college's blog (Mean=2.46, Std. Deviation=0.959). This implies that while social media is present and contains educational content, its direct impact on students' knowledge acquisition and preference for

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cleanliness through college-specific blogs is perceived as low. That is, their environmental awareness was not significantly shaped by these platforms.

The findings align with previous researchers, where Instagram campaigns positively influenced environmental attitudes, especially when content was clear, visual, and engaging. They further explain that attractive campaign messages with good content via social media platforms can generate positive responses[4]. Similarly, it was also found that digital campaigns, though passive, improved recycling behaviour[5]. Despite its significant effect, the explained variance ($R^2 = 0.179$) remains relatively low. The implication is that campaigns on social media should leverage other activities like visual content, influencer models to integrate environmental messages into the content. It was opined that such strategies can enhance recall and a positive attitude to drive waste management[13]. Furthermore, digital platforms alone may not sufficiently drive waste management without strong offline reinforcements or campaigns.

Eco-labelling and waste management in Federal Colleges of Education, Southwest, Nigeria

Eco-labelling was found to have a significant influence on waste management ($\beta = 0.404$, $t = 8.680$, $p = 0.000$). The null hypothesis was rejected, indicating that eco-labelling has a significant positive effect on waste management among students. Eco-labelling platforms explain 16.3% of the variance in waste management ($R^2=0.163$). It further implies that other factors constitute 84% of the variance in waste management. Although students acknowledged the existence of colour-coded bins, the poor recognition of recycling symbols reflects low eco-labelling literacy.

Respondents showed a moderate agreement with items measuring eco-labelling. Students mildly agreed that their college has colour-coded bins for proper waste sorting (Mean=2.58, Std.

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Deviation=0.862). However, they gave a low response to seeing and recognising recycling symbols on waste bins (Mean=2.52, Std. Deviation=0.936). This indicates that while colour-coded bins are recognised, consistent recognition of symbols and strategic placement of bins may require more effort.

A finding at FUTA showed that colour-coded bins enhanced sorting behaviours and improved waste management[6]. However, it was opined that reinforcing that labelling alone is insufficient without effective student orientation and consistent signage[7]. They further explained that the challenge of contamination across colored waste bins, despite policies and facilities, further supports the need for improved eco-labelling strategies.

While eco-labelling has a positive effect, the low recognition of recycling symbols suggests a gap in understanding or the effectiveness of the labelling itself. This implication is that colleges need to combine colours, shapes and textual cues on bins to improve sorting accuracy. It was opined that the use of educational programmes across departments can enhance their ability to recognise eco-labels[14].

Incentive-based Initiatives and waste management in Federal Colleges of Education, Southwest, Nigeria

The results revealed a significant positive relationship ($\beta = 0.408$, $t = 9.177$, $p = 0.000$) between incentive-based Initiatives and waste management. The null hypothesis was rejected, indicating that incentive-based initiative has a significant positive effect on waste management among students. Incentive-based Initiatives explains 8.8% of the variance in waste management ($R^2=0.088$). It further implies that incentive-based Initiatives are not a major driver, as there are other factors that could influence waste management. It is either that the financial or material rewards are under-promoted or not compelling enough for widespread adoption.

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Respondents showed a moderate agreement regarding the incentive-based program. While students agreed that a clean environment improves healthy living and reduces money spent on medications (Mean=2.72, Std. Deviation=0.874), they gave a low response to earning extra income by using trash to create meaningful artworks (Mean=2.53, Std. Deviation=0.921). The perceived impact of existing incentives, such as selling recyclables, art from trash, awards, or vouchers, is moderate and not seen as a highly impactful or driving force for recycling.

This aligns with previous scholars who found that reward systems significantly enhanced participation in recycling programs[7,8]. However, the study also found that many of these Initiatives were either unknown or not effectively implemented on Nigerian campuses. Thus, colleges must think of other reward mechanisms to motivate and drive participation.

Students' Attitude Moderates the Relationship between green campaign strategies and waste management in Federal Colleges of Education, Southwest, Nigeria.

