International Journal of Innovative Research and Scientific Studies, 8(3) 2025, pages: 774-790

IJIRSS
International Journal of Innovative Research & Scientific Studies

ISSN: 2617-6548

URL: www.ijirss.com

Leveraging recycling initiatives for youth empowerment and environmental sustainability: A case study of Mombasa, Kenya

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Abstract

Solid waste management remains a critical global challenge, impacting both environmental sustainability and public health. This study examines the role of recycling initiatives in fostering youth development in Mombasa, Kenya, where nearly 45% of the population comprises young people. Despite this demographic prominence, only about 20% actively participate in waste management efforts, as indicated by recent community surveys. Addressing this gap, the research evaluates how youth involvement in recycling initiatives influences their personal and socio-economic development. The study adopted a survey research design and employed purposive sampling to collect data. From a population of 300 urban youth engaged in waste collection, a sample of 175 respondents was selected using the Taro Yamane formula, ensuring a 95% confidence level with a 5% margin of error. Primary data collection involved structured questionnaires, with a pilot study conducted in Nakuru City to validate research instruments. Data analysis was carried out using SPSS, incorporating descriptive statistics and advanced quantitative techniques, including t-tests, ANOVA, and correlation analysis. Results were visually represented using bar charts, graphs, tables, and pie charts for clarity. Findings revealed a significant correlation ($r = 0.361$, $p = 0.000$) between youth participation in recycling initiatives and youth development. Regression analysis further confirmed the positive impact of these initiatives, highlighting the crucial role of youth in addressing urban sustainability challenges. The null hypothesis was rejected, affirming that engagement in recycling efforts positively influences youth development. Survey responses reflected a strong consensus on the benefits of youth participation in waste management initiatives. Beyond contributing empirical evidence on the link between youth involvement in recycling and development, this study offers policy recommendations for designing inclusive waste management programs, highlights the role of youth in urban sustainability, and emphasizes community engagement in environmental conservation. It also provides a foundation for future research on sustainable waste management practices and youth empowerment in Kenya and similar urban settings.

Keywords: Environmental sustainability, Mombasa, Kenya, recycling initiatives, solid waste management, urban sustainability, youth development.

DOI: 10.53894/ijirss.v8i3.6612
Funding: This study received no specific financial support.
History: Received: 10 March 2025 / **Revised:** 11 April 2025 / **Accepted:** 14 April 2025 / **Published:** 30 April 2025

Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

Transparency: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.
Publisher: Innovative Research Publishing

1. Background of the Study

Solid waste management remains a critical global challenge, affecting environmental sustainability, public health, and economic development [1]. Rapid urbanization, population growth, and shifting consumption patterns have exacerbated waste disposal challenges, particularly in developing nations [2]. In Kenya, Mombasa faces increasing waste management issues with significant implications for both environmental sustainability and human resource development [3].

As Kenya's second-largest city and a major economic hub, Mombasa struggles with waste accumulation due to high population density and industrial activities [4]. Poor waste disposal has led to environmental degradation, water pollution, and public health risks, disproportionately affecting marginalized communities, including youth [5, 6]. Despite these challenges, youth participation in waste management initiatives remains low, limiting their contribution to sustainable urban development and personal growth.

Globally, youth involvement in waste management has been recognized as a strategy to address environmental and socio-economic challenges [7]. Engaging young people in waste collection, recycling, and disposal fosters environmental responsibility, economic empowerment, and skills development [8]. Studies suggest that active youth participation in sustainable practices enhances entrepreneurial, technical, and leadership skills, benefiting both individuals and communities [9].

Several studies have highlighted the success of recycling initiatives in promoting sustainability and economic opportunities. For instance, a study in South Africa found that youth-led recycling programs significantly reduced plastic waste and generated income through innovative upcycling projects [10]. In Brazil, community-based recycling cooperatives have empowered marginalized youth by providing employment, vocational training, and environmental awareness [11]. Similarly, research in Ghana demonstrated that integrating youth into recycling initiatives improved waste collection efficiency and fostered eco-entrepreneurship [12]. These studies underscore the potential of recycling programs to transform waste management systems while simultaneously contributing to youth development.

In Nigeria, Effiong et al. [13] found that youth participation in solid waste management projects effectively addressed environmental and social challenges [13]. His study emphasized that engaging young people in waste collection, recycling, and clean-up initiatives reduced pollution, created employment, and fostered environmental responsibility. These efforts promoted sustainable practices, local economic development, and improved community well-being.

Similarly, Bauer [14] examined youth-led recycling campaigns in South Africa, highlighting their role in improving waste disposal, strengthening social cohesion, and nurturing leadership [14]. His findings demonstrated that youth became change agents, advocating for proper waste management and fostering community pride. These studies suggest that engaging youth in waste management initiatives in Mombasa and Kenya could enhance waste reduction, create job opportunities, and promote sustainable urban development. Such involvement can transform communities by addressing waste challenges while empowering young people as environmental leaders.

Kimani and Wang [15] found that youth participation in solid waste management reshapes urban landscapes and fosters environmental consciousness [15]. His study highlighted that youth-led waste collection and recycling initiatives not only improved waste management but also instilled responsibility and civic pride, influencing broader societal attitudes toward sustainable practices. Similarly, Manyara et al. [16] examined youth-led waste segregation and recycling projects in Mombasa, emphasizing their role in environmental health and economic empowerment [16]. Her study revealed that young participants gained valuable skills in waste separation and recycling, positioning themselves as change agents for a cleaner environment and local economic growth.

However, there is limited research on how waste disposal practices influence youth development in Mombasa. Existing policies often overlook the role of young people in advancing environmental sustainability while benefiting from economic and social empowerment [17]. This study is necessary to provide empirical evidence on the impact of recycling initiatives on youth development, inform policy formulation, and promote inclusive urban sustainability strategies. Additionally, understanding the barriers to youth engagement in waste management can help design targeted interventions that enhance their participation, reduce unemployment, and foster innovation in the green economy. By addressing these gaps, this research contributes to broader discussions on sustainable urban development and youth empowerment in Kenya and beyond.

1.1. Youth Development

Youth development is a multifaceted process encompassing cognitive, social, emotional, and physical growth [18]. Project management principles provide a structured approach to designing programs that enhance critical thinking, decision-making, and continuous learning [19]. Aligning these initiatives with cognitive milestones, such as improved reasoning and abstract thinking, equips youth to navigate challenges effectively [20].

Social and emotional development is also strengthened through teamwork and leadership roles within structured projects [21]. Creating environments that foster positive interactions enhances self-efficacy and empathy, promoting a sense of belonging and responsibility [22]. Additionally, physical health, a key aspect of youth development, benefits from structured activities integrated through effective project management. Engaging in planned physical activities supports self-esteem,

mental well-being, and lifelong healthy habits [23]. By incorporating these elements, well-managed youth initiatives contribute to holistic development and long-term sustainability [24].

1.2. Statement of the Problem

Engaging youth in recycling initiatives not only promotes cleaner and more sustainable communities but also serves as a catalyst for youth development. Through active participation, young individuals acquire practical skills, develop a sense of responsibility, and foster a deeper connection to their environment. This involvement enhances essential skills such as leadership, teamwork, and problem-solving, preparing them to become informed and engaged citizens.

However, previous efforts to involve youth in community development initiatives, such as urban beautification and tree planting, have struggled to sustain long-term participation. Many of these projects fail to maintain youth interest due to a perceived lack of relevance, excitement, or tangible benefits. This raises concerns about how recycling initiatives can more effectively engage young people and support their overall development.

In Mombasa, where youth constitute 45% of the population Ozoike-Dennis et al. [25] only 20% actively participate in organized recycling initiatives [26]. This low engagement rate highlights critical gaps in understanding the barriers to participation and the developmental benefits of youth involvement in recycling programs. Despite the potential advantages of these initiatives, there is limited empirical research examining their impact on youth development in Mombasa. This lack of evidence-based insights hinders the formulation of effective policies and programs that could harness youth energy, creativity, and potential to drive sustainable recycling practices while fostering their personal and economic growth.

Therefore, this study seeks to address this gap by exploring the holistic effects of youth participation in recycling initiatives on their development in Mombasa, Kenya.

1.3. Objective of the Study

To examine the effect of recycling initiatives on youth development in Mombasa, Kenya

1.4. Research Hypothesis

H0: Recycling initiatives have no significant effect on youth development in Mombasa, Kenya

1.5. Significance of the Study

This study is crucial for multiple stakeholders. Youth in Mombasa will benefit from skill development, leadership growth, and increased community engagement through participation in recycling initiatives, preparing them for future roles in entrepreneurship and social development.

Policymakers and local authorities will gain evidence-based insights to design targeted programs that enhance youth participation in recycling while improving waste management systems. Environmental and community organizations can use the findings to develop initiatives that boost youth involvement, leading to cleaner urban spaces and greater environmental awareness.

Additionally, the study may highlight economic opportunities in recycling, encouraging youth entrepreneurship and contributing to local economic growth. The broader Mombasa community will benefit from improved environmental conditions and stronger social cohesion driven by youth-led efforts.

Academically, the research will provide valuable insights for scholars, students, and researchers exploring sustainable development and youth empowerment. Ultimately, this study offers practical solutions for increasing youth engagement in recycling, contributing to Mombasa's environmental sustainability and socio-economic progress.

2. Theoretical Framework

This study was led by the self-determination theory

2.1. Self-Determination Theory

Developed by Edward L. Deci and Richard M. Ryan in the 1980s, self-determination theory (SDT) posits that humans have innate psychological needs for autonomy, competence, and relatedness [27]. The theory distinguishes between intrinsic motivation, where individuals engage in activities for personal satisfaction, and extrinsic motivation, where actions are driven by external rewards [28].

SDT suggests that recycling initiatives can enhance youth development in Mombasa by fostering intrinsic motivation and satisfying these psychological needs [29]. Participation in recycling programs allows youth to make autonomous choices, develop environmental conservation skills, and strengthen their sense of community. This engagement may lead to increased well-being, personal growth, and environmental awareness [30].

A critique of SDT is its limited focus on cultural and contextual factors, potentially overlooking social and environmental influences on behavior. However, it remains highly relevant for understanding how youth involvement in recycling initiatives in Mombasa can promote positive developmental outcomes, including leadership, responsibility, and sustainable practices.

Self-Determination Theory (SDT) is well-suited for this study as it provides a strong framework for understanding how youth participation in recycling initiatives influences their development. The theory emphasizes the psychological needs of autonomy, competence, and relatedness, which are crucial for motivating youth engagement in meaningful activities. By applying SDT, this study can explore how recycling initiatives satisfy these needs, leading to increased motivation, skill development, and community connection among young people in Mombasa.

The theory's focus on intrinsic motivation is particularly relevant, as youth participation in recycling is not solely driven by external rewards but also by personal fulfilment, environmental responsibility, and a sense of belonging. Engaging in recycling initiatives allows youth to make independent choices, develop expertise in waste management, and establish meaningful connections with their peers and community members. These factors contribute to their overall personal and professional growth, making SDT an ideal lens through which to analyze their development.

Additionally, SDT helps explain the sustainability of youth involvement in recycling initiatives. When young people find personal satisfaction and purpose in these activities, they are more likely to continue participating over the long term. This aligns with the study's goal of identifying ways to enhance youth engagement in recycling programs for both environmental sustainability and socio-economic benefits. Therefore, SDT provides a comprehensive perspective on how recycling initiatives can foster self-motivation, skill acquisition, and social integration, ultimately contributing to youth empowerment and sustainable urban development in Mombasa.

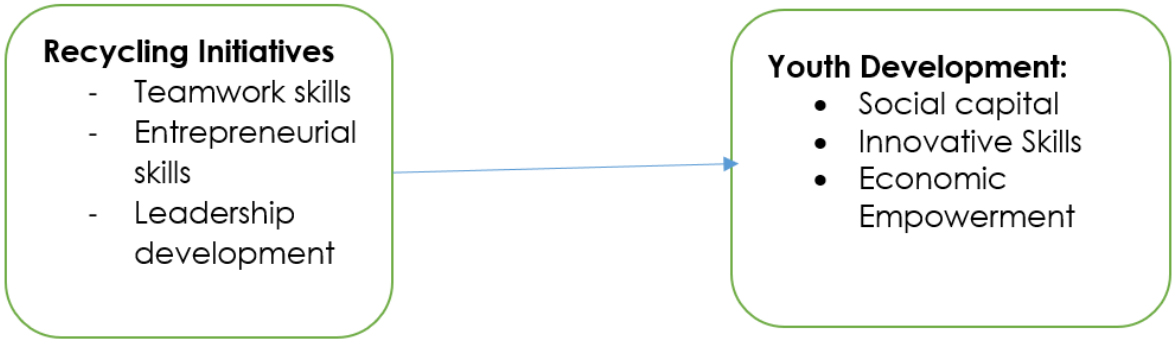

Figure 1.
Conceptual Framework.