The results supported the null hypothesis, indicating that students' attitudes do not play a significant moderating role in the relationship between green campaign strategies and waste management (β = -0.006, t = 0.167, p = 0.867). Although descriptive analysis revealed high behavioural intentions (e.g., students report engaging in waste separation and using reusable containers), however, the moderating role suggests that students' attitudes may not translate into actual behaviour change, thereby affecting waste management. There are other factors (such as infrastructure, University policy) aside individual attitude that could affect waste management

This is consistent with previous scholars who observed a gap between attitude and practice, particularly among male students in poorly resourced settings[10,11].

This research suggests that for the direct effect of green campaigns on waste management, attitudes do not alter the relationship. This could imply that other factors exert a stronger influence on the waste management outcomes, overshadowing the moderating role of attitude.

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Chapter Five

Conclusion

This chapter discusses the summary of the study, conclusion and recommendations of the study. The chapter also entails contributions to knowledge and suggestions for further studies.

5.1 Summary of the Findings

The study laid a foundation for green campaign strategies, students' attitudes and waste management in the Federal Colleges of Education in South-West Nigeria. The study focused on environmental advertising, social media platforms, eco-labelling and incentive-based initiatives to measure green campaign strategies; while waste collection, waste generation, waste separation and waste recycling were used to measure waste management. The statement of the problem examined how waste mismanagement remains a critical challenge in Nigeria, including within Higher Education Institutions (HEIs), thereby affecting the institutional reputation of HEIs and hindering the potential contribution to global environmental sustainability goals. The specific objectives are in line with the research questions and hypotheses. The significance of the study followed the specific objectives, as it highlighted the various groups and stakeholders that were of importance to this study.

The chapter two presents a comprehensive literature review of relevant literature on green campaign strategies, students' attitudes and waste management. The chapter presents the conceptual, empirical and theoretical review of the study. The conceptual review focused on relevant concepts environmental advertising, social media platforms, eco-labelling, incentive-based initiatives, waste collection, waste generation, waste separation, waste recycling, green campaign strategies, students' attitude and waste management. The theoretical review of the study includes: Theory of planned behaviour, social marketing theory, protection motivation

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theory and waste management theory. The empirical framework for the study was in line with the objectives of the study. This chapter concluded with the summary and gaps in the review of the literature.

The study adopted a descriptive research design. The population of the study comprised 11,320 students in the Federal Colleges of Education in South-West, Nigeria. The sample size, which is 386, was based on Taro Yamane's Formula. Simple random sampling techniques were used to select students in Federal College of Education in South-West, Nigeria. A structured questionnaire was used to collect information from students. A reliability analysis test was carried out to determine the internal consistency of the questionnaire items. Data were analysed with the use of the Statistical Package for Social Sciences (SPSS) version 26 and Smart PLS.

The data analysis was presented in this study. The data were analysed using descriptive and inferential statistics. The hypotheses formulated were tested using the structural equation modelling analytical technique, and the empirical findings are explained below

i. The hypothesis proposed that environmental advertising does not significantly affect waste management. The results ($\beta = 0.429$, $t = 9.287$, $p = 0.000$) reject the null hypothesis, indicating that environmental advertising has a significant positive effect on waste management among students in Federal Colleges of Education, Southwest Nigeria.
ii. The results ($\beta = 0.423$, $t = 9.184$, $p = 0.000$) indicate a significant and positive influence. The null hypothesis was rejected, indicating that social media platform has a significant positive effect on waste management among students.
iii. Eco-labelling was found to have a significant influence on waste management ($\beta = 0.404$, $t = 8.680$, $p = 0.000$). The null hypothesis was rejected, indicating that eco-labelling has a significant positive effect on waste management among students.

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iv. The results revealed a significant positive relationship (β = 0.408, t = 9.177, p = 0.000) between incentive-based initiatives and waste management. The null hypothesis was rejected, indicating that incentive-based Initiatives has a significant positive effect on waste management among students.

v. Students' attitudes do not play a significant moderating role in the relationship between green campaign strategies and waste management (β = -0.006, t = 0.167, p = 0.867).