2.2. The Impact of Recycling Initiatives on Youth Development

Recycling initiatives significantly contribute to youth development by fostering teamwork skills, entrepreneurial abilities, and leadership growth, which in turn lead to the enhancement of social capital, innovative skills, and economic empowerment. These initiatives provide young people with practical experiences that shape their personal and professional growth while also promoting environmental sustainability.

2.3. Teamwork Skills and Social Capital

Recycling initiatives encourage young people to work together in community-driven waste management activities such as waste collection, sorting, and upcycling. Through these collaborative efforts, they develop strong teamwork skills, including communication, problem-solving, and conflict resolution. Working in teams requires them to share responsibilities, listen to different perspectives, and coordinate their efforts toward a common goal.

This teamwork directly contributes to the development of social capital, which refers to the relationships, networks, and trust that individuals build within their communities. As youth interact with peers, local businesses, environmental organizations, and policymakers in recycling initiatives, they expand their social networks and establish valuable connections. These networks provide opportunities for mentorship, job placements, business partnerships, and access to funding or resources for future projects. Additionally, by engaging in group projects, young people develop a sense of belonging and community identity, which strengthens their commitment to civic responsibilities and social development.

2.4. Entrepreneurial Skills and Innovative Thinking

Recycling initiatives also serve as a platform for youth to acquire entrepreneurial skills, such as creativity, business management, marketing, and financial literacy. Through hands-on involvement in recycling businesses, such as producing eco-friendly products from waste materials or selling collected recyclables, young individuals learn how to identify market opportunities, develop sustainable business models, and manage financial resources.

These entrepreneurial experiences foster innovation, as youth are encouraged to think creatively about waste management solutions. They learn how to turn discarded materials into useful products, explore new recycling technologies, and develop environmentally sustainable business ideas. Innovation in recycling also promotes research and development, as young people experiment with new methods to improve waste processing efficiency, reduce costs, and create high-value products from recycled materials. This mindset of innovation is essential in preparing youth to adapt to changing economic landscapes and contribute to green industries.

2.5. Leadership Development and Economic Empowerment

Another critical benefit of recycling initiatives is the development of leadership skills among youth. Many young individuals take on leadership roles in organizing recycling programs, mobilizing communities, and advocating for better waste management policies. Through these experiences, they enhance their ability to make strategic decisions, manage resources, and inspire others toward collective action. Leadership in recycling initiatives teaches responsibility, resilience, and the ability to navigate challenges, all of which are essential traits for long-term success.

The leadership experience gained through recycling initiatives directly contributes to economic empowerment. As young people develop confidence in their abilities, they become more prepared to start their own businesses, secure employment, or take on leadership roles in environmental organizations and government agencies. Economic empowerment is further reinforced when youth-led recycling initiatives generate income, create job opportunities, and contribute to local economies. By learning to manage waste sustainably and turn it into profitable ventures, young individuals can break free from economic dependency and achieve financial independence.

Recycling initiatives serve as a powerful tool for youth development, equipping young individuals with essential life and career skills. Through teamwork, they build social capital, fostering strong relationships and networks that enhance their social and economic prospects. Entrepreneurial skills gained in recycling drive innovation, encouraging creative problem-solving and business growth. Additionally, leadership development within these initiatives promotes economic empowerment, enabling young people to take charge of their futures and contribute to sustainable development.

By participating in recycling initiatives, youth not only contribute to environmental sustainability but also position themselves as key players in economic and social transformation. These initiatives provide a foundation for personal growth, career advancement, and community development, ensuring a future where young individuals play a central role in building resilient, eco-conscious societies.

2.6. Empirical Literature Review on the Effect of Recycling Initiatives on Youth Development

Recycling initiatives play a vital role in shaping youth development by fostering environmental consciousness, enhancing social responsibility, and promoting economic empowerment. Several studies have examined how youth participation in recycling programs influences their personal growth, leadership skills, and engagement in sustainable practices.

Campbell et al. [31] explored the impact of youth participation in recycling programs in urban areas of the U.S. [31]. Their findings revealed that young individuals involved in recycling initiatives demonstrated higher levels of environmental awareness, pro-environmental behaviors, and civic responsibility. The study emphasized that such programs provide youth with hands-on experience in waste management and sustainability, leading to long-term positive behavioral changes. However, it also pointed out the challenge of sustaining youth interest without continuous incentives and engagement strategiesWesonga and Van Der Westhuizen [32] and Atambo and Nyongesa [33].

Garcia and Lopez [34] examined recycling initiatives in rural Spain, highlighting how youth engagement in waste segregation and recycling contributed to increased environmental responsibility and social cohesion [34]. The study found that young participants not only developed a stronger commitment to environmental conservation but also gained valuable teamwork and leadership skills. However, the research noted that limited infrastructure and resources in rural areas posed challenges to sustaining these initiatives. The study recommended stronger community support, educational outreach, and policy incentives to enhance youth participation.

Chaudhary and Bisai [35] studied recycling programs in urban slums of India and found a positive correlation between youth involvement and increased environmental knowledge, awareness, and responsibility [35]. The study highlighted that participation in recycling initiatives empowered young people by providing them with skills in waste management, resource recovery, and entrepreneurial opportunities, particularly in the informal recycling sector. However, the research identified barriers such as lack of proper training, poor policy implementation, and minimal financial support as constraints to maximizing youth engagement, Wesonga and Van Der Westhuizen [36].

Nguyen and Kim [37] investigated recycling initiatives in suburban Vietnam, emphasizing their role in fostering social capital and sustainable behaviors among youth [37]. The study revealed that participation in recycling programs not only increased ecological awareness but also strengthened community engagement. Young individuals involved in these programs built networks, developed advocacy skills, and contributed to local environmental policies. However, the study highlighted the need for long-term strategies to sustain youth interest, including integrating recycling education into school curricula and promoting youth-led environmental projects.

2.7. Broader Implications

The findings from these studies underscore the significant role recycling initiatives play in youth development. One of the major impacts is the enhancement of social capital. Youth who engage in recycling programs build networks within their communities, strengthening their sense of belonging and civic responsibility. By working together on waste collection and recycling projects, young people form valuable connections that encourage collaboration and teamwork, fostering a culture of collective action for environmental sustainability.

Recycling initiatives also promote innovative skills among youth. As they participate in waste management efforts, young individuals often develop creative problem-solving abilities and entrepreneurial mindsets. Many are inspired to explore new ways to recycle waste into valuable products, leading to the development of eco-friendly business ideas. These experiences not only nurture their creativity but also enhance their capacity to contribute to environmental conservation through innovative solutions.

Economic empowerment is another key outcome of youth participation in recycling initiatives. Many young individuals engaged in waste recycling programs gain opportunities for income generation. Through activities such as waste collection, sorting, and upcycling, they acquire skills that enable them to establish small businesses or secure employment in the recycling industry. This economic aspect is particularly important in communities where unemployment rates among youth are high, as it provides an alternative means of financial independence and economic stability.

While recycling initiatives offer numerous benefits for youth development, their success depends on sustained engagement, supportive policies, and investment in infrastructure. Governments, non-profits, and educational institutions

must collaborate to provide training, resources, and incentives that ensure long-term youth participation in sustainable waste management. By integrating recycling education into school curricula, fostering youth-led environmental campaigns, and establishing financial support mechanisms, stakeholders can maximize the impact of recycling initiatives on youth development, creating a generation that is environmentally conscious, socially responsible, and economically empowered.

2.8. Identified Research Gap

Although existing studies have demonstrated the positive impact of recycling initiatives on youth development, they primarily focus on developed nations and select urban or rural settings, with limited research conducted in African cities such as Mombasa, Kenya. Most studies emphasize environmental awareness and community engagement but do not extensively explore the link between recycling initiatives and youth economic empowerment, leadership development, or skill acquisition within an African context.

Additionally, prior research often lacks a comprehensive analysis of the specific barriers preventing youth participation in recycling initiatives, such as socio-economic constraints, inadequate policy support, or limited access to recycling infrastructure. While studies highlight the benefits of youth involvement, they fail to provide actionable strategies tailored to African urban settings to enhance participation and long-term engagement.

Given Mombasa's growing waste management challenges and high youth unemployment rates, understanding how recycling initiatives can contribute to youth development in this context is critical. This study seeks to fill this gap by examining the effect of recycling initiatives on youth development in Mombasa, Kenya, focusing on how participation enhances teamwork skills, entrepreneurial skills, and leadership development while contributing to social capital, innovative skills, and economic empowerment. The findings will provide localized insights that can inform policies, improve youth engagement strategies, and promote sustainable recycling practices in urban Kenya.

3. Materials and Methods

3.1. Research Design

This study adopted a descriptive survey design to assess the impact of youth participation in recycling initiatives on their development in Mombasa, Kenya. This design was selected because it facilitates the collection of both quantitative and qualitative data, allowing for a comprehensive analysis of the relationship between recycling initiatives and youth development.

According to Asenahabi [38] research design provides a structured framework for systematically collecting and analyzing data to answer research questions effectively [38]. The descriptive survey design is particularly suitable for studies that seek to describe characteristics, behaviors, and perceptions of a population based on empirical evidence [39]. By employing this approach, the study was able to gather statistical insights on participation levels, skill acquisition, and socio-economic benefits while also capturing contextual narratives on youth experiences, motivations, and challenges in recycling initiatives.

Moreover, the design's flexibility enabled the use of structured questionnaires and interviews, ensuring diverse perspectives were considered. The findings from this research will provide evidence-based recommendations for policymakers, environmental organizations, and community stakeholders to enhance youth engagement in recycling for both environmental sustainability and socio-economic empowerment.

3.2. Target Population and Sample Size

3.2.1. Target Population

The target population refers to the specific group from which data is collected and analyzed in a study [39]. It includes individuals, organizations, or communities that share relevant characteristics. This study focused on 300 urban youth waste collectors in Mombasa, actively engaged in recycling initiatives. These individuals play a crucial role in waste segregation, collection, and recycling efforts, making them a valuable group for assessing the impact of participation in recycling activities on youth development.

3.2.2. Sample Size

Based on the Otundo Richard [40], the city has 300 urban youth collectors involved in recycling efforts. To ensure a representative and statistically reliable sample, a sample size of 175 was determined using the Taro Yamane formula at a 95% confidence level with a 5% margin of error. This sample size ensures a balance between accuracy and feasibility in data collection while providing meaningful insights into the role of recycling initiatives in youth empowerment.

Confidence level (C): 95% (expressed as a decimal, C = 0.95)
The margin of error (E): 5% (expressed as a decimal, E = 0.05)
The formula to calculate the sample size (n) is:
n = N / (1 + N (E^2))
Where: n = sample size N = total population
Given that the total Population of urban youth collectors in Mombasa is 300:
n = 300 / (1 + 300 (0.05^2))
n = 300 / (1 + 300 0.0025)
n = 300 / (1 + 0.75)
n = 300 / 1.75
n ≈ 174.43. This is rounded up to 175

Simple random sampling was used to pick the required number by just organizing their names in alphabetical order and then issuing them numbers, picking from number one to one seventy-five.

3.3. Research Instruments

3.3.1. Data Collection Method

This study relied on primary data, which was collected directly from urban youth collectors in Mombasa. A structured questionnaire with a five-point Likert scale was the primary tool used to gather data. According to Ospina (2019), a questionnaire is an effective instrument for collecting empirical data, as it allows respondents to express their opinions systematically [39]. The questionnaire was designed to inform respondents about the study objectives while ensuring the collection of relevant and measurable data [41].

3.4. Pilot Testing

To enhance the reliability and clarity of the research instrument, a pilot study was conducted with 20 urban youth collectors in Kisumu County, selected due to similarities in waste management practices with Mombasa County. This pre-test helped identify ambiguities, biases, and potential errors in the questionnaire [42]. The feedback obtained was used to refine the questions, improve clarity, and ensure the instrument effectively captured the intended data. This process also optimized resource use and improved the quality of the main study.

3.5. Validity and Reliability of Instruments

3.5.1. Validity

Validity refers to the accuracy of a research instrument in measuring what it is intended to measure [43]. To ensure face and content validity, the questionnaire was reviewed by experts in the field, who assessed its structure, wording, and relevance to the research objectives. Their insights ensured the instrument effectively captured key aspects of youth participation in recycling initiatives.

3.5.2. Reliability

Reliability assesses the consistency of a research instrument across multiple trials. Cronbach's Alpha coefficient, a widely used reliability test, was applied, with a threshold of 0.70 considered acceptable [44]. The study achieved a Cronbach's Alpha reliability coefficient of 0.943, confirming that the questionnaire was highly reliable [43].

3.6. Data Analysis Procedure

Before analysis, all returned questionnaires were checked for completeness, ensuring that missing or inconsistent responses did not affect the study's accuracy. The data was then coded, sorted, and categorized for clarity and ease of interpretation.

To assess the relationship between youth participation in recycling initiatives and their development outcomes, both descriptive and inferential statistics were applied. Descriptive statistics summarized the data using frequencies, percentages, means, and standard deviations. Inferential analysis involved regression modelling to examine the strength and significance of relationships between variables.