5.2 Conclusion

The study, conducted across Federal Colleges of Education in Southwest Nigeria, revealed that green campaign strategies significantly influence waste management among students. Environmental advertising, social media platforms, eco-labelling, and incentive-based programs all demonstrated a significant positive effect on waste management practices. Specifically, environmental advertising showed the highest impact on waste management. Illustrative drawings and materials on school blogs educated students, and the presence of colour-coded bins was noted, but the recognition of recycling symbols needs improvement. While various incentive-based programs exist, their perceived impact on driving recycling behaviour was moderate.

Despite the importance of these strategies, the study found that students' attitudes do not significantly moderate the relationship between green campaign strategies and waste management. This implies that the effectiveness of green campaigns on waste management remains consistent regardless of individual student attitudes.

The findings align with theoretical frameworks such as the Theory of Planned Behaviour (TPB), which posits that attitudes, subjective norms, and perceived behavioural control influence behavioural intention. Social Marketing Theory also supports the use of marketing principles,

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like green campaigns, to influence behaviours for the greater social good, such as responsible waste disposal. Ultimately, the research underscores the need for robust and visible green campaign strategies and integrated environmental marketing communication strategies, combining both online and offline channels, to enhance waste management practices in higher education institutions

5.3 Recommendations

This study carried out in-depth research on green campaign strategies, students' attitudes and waste management. From the findings of the research, the following recommendations were put forward:

Arising from the findings between environmental advertising and waste management, the following recommendations are provided:

i. Institutions should prioritise and enhance their environmental advertising efforts. They should ensure environmental advertisements are displayed prominently across various campus locations, including academic buildings, dormitories, cafeterias, and common areas. There is a need to utilise diverse media like posters, billboards, campus radio, and newsletters to maximise exposure.

ii. They should can encourage the use of billboards and signage to promote sense of responsibility among students and staff for maintaining a clean and sustainable school environment.

Arising from the findings between social media platforms and waste management, the following recommendations are provided:

iii. Institutions should leverage social media platforms more extensively for green campaigns. This can be achieved by developing engaging and interactive content to

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promote waste management practices, share success stories, and facilitate discussions among students to foster a strong online community around sustainability.

iv. Institutions should use social media to share clear, concise information about waste management processes, the benefits of recycling, and to uncover common misconceptions about waste.

v. Institutions should run campaigns that encourage students to share their own waste management efforts, tips, or creative projects related to sustainability. This fosters community engagement and peer influence.

Arising from the findings between eco-labelling and waste management, the following recommendations are provided:

vi. Institutions should ensure that eco-labels on waste bins are universally recognised, easy to understand, and consistent across all colleges and even potentially across different institutions. Complex or varied labelling can lead to confusion and incorrect sorting.

vii. Conduct dedicated campaigns to educate students on what each eco-label signifies and which types of waste belong in each bin. This can be done through workshops, short videos, informational posters near bins, and online resources.

Arising from the findings between incentive-based initiatives and waste management, the following recommendations are provided:

viii. Institutions should develop and implement attractive incentive-based programs that reward students for proper waste management and recycling. These incentives could range from recognition programmes to tangible rewards, encouraging greater participation and adherence to waste management guidelines.

ix. There should be clear and consistent communication about the details of incentive programs to all students. Utilise multiple channels such as campus-wide emails, social

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media, posters, and student union announcements to ensure high visibility and understanding of how to participate and what rewards are available.

Arising from the findings between green campaign strategies and waste management, the following recommendations are provided:

x. Institutions should continue to develop, diversify, and strengthen their overall green campaign strategies. A holistic green campaign strategy that integrates environmental advertising, social media engagement, clear eco-labelling, and incentive-based programs will be more effective in driving sustainable waste management practices across the colleges. These elements should work in synergy to reinforce messages and actions.

xi. Green campaigns should not be one-off events but continuous efforts throughout the academic year. Regular reminders, updates, and varied campaign themes can help maintain student engagement and reinforce desired behaviours over time.

xii. Ensure that all green campaign messages and recommended actions are easy to understand, accessible to all students, and simple to implement. Overly complex instructions or inaccessible information can hinder participation.

Arising from the findings of the moderating effect of students' attitude on green campaign strategies and waste management, the following recommendations are provided:

xiii. Fostering positive attitudes towards waste management is crucial for overall engagement and long-term sustainability efforts. Institutions can embed waste management principles and the importance of sustainability into various academic disciplines. This will provide a deeper understanding of environmental issues and their connection to personal actions.

xiv. Connect waste management efforts directly to the students' immediate environment – their campus and local community. Show how effective waste management leads to a cleaner, healthier, and more appealing living and learning space.

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xv. Empower and train students as sustainability ambassadors or peer educators who can share information, demonstrate proper waste sorting, and lead discussions among their peers. Students often respond well to messages from their fellow students.

xvi. Showcase students, faculty, or hotels who are exemplary in their waste management practices. Highlighting positive role models can inspire others to adopt similar behaviors.

5.4 Contribution to Knowledge

This study offers a significant contribution on waste management, particularly within the context of Federal Colleges of Education in Southwest, Nigeria.

Conceptual Contribution

This study proposes a multidimensional framework linking green campaign strategies, students' attitudes and waste management. This integration offers a new conceptual lens of understanding on how to enhance sustainability in academic institutions.

Empirical Contribution

The study validated the significant impact of green campaign components on waste management among students in Federal Colleges of Education, Southwest, Nigeria. Unlike prior studies that focused on the general public or urban communities, this research uniquely applies statistical evidence from a well-defined academic population, providing new data on how specific green campaign strategies can shape sustainable environmental practices within educational settings.

Furthermore, the empirical evidence that students' attitudes do not significantly moderate the relationship between green campaign strategies and waste management offers a unique contribution, challenging conventional assumptions that behavioural change is always heavily dependent on pre-existing attitudes in such contexts.

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Practical Contribution

The study provides actionable insights for educational institutions and policymakers on how to enhance waste management practices. By demonstrating the significant positive impact of various green campaign strategies, that is, environmental advertising, social media platforms, eco-labelling, and incentive-based initiatives; it identified strategies to empower institutions to improve waste management.

5.5 Suggested Areas for Further Research

The suggestions for further studies are as follows:

i. There is a need to research other geographical zones in Nigeria. This would help to strengthen the validation of the study.

ii. There is a need to research other higher institutions in Southwest, Nigeria and compare it with the Federal College of Education.

iii. Although students were the focus, further research could incorporate staff to examine their role in waste management.

iv. Further studies can evaluate institutional policies to influence the implementation of green campaign strategies on waste management.

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Appendix 1
Pictorial Evidence of Waste Management



Fig. 2.2: Heap of waste, Source: [47]



Fig. 2.3 - Compact Garbage Collection Trucks – Source[60]



Fig. 2.4 – Open truck[60]



Fig. 2.5 – Wecycler - Source[60]

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Fig. 2.6 - Informal Waste Workers
Source: Researcher's field work, 2023

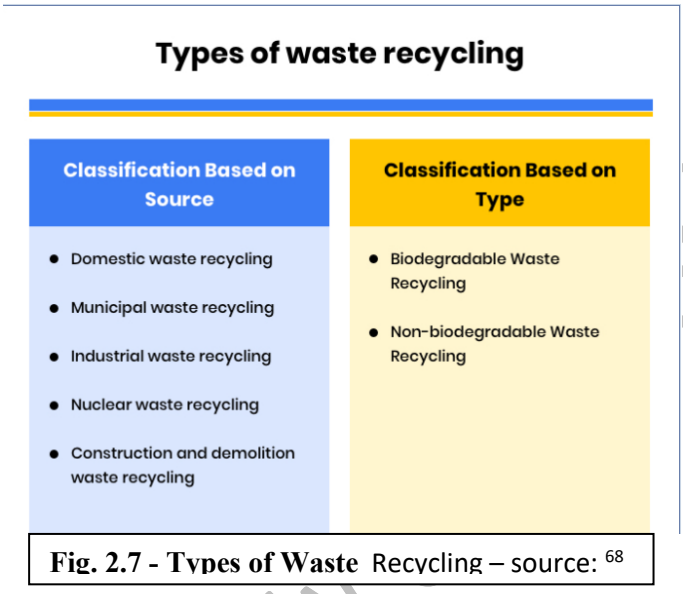


Fig. 2.7 - Types of Waste Recycling – source: [68]