A simple linear regression analysis was conducted to establish the influence of independent variables on the dependent variable. This method has been widely used in previous studies on urban waste management in Kenya [45-47]. The R-value measured the correlation strength, while R-squared (R^2) indicated the extent to which independent variables explained variations in youth development outcomes.

To test the model's significance, an F-test (Fisher distribution test) was applied at a 95% confidence level with a 5% significance threshold, using ANOVA. The t-test assessed the predictive power of the model, where a t-value between -2 and +2 indicated an insignificant relationship, supporting the null hypothesis. A p-value greater than 0.05 suggested that the model had low explanatory power.

Additionally, a multiple regression analysis was conducted to further verify the strength and consistency of relationships among variables, ensuring robust findings for policy and practice.

$Y = \beta0 + \beta1X1 + \varepsilon$

Where: Y = solid waste management project

X1 = recycling initiatives

$\beta0$ = Constant

$\beta1$ = Coefficients for independent variable

ε = Error term

3.7. Correlation Analysis

Correlation analysis examines the strength and direction of the linear relationship between two variables [43]. This study employed Pearson's correlation coefficient to assess the association between independent and dependent variables at a 95% confidence level, using the following hypothesis:

- H_0: $r = 0$ (No linear relationship)
- H_1: $r \neq 0$ (Linear relationship exists)

The t-distribution test (with n-2 degrees of freedom) determined significance. A positive correlation indicated a direct relationship, while a negative correlation signified an inverse one. The correlation coefficient ranged from -1 to 1.

3.8. Multiple Linear Regression Model

A multiple linear regression model was used to test the research hypotheses and address the research question. The F-test determined the overall significance of the model, while the t-test evaluated the statistical relevance of individual regression coefficients. This approach ensured a comprehensive analysis of the relationship between independent and dependent variables.

4. Results and Findings

4.1. Demographic Information

4.1.1. Gender

The respondents were asked to indicate their gender. The findings are shown in the figure below.

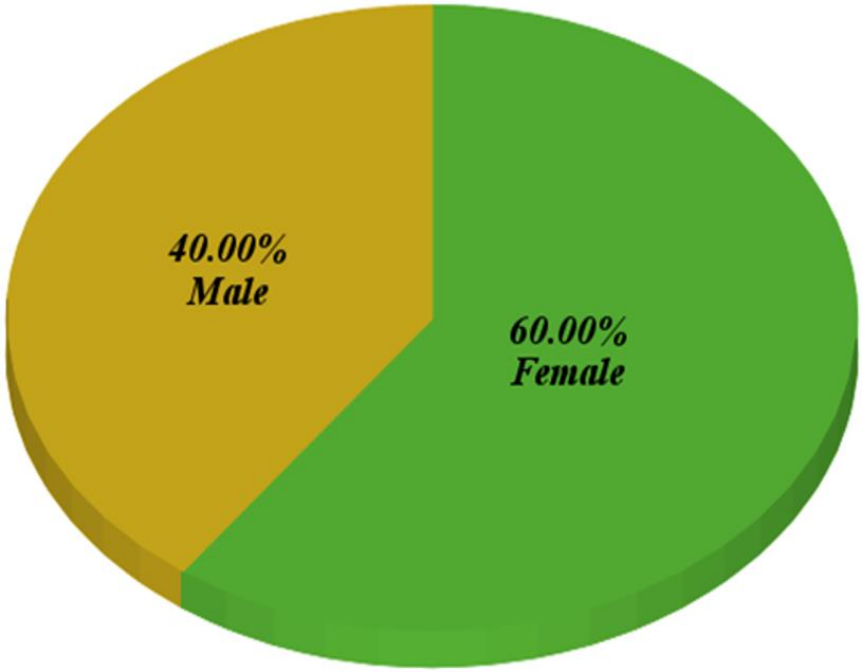

Figure 2.
Gender of Respondents.

Gender analysis provides insight into respondent demographics and ensures a comprehensive evaluation of how solid waste management projects impact youth development in Mombasa County, Kenya. The Study considered 40% male and 60% female respondents, ensuring inclusivity and recognizing potential gender-specific effects. This aligns with Nguyen and Kim [37], who stated that a response rate above 70% is sufficient for a descriptive study. A total of 172 questionnaires were used for analysis.

4.1.2. Age

The respondents were requested to indicate their age. The age bracket is shown below

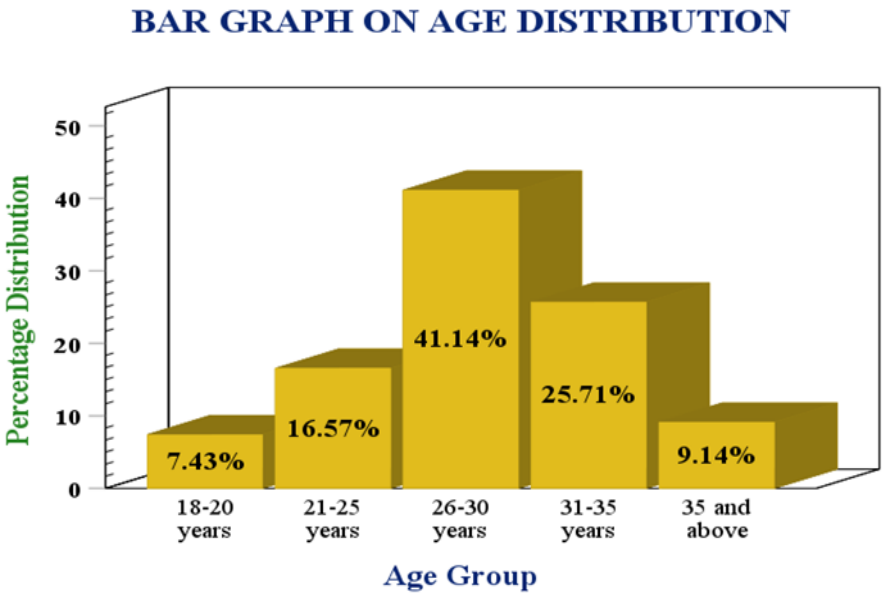

Figure 3.
Age.

Age is crucial in understanding respondent demographics and analyzing the impact of solid waste management projects on youth development in Mombasa Town, Kenya. The study ensured inclusivity by covering various age groups: 41.4% (26-30 years), 25.71% (31-35 years), 16.57% (21-25 years), 9.14% (35+ years), and 7.34% (18-20 years). This diverse representation enriched the data and provided a well-rounded analysis.

4.1.3. Years of Involvement in Solid Waste Management Projects

The respondents were asked to indicate their years of involvement in solid waste management projects. Their responses are illustrated below.

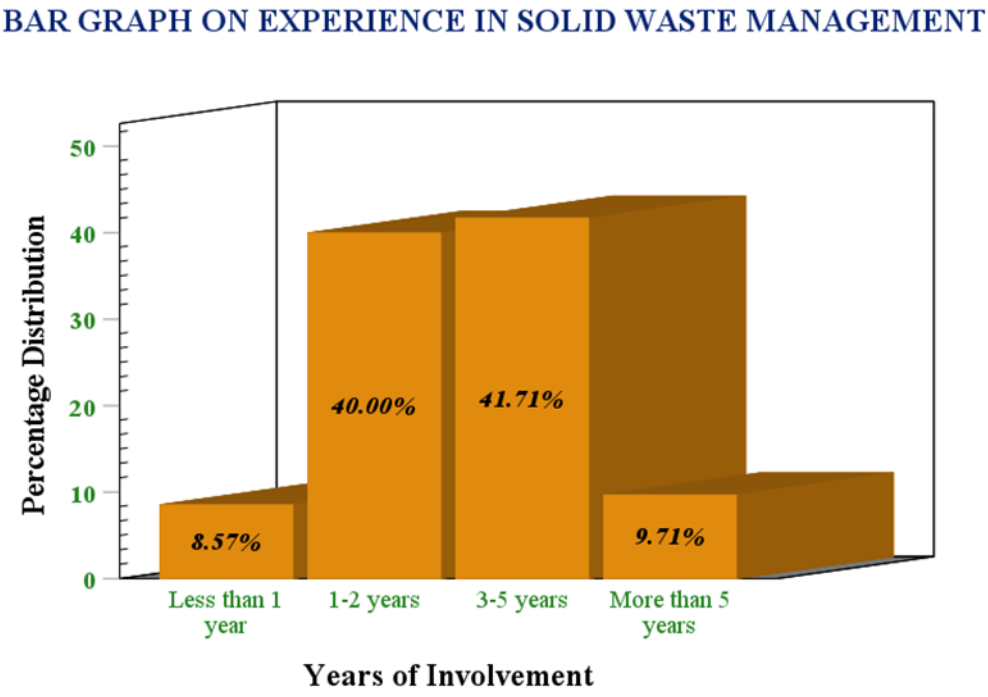

Figure 4.
Years of involvement.

The respondents' years of participation provide crucial insights into their experiences and expertise. The Study found 41.7% had 3–5 years of experience, 40.0% had 1–2 years, 9.71% had over 5 years, and 8.57% had less than a year. This diversity ensures a well-rounded understanding of solid waste management in Mombasa Town, Kenya.

4.1.4. Effect of Recycling Initiatives on Youth Development in Mombasa

The Study's objective was to determine the effect of Recycling Initiatives on youth development. The findings were presented using a 1-5 Likert scale. The results of the descriptive statistics calculation are shown in the table below.

Table 1.
Effect of Recycling Initiatives on Youth Development in Mombasa.

	Very Low		Low		Moderate		High		Very High	
	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
Rate the extent to which recycling initiatives enhance teamwork skills among youth in Mombasa	0	0.0%	0	0.0%	0	0.0%	18	10.3%	157	89.7%
Rate the extent to which recycling initiatives foster entrepreneurial skills among youth in Mombasa	0	0.0%	0	0.0%	0	0.0%	20	11.4%	155	88.6%
Rate the extent of the contribution of recycling initiatives to leadership development among youth in Mombasa:	0	0.0%	0	0.0%	0	0.0%	19	10.9%	156	89.1%
Rate the extent of the effectiveness of recycling initiatives in promoting teamwork skills among youth in Mombasa	0	0.0%	0	0.0%	0	0.0%	22	12.6%	153	87.4%
Rate the extent of the importance of recycling initiatives in nurturing entrepreneurial skills among youth in Mombasa.	0	0.0%	0	0.0%	0	0.0%	20	11.4%	155	88.6%

The survey findings strongly indicate that recycling initiatives play a crucial role in youth development by enhancing teamwork, entrepreneurial skills, and leadership abilities.

4.2. Impact on Teamwork Skills

Respondents were asked to evaluate the extent to which recycling initiatives enhance teamwork among youth. The results showed that 10.3% of respondents rated the effect as High, while a significant majority (89.7%) rated it as Very High. Notably, no respondents rated it as Low or Moderate, highlighting a unanimous agreement on the positive impact of recycling initiatives in fostering teamwork. These findings align with Sorkness et al. [48] who observed a similar trend in urban settings, emphasizing the role of recycling programs in building collaboration and cooperation among young participants.

4.3. Impact on Entrepreneurial Skills

When asked about the role of recycling initiatives in fostering entrepreneurial skills, 11.4% of respondents rated the effect as High, while the majority (88.6%) rated it as Very High. Again, no responses indicated lower levels of agreement, reinforcing the belief that participation in recycling activities equips youth with business-oriented skills such as resource management, financial literacy, and innovation. These findings align with Garcia and Lopez [34] who highlighted that

exposure to recycling initiatives provides young people with opportunities to develop small-scale enterprises, such as waste repurposing and sustainable product creation.

4.4. Impact on Leadership Development

Regarding the contribution of recycling initiatives to youth leadership development, 10.9% of respondents rated the effect as High, while 89.1% rated it as Very High. The absence of lower ratings suggests a widespread acknowledgment of the significant role these initiatives play in cultivating leadership qualities, including decision-making, responsibility, and mentorship. These findings support Nguyen and Kim [37] who found that youth actively involved in recycling programs were more likely to take leadership roles in environmental conservation efforts within their communities.

4.5. Overall Effectiveness of Recycling Initiatives

Further questions explored the overall effectiveness of recycling initiatives in promoting youth development. 12.6% of respondents rated it as High, while 87.4% rated it as Very High, reinforcing the strong perception of the impact of these initiatives. Similarly, when assessing the role of recycling programs in nurturing entrepreneurial skills, 11.4% of respondents rated it as High, while 88.6% rated it as Very High. These results are consistent with Patel et al. [49] who also observed a high level of agreement regarding the importance of recycling initiatives in developing entrepreneurial competencies among youth.

4.6. Broader Implications

The overwhelming agreement across all categories confirms that youth participation in recycling initiatives has a substantial positive impact on their development. The absence of responses indicating moderate, low, or very low effects underscores the consensus among participants regarding the transformative potential of such programs. Beyond environmental sustainability, these initiatives serve as platforms for skill-building, fostering social responsibility, and preparing youth for future leadership and economic opportunities.

By actively engaging in recycling projects, youth become agents of positive change in their communities, contributing to environmental conservation while gaining valuable personal and professional skills. This aligns with the broader goal of empowering young people to take ownership of societal challenges, promoting a culture of innovation, responsibility, and sustainable development.