Fig. 2.8 –Plastic Recycling Process – Source:[69]



Fig. 2.9 –Recycling of Plastic Waste to Vehicle Tire - Source[69]

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Fig. 2.10 – Shredded waste paper recycled to Tissue paper of different shapes – Source[70]

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Fig. 2.11 – Recycling of metal (tire rims) to cooking utensils, Source: [71]



Fig. 2.15 – Waste Shredding Machine - Source[94]

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Fig. 2.16 – Coloured Waste Separation Bins. Source:[75]



Fig.2. 17: Different items made from plastic recycling. Source [132]



Fig. 2.18: Different items made from metal recycling. Source [135]

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Appendix 2

Questionnaire

Green Campaign Strategies, Students' Attitude and Waste Management in Federal Colleges of Education in Southwest, Nigeria

Dear respondents,
As part of the requirements for a Doctoral Degree in Business Administration, I am currently carrying out a study on **"**Green Strategies, Students' Attitude and Waste Management in Federal Colleges of Education in Southwest, Nigeria**"** and your institution has been chosen as a case study. The research is mainly an academic exercise as all information will be treated with the utmost confidentiality. Be rest assured that your privacy will be safeguarded throughout the research and your involvement will be held in strict confidence. Please, feel free to tick the option that best express your personal views.

Thank you for your time and cooperation.

Section A: Socio-Demographic - Please tick the option as appropriate

Name of your Institution _____
Sex: Male ( ) Female ( )
Age: Less than 16 years ( ) 16-20 years ( ) 20 years and above ( )

Level / Year: 100 Level ( ) 200 Level ( ) 300 Level ( )

Section B: Green Campaign Strategies
This section seeks to measure Green Campaign Strategies on Waste Management in FCEs
Instruction: PLEASE TICK IN THE BOX. 1- Strongly Disagree (SD), 2-Disgree (D), 3-Agree (A), 4-Strongly Agree (SA)

	Environmental Advertising	**1 (SD)**	**2 D)**	**3 (A)**	**4 (SA)**
1.	My College signage provides information about waste				
2.	The information on the board in my College is clear and helpful				
3.	My College distributes fliers to educate students on zero-waste campaign				
4.	Information on my College billboards are displayed with colorful photos and infographics				
5.	The information on the signage board displays recycling symbols.				
	Social Media Platforms				
6.	I frequently see green campaign messages on my College's social media platforms (instagram and facebook)				

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7.	My College uses social media platforms to communicate and educate us on environmental issues.				
8.	My College's social media platforms' content (visuals and audio-visuals) are easy to understand.				
9.	Illustrative drawings and materials are displayed on my school's blog to educate students.				
10.	I acquire my knowledge and preference for a clean environment through my college's blog.				
	Eco-Labeling				
11.	I see and recognize recycling symbols on waste bins.				
12.	My college has colour coded bins for proper waste sorting.				
13.	My college has facilities to support the disposal of eco-labeled products after use.				
14.	My College has colour-coded bins at strategic places.				
15..	Colour-coded bins allow me to separate recyclable and non-recyclable waste.				
	Incentive – Based Initiatives				
16.	Selling of recyclables are available within my college				
17.	Students earn extra income by using trash to create and meaningful art works				
18.	My college organizes awards (in hostel, departments and units) to promote cleanliness.				
19.	My college gives cafeteria vouchers, credit cards) in exchange for recyclable items				
20.	Clean environment improves healthy living and reduces money spent on medications.				

Section C: Students' Attitude

This section seeks to measure Students' Attitude on Waste Management

Instruction: PLEASE TICK IN THE BOX. Please write your rating in the box. 1- Strongly Disagree (SD), 2-Disgree (D), 3-Agree (A), 4-Strongly Agree (SA)

	Knowledge and Awareness	**1 (SD)**	**2 D)**	**3 (A)**	**4 (SA)**
1.	There is enough awareness on environmental cleanliness in my campus.				
2.	Recycling education is part of the orientation Initiatives in my college.				
3.	Attractive campaign messages on signposts motivate my positive response to clean environment.				