To further validate these findings, the data was subjected to Pearson's Correlation Analysis to assess the statistical relationship between youth participation in recycling initiatives and their overall development. The results provide deeper insights into the strength and significance of these associations.

4.7. Pearson's Correlation Analysis Between Recycling Initiatives and Youth Development

Table 2.
Pearson's Correlation Analysis Between Recycling Initiatives and Youth Development.

		Youth development
Recycling Initiatives	Pearson Correlation	0.361
	Sig. (2-tailed)	0.000
	N	175

Note: *. Correlation is significant at the 0.05 level (2-tailed).

The table results indicate a strong positive and significant correlation ($r = 0.361$, $p = 0.000$) between recycling initiatives and youth development in Mombasa. This finding suggests that youth participation in recycling activities contributes significantly to their personal and professional growth. The positive correlation highlights that as engagement in recycling initiatives increases, youth development outcomes such as social capital, innovative skills, and economic empowerment also improve.

To further investigate this relationship, the study aimed to determine the specific effects of recycling initiatives on youth development in Mombasa, Kenya. This was achieved by testing the following hypothesis:

H_{O1}: There is no significant effect between recycling initiatives and youth development in Mombasa.

A simple linear regression analysis was conducted to establish the extent to which recycling initiatives influence youth development. The regression model assessed the predictive power of recycling initiatives in shaping various youth development indicators, including leadership skills, teamwork, entrepreneurial competencies, and economic empowerment.

The results, presented in the following table, provide further insight into the statistical significance and strength of this relationship. If the p-value is less than 0.05, the null hypothesis will be rejected, confirming that recycling initiatives significantly impact youth development. Additionally, the coefficient of determination (R^2) will indicate the proportion of variation in youth development explained by recycling initiatives, further strengthening the argument for their role in fostering youth growth and engagement in Mombasa.

4.8. Regression Coefficient for Recycling Initiatives

Table 3.
Regression Coefficient for Recycling Initiatives.

R^2	β	F	t	p
0.130	0.783	12.893	3.616	0.000

The table presents the goodness of fit for the regression model examining the relationship between youth participation in recycling initiatives and youth development in Mombasa. The coefficient of determination (R^2) of 0.130 indicates that 13% of the variance in youth development can be attributed to youth engagement in recycling initiatives. This suggests that while recycling initiatives contribute significantly to youth development, other factors may also influence their growth and empowerment, such as education, mentorship, and economic opportunities.

The standardized coefficient (β) of 0.783 indicates a moderately strong positive relationship between youth participation in recycling initiatives and youth development. This implies that increased involvement in recycling activities is associated with improved youth development outcomes, including skill acquisition, leadership, and economic empowerment. These initiatives provide young people with valuable opportunities to develop teamwork, problem-solving, and entrepreneurship skills, which are essential for personal and professional growth.

Additionally, the F-value of 12.893, which is statistically significant ($p < 0.001$), confirms that the regression model is a good fit for the data. This means that the relationship between recycling initiatives and youth development is not due to chance, and the model reliably explains the connection between these two variables. Furthermore, the t-value of 3.616 for the predictor variable reinforces its statistical significance in explaining variations in youth development. A t-value above 2.0 generally indicates that the predictor variable has a meaningful influence, and in this case, it strongly supports the positive impact of recycling initiatives on youth.

These findings suggest that youth participation in recycling initiatives has a substantial and positive effect on youth development in Mombasa. Beyond promoting environmental sustainability, these initiatives foster crucial life skills that empower youth to become innovative, self-reliant, and socially responsible individuals. By engaging in recycling activities, young people develop a sense of purpose and community involvement, leading to increased self-confidence and career opportunities. Moreover, the economic benefits of recycling, such as income generation through waste collection and recycling businesses, further contribute to economic empowerment and poverty alleviation among youth.

Given these results, the study recommends expanding and institutionalizing youth-centered recycling initiatives through community partnerships, government policies, and private-sector support. Creating training programs, mentorship opportunities, and financial incentives for youth engaged in recycling could further enhance the long-term impact on their economic and social well-being. These interventions can ensure that recycling initiatives remain sustainable, impactful, and accessible to a broader segment of the Mombasa youth population.

4.9. Youth Development

The Study's objective was to determine how the three criteria covered in this section relate to youth development in Mombasa. The findings are shown in the table below.

Table 4.
Youth Development.

	Very Low		Low		Moderate		High		Very High	
	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %	Count	Row N %
Rate the extent to which youth participation in solid waste management projects contributes to the development of social capital in Mombasa.	0	0.0%	0	0.0%	0	0.0%	5	2.9%	170	97.1%
Rate the extent to which youth participation in solid waste management projects contributes to developing	0	0.0%	0	0.0%	0	0.0%	33	18.9%	142	81.1%

innovative skills in Mombasa										
Rate the extent to which youth participation in solid waste management projects contributes to the economic empowerment of youth in Mombasa.	0	0.0%	0	0.0%	0	0.0%	24	13.7%	151	86.3%

The table illustrates the impact of youth participation in solid waste management projects on various aspects of youth development in Mombasa.

4.10. Development of Social Capital

A vast majority of respondents (97.1%) rated the contribution of waste management projects to social capital development as "Very High," while a small percentage (2.9%) rated it as "High." This overwhelming consensus highlights the significant role of these initiatives in fostering social connections, collaboration, and community engagement among youth. These findings align with the research conducted by Blunden et al. [50], which emphasized how participation in such projects strengthens social cohesion and enhances networking opportunities among young people.

4.11. Enhancement of Innovative Skills

Regarding the development of innovative skills, 81.1% of respondents rated the contribution of waste management projects as "Very High," while 18.9% rated it as "High." This suggests a strong perception that participation in waste management projects stimulates creativity, problem-solving abilities, and entrepreneurial thinking among youth. These findings support the research by Kimani and Wang [15] which highlighted the role of waste management initiatives in nurturing innovation and equipping youth with adaptive skills to address environmental challenges through creative solutions.

4.12. Economic Empowerment of Youth

On economic empowerment, 86.3% of respondents rated the contribution as "Very High," while 13.7% rated it as "High." This demonstrates a widespread acknowledgment of the positive economic impact of youth engagement in waste management initiatives. Such projects provide income-generating opportunities, employment prospects, and financial independence for young people. The findings align with the study by Wesonga [6], which underscored the economic benefits of recycling and waste management programs in creating sustainable livelihoods for youth.