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4.	I have a good level of knowledge about solid waste management.				
5.	I know where to take my recyclable items to for reprocessing.				
	Behavioral Intentions				
6.	I take initiatives to promote cleanliness around me.				
7.	I use reusable bags and containers to carry my items of food and drinks.				
8.	I separate waste based on the coloud-coded bins provided.				
9.	I always use reusable bags, containers, and bottles to carry my items and food stuffs.				
10.	I volunteer to clean up trash in the School environment.				

Section D: Waste Management
This section contains the measurement of Waste Management

	Waste Generation	**1 (SD)**	**2 (D)**	**3 (A)**	**4 (SA)**
1.	Poor waste management spread of diseases and environmental pollution.				
2.	Unregulated lifestyles among students increase the waste in my college.				
3.	The waste generated in my hostel is mostly food waste.				
	Waste Collection				
4.	Waste collection points are inadequate in my college				
5.	The maintenance workers in my college are not adequate to handle the waste issues.				
6.	My college partners with external stakeholders to address the waste issue.				
	Waste Separation				
7.	Separating waste to recover re-useable items reduces consumption of materials.				
8.	I separate wastes into recyclable and non-recyclable items on campus.				
9.	Inadequate bins in my college prevent proper sorting of waste				
	Waste Recycling				
10.	Waste reuse and recycling reduce the volume and cost of waste				
11.	My college organizes regular awareness Initiatives on waste recycling				
12.	We identify and remove potentially useful material from waste				

Instruction: PLEASE TICK IN THE BOX. Please write your rating in the box. 1- Strongly Disagree (SD), 2-Disgree (D), 3-Agree (A), 4-Strongly Agree (SA)

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Bio-data

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Educational Background
Institutions Attended:

- Lead City University, Ibadan, Oyo State (2025)
- Federal College of Education (T) Consult, Akoka, Lagos (2023)
- University of Education, Winneba, Ghana (2014)
- University of Lagos, DLI (2013)
- Federal College of Education (T), Akoka, Lagos (2008)
- Yaba College of Technology, Lagos (1991)
- Ibadan Grammar School, Oyo State (1986)

Academic Qualifications:

- Ph.D. Business Administration – 2025
- M.Sc. Management Science – 2014
- B.Sc. Accounting – 2013
- Technical Teachers Certificate, Business Education – 2008
- HND, Business Administration – 1991
- ND, Business Administration – 1988
- WASC – 1986

Professional Qualifications & Membership

- Basic Computer Certificate (2023)
- Certificate in Computer (Digital Bridge Institute, 2022)
- Certificate in E-book Creation and Publishing (2021)
- Association of Business Educators of Nigeria (2020)
- Associate Chartered Accountant **(ACA)** – (2017)
- Teachers Registration Council of Nigeria (TRCN) (2008)

Work Experience
Federal College of Education (T), Akoka
Lecturer, 2019 – date: Subjects: Marketing, Management, Economics, Financial Accounting
Federal College of Education (T), Akoka Secondary School
Teacher, 2011 – 2019: Subjects: Accounting, Commerce, Economics
WAEC (Examiner No. 1032/48) 2010 – 2014: Commerce Examiner,
Anchor Creativities Company, Lagos 2002 – 2007- Administrative/Training Officer,

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Desulco International Agencies, Lagos, 1995 – 2001: Admin/Accounting Officer,
Baseline Computers Ltd., Lagos, 1994 – 1995: Computer Trainer/Admin Assistant,
Sunflag Textile Mills (Nig.) Ltd., Lagos, 1992 – 1994: Accounting/Sales Officer,
Idia College (NYSC), Benin City, 1991 – 1992: Teacher,
Okubule, Ogunbajo & Co., Lagos, 1988 – 1989: Auditor/Secretary (IT),

Research & Publications

Publications

- Azeez, S. A. & Oreagba, O. T. (2025). Green Campaigns Strategies and Waste Management in Higher Educational Institutions in Nigeria, Multitech Journal of Education Science, Vol.2 (2), 79 – 94.
- Azeez, S. A. & Oreagba, O. T. (2025). Evaluating the Impact of Students' Attitudes on Waste Management in Federal Colleges of Education, Southwest, Nigeria, Lead City Journal of Social Sciences (LCJSS), Vol. 10, No. 2.
- Azeez, S. A. (2024). Digital Marketing Strategies and Sustainable Solid Waste Management in Nigeria, Journal of Business and Educational Policies, Vol.3 (2), 26 – 40.
- Ogunleye, O. R. & Azeez, S. A. (2023). Mitigating Youth Restiveness and Unemployment in Nigeria Higher Institutions through Information and Communication Technology (ICT) and Entrepreneurial Education, International Journal of Educational Research (IJER), The Department of Educational Foundation, University of Lagos, Vol. 12 (1), 132 – 143.
- Oyedokun, G. E. & Azeez, S. A. (2022), Environmental Factors and Performance of Small-Scale Businesses in Shomolu Local Government, Lagos, OGE Business School Publisher, 17 - 40
- Azeez, S. A. (2022).The Application of Information And Communication Technology In Management For School Records In Tertiary Institutions, Akoka Journal of Education, Vol. 9 (1) 76 – 91

Research Projects:

- Green Campaign Strategies, Students' Attitudes and Waste Management in Federal College of Education, Southwest, Nigeria – PhD Thesis
- Mitigating Youth Restiveness through Information and Communication Technologies (ICT) and Entrepreneurial Education – TETFund IBR, 2023.
- Total Quality Management Techniques Manufacturing Companies – 2014
- Microfinance Banks and Small Business Enterprises - 2012

Conferences Attended

- 4th National Conference, School of Business Education, Federal Colleges of Education (Technical), Akoka – June 2025.
- 4th FMSS International Conference, Lead City University, Ibadan – May 2025
- 3rd FMSS International Conference, Lead City University, Ibadan – June 2024
- 11th Biennial Conference, School of Science Education, FCE Akoka – May 2023
- 7th S/W Biennial WICE Conference, FCE Abeokuta – April 2024
- 27th Annual National WICE Conference, Alvan-Ikoku College of Education, Owerri – October 2023
- 6th COEASU National Conference, FCE Akoka – August 2023

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Book Chapters Contributed

- Aderoju, J. A., Azeez, S.A., Oladeji, I. O., Omale, O. E., And Wahab, A. A. (2022). Fundamental Principles of Financial Accounting, Sagamu, Ogun State
- Ogunwole, G. T. & Azeez, S. A, (2024), Contemporary Issues in Marketing, Anchor Creativities, Lagos, 86 – 134

Trainings, Seminars & Workshops (Selected)

- Capital Market Education Outreach (Fund Managers Association of Nigeria) – Aug 2025
- Blackboard Learning Management System – Federal College of Education (T) Akoka, July, 2025
- Unlock Your Research Potentials (School of Business Ed.) – Sept 2024
- Integrated Digital Marketing (Gamart Training Academy) – May 2024
- ICDL Training (Hopewell Solutions) – Jan 2024
- Human Capital Development (Hopewell Solutions) – Sept 2024
- TVET e-Learning, YabaTech – August 2023
- Enhancing Presentation Skills – July 2023

Official Duties

- Course Adviser, Year 4, Vocational & Technical Education, UNIBEN, FCE Akoka (2024/2025)
- Chairman, NCE Accreditation Readiness Committee (2023)
- Member, FCE (T) Beautification Committee (2023)
- Member, SBE Marketing Studio, Examination, and Laboratory Committees
- Finance Officer, Business Development Centre (2019 – 2021)
- Member, FCE (T) Secondary School Board (2021 – 2024)

Commendations & Awards

- **Commendation Letters:**
  - Secretary, UNIBEN Accreditation Committee
  - Member, 3rd National/1st International Conference Committee, FCE (T), 2021
- **Award:**
  - Exceptional Mother Award, FCE (T) Secondary School, 2025
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The University Compliance Certification

This is to certify that the Dissertation written by Sherifat Abiodun AZEEZ with Matriculation Number LCU/PG/002614 in the Department of Management & Accounting, Faculty of Management and Social Sciences, Lead City University, Ibadan is in compliance with the approved University format and style.

_____ _____

Signature Date

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