5. Conclusion

The results clearly indicate a strong consensus among respondents on the substantial positive influence of youth participation in solid waste management projects on social capital, innovation, and economic empowerment. These findings reaffirm existing research emphasizing the transformative potential of such initiatives in shaping youth development, fostering self-reliance, and promoting sustainable community growth in Mombasa. Expanding and supporting these programs can further enhance their long-term impact, equipping youth with essential skills and opportunities for future success.

5.1. Model Summary and Parameter Estimates

Table 5.
Model Summary and Parameter Estimates.

			t	Sig.
	B	**Std. error**		
(Constant)	0.161	0.273	2.343	0.10
Recycling initiative	0.783	0.152	3.6161	0.000.

From the table above, the model regression equation was established as follows:

$Y = 0.161 + 0.782X$

5.2. Interpretation of the Regression Equation

The regression equation provides critical insights into the relationship between youth participation in solid waste management and youth development. The constant term (0.161) suggests that even in the absence of waste management

activities, youth development in Mombasa remains influenced by other external factors such as education, employment opportunities, and social policies. However, the three independent variables significantly contribute to youth development, as indicated by their respective regression coefficients.

The results indicate that a one-unit increase in recycling initiatives contributes 0.782 units to youth development. These findings suggest that proper waste disposal strategies may have a particularly strong effect on youth development, likely due to their role in improving public health, sanitation, and environmental sustainability.

Furthermore, the statistical significance of the F-value (12.893, $p < 0.001$) confirms that the regression model is a good fit for explaining the relationship between youth participation in waste management and their development. The t-values associated with each predictor variable reinforce their individual significance in predicting youth development outcomes. These results align with previous studies that highlight the multifaceted benefits of youth involvement in waste management.

5.3. Broader Implications

The findings underscore the transformative potential of youth engagement in waste management initiatives. The strong association between these activities and youth development suggests that expanding waste management programs can lead to enhanced skill acquisition, economic opportunities, and social empowerment for young people. Proper recycling not only promotes environmental sustainability but also equips youth with valuable competencies, including teamwork, leadership, and entrepreneurship.

This study aligns with the research conducted by Blunden et al. [50]; Wesonga [6]; Manyara et al. [16] and Kimani and Wang [15] which emphasize the transformative impact of youth-led waste management initiatives. These studies highlight how such initiatives foster environmental consciousness and civic responsibility, encouraging sustainable behaviors among young people. Additionally, they contribute to economic empowerment by creating income-generating opportunities, such as selling recyclables or developing waste-based enterprises. Proper waste disposal also offers public health benefits by reducing pollution-related diseases and promoting cleaner urban environments. Furthermore, these initiatives enhance social inclusion and community engagement, allowing young people to take an active role in urban development and decision-making processes. Collectively, these findings underscore the importance of integrating youth participation into waste management policies and programs to maximize both environmental and socio-economic benefits.

The evidence suggests that policies and programs that prioritize youth involvement in solid waste management should be scaled up to maximize their developmental impact. Governments, NGOs, and private-sector stakeholders should invest in capacity-building programs, provide financial and technical support, and create platforms for youth-driven waste management innovations.

In conclusion, recycling initiatives serve as a catalyst for youth empowerment and sustainable urban development. By increasing participation in these initiatives, Mombasa can not only improve its environmental sustainability but also unlock new pathways for youth economic and social advancement, ultimately fostering a more resilient and self-sufficient community.

6. Conclusion

The study utilized a Likert scale survey to assess the impact of recycling initiatives on youth development in Mombasa, Kenya. Findings indicate a strong positive correlation between recycling initiatives and youth development, with respondents overwhelmingly acknowledging their benefits. A majority rated the influence of recycling initiatives on teamwork, entrepreneurial skills, and leadership development as "Very High," with no disagreement recorded. Pearson's correlation confirmed a significant positive relationship, while regression analysis showed that recycling initiatives explain approximately 13% of the variance in youth development. The standardized coefficient suggests a moderately strong impact, reinforcing the role of recycling in skill-building and empowerment.

Overall, the study provides strong evidence that youth participation in recycling initiatives enhances their development, fostering teamwork, entrepreneurship, and leadership. These initiatives contribute to environmental sustainability while equipping youth with essential skills for future success, positioning them as proactive agents of positive change within their communities.

7. Recommendations of the Study

Based on the study's findings, the following recommendations are proposed:

1. Policy Integration: The local government and urban planners should incorporate youth-led waste management initiatives into formal municipal solid waste management strategies. This includes providing policy frameworks that support youth participation through financial incentives, technical training, and access to resources.

2. Capacity Building and Training: Youth should be equipped with skills in waste management, entrepreneurship, and environmental conservation. Training programs focusing on innovative waste processing techniques and business models in waste management can enhance their employability and economic prospects.

3. Community Awareness Campaigns: Public education and sensitization campaigns should be conducted to emphasize the role of youth in waste management. Creating awareness about the benefits of recycling, waste segregation, and responsible disposal practices will promote broader community participation.

4. Partnerships and Stakeholder Engagement: Government agencies, non-governmental organizations, private sector players, and academic institutions should collaborate to support youth in waste management. Multi-stakeholder partnerships can provide funding, mentorship, and technological innovations to enhance the effectiveness of these initiatives.

5. Monitoring and Evaluation: Regular assessment of youth-led waste management initiatives should be conducted to track their impact, identify challenges, and develop strategies for improvement. Establishing measurable indicators will help assess progress and ensure sustainability.

8. Implications for Theory, Practice, and Future Research

8.1. Implications for Theory

This study contributes to the broader theoretical understanding of youth development by demonstrating how waste recycling initiatives serve as a platform for skill acquisition, economic empowerment, and civic engagement. The findings align with social capital and human capital theories, suggesting that youth participation in environmental initiatives fosters community bonds, enhances knowledge acquisition, and strengthens employability. Future research can explore additional theoretical frameworks, such as behavioral change theories, to understand how youth perceptions of waste management evolve over time.

8.2. Implications for Practice

The study underscores the practical significance of youth involvement in urban waste management, particularly in addressing sustainability challenges in cities. Local governments and development organizations should leverage youth-led initiatives to enhance waste management efficiency and promote green economies. Furthermore, policymakers should recognize the untapped potential of waste management as a means of job creation and entrepreneurship for young people.

8.3. Implications for Future Research

While this study provides valuable insights, further research is necessary to explore additional aspects of youth participation in waste management. Future studies could:

- Investigate the long-term socio-economic impact of youth-led waste management initiatives.
- Examine gender dynamics in youth participation and their influence on waste management effectiveness.
- Explore the role of digital technologies and innovations, such as mobile applications and block chain, in improving waste management and youth engagement.
- Conduct comparative studies between different urban centers to identify best practices and scalable models for youth-led waste management.

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