

Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs

¹Abubakar Yerima Chabbal, ²Aisha Ibrahim Umar and ³Muhammed Ibrahim Gana
Department of Accountancy, Federal Polytechnic, Damaturu, Yobe State

Abstract

Rapid urbanization and weak waste infrastructure have intensified environmental degradation in Nigeria, particularly in the North-East. Scavenging has consequently emerged as a critical livelihood strategy and a complementary waste management practice. This study investigates the economic and environmental contributions of scavenging activities in North-Eastern Nigeria, emphasizing the moderating role of government support programs. Anchored on the Sustainable Livelihoods Framework, the study employed a quantitative research design using structured questionnaires administered to 245 respondents comprising scavengers, community leaders, government officials, and NGO representatives across major towns. Data were analyzed using STATA 15.0 through descriptive and inferential statistics. Results reveal that scavenging contributes moderately but significantly to household income, with 63% of scavengers earning ₦31,000–₦50,000 monthly, confirming its role in informal employment and poverty mitigation. Environmental models demonstrated stronger significance, with scavengers' experience significantly predicting hazardous waste prevention awareness ($p < 0.05$). However, government support programs exhibited weak and inconsistent effects ($p = 0.0312$ among scavengers only), reflecting low policy coherence and limited institutional visibility. The study concludes that scavenging enhances both income generation and environmental preservation but remains under-optimized due to fragmented policies and minimal institutional backing. It recommends formalizing scavenging through registration, cooperatives, training, and provision of infrastructure to professionalize operations and strengthen inclusion in municipal waste systems.

Keywords: Scavenging, informal economy, environmental sustainability, government support, livelihoods, waste management, Northeastern Nigeria.

1.0 INTRODUCTION

Rapid urbanization, population growth and weak waste management infrastructure have intensified environmental challenges across many developing economies, particularly in Nigeria. In response, scavenging an informal waste recovery practice has emerged as both an economic survival strategy and an environmental management mechanism. In North-Eastern Nigeria, where poverty, displacement and unemployment remain pervasive, scavenging serves as a vital livelihood for marginalized populations, especially young adults. Despite its contributions to local economies and ecological sustainability, the sector remains undervalued, poorly regulated and largely excluded from formal policy frameworks (Kodiya et al., 2023; Msukwa, et al., 2023). Scavenging activities play a dual role in economic empowerment and environmental preservation. Economically, scavengers derive substantial income through the recovery, sorting, and sale of recyclable materials, often serving as the main income source for low-income households (Mapa et al., 2019; Erude, et al., 2023).

The activity also supports recycling industries by ensuring a steady flow of raw materials at lower cost, thus fostering industrial linkages and reducing the demand for virgin resources (Al-Khatib, et al., 2020b). Environmentally, scavengers mitigate landfill pressures and reduce municipal waste collection costs by diverting recyclable waste streams, thereby contributing significantly to pollution reduction, resource conservation, and climate change mitigation (Fidelis, et al., 2020; Jeswani, et al., 2021). These contributions demonstrate the potential of scavenging as a mechanism for sustainable urban waste management. However, scavengers operate under precarious conditions, often exposed to occupational hazards, social stigma, and institutional neglect (Ogbu, et al., 2021; Patrick, et al., 2022). Although government and non-

governmental organizations have initiated various support schemes—ranging from training and equipment provision to market access facilitation—such interventions remain fragmented, poorly implemented, and weakly institutionalized (Fidelis et al., 2020; Jung & Feng, 2020). The lack of coherent policy frameworks and inadequate infrastructural support hinder the integration of scavenging into formal waste management and poverty reduction strategies. Consequently, the economic and environmental potential of scavenging remains underexplored in both research and policy discourse, especially in Nigeria's North-East, where vulnerability and environmental degradation are most severe (Gutberlet, 2021).

This study was therefore undertaken to empirically assess the economic and environmental contributions of scavenging activities in North-Eastern Nigeria, with a focus on the moderating role of government support programs. Specifically, it aims to (i) evaluate the extent to which scavenging contributes to income generation and poverty reduction; (ii) determine its environmental benefits in terms of waste reduction and pollution control; and (iii) examine how government interventions influence these outcomes. The guiding research questions include: To what extent do scavenging activities contribute to the economic well-being of individuals and communities in North-Eastern Nigeria? What are the measurable environmental impacts of scavenging practices in the region? How do government support programs moderate the relationship between scavenging activities and their economic and environmental outcomes? The study is anchored on the Sustainable Livelihoods Framework (SLF) (Kabonga, 2020), which emphasizes the interaction of assets, activities, and institutional factors in determining livelihood sustainability. This framework provides a multidimensional lens through which the economic and ecological functions of

Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs

scavenging can be understood, incorporating both material (income, infrastructure) and non-material (policy, social recognition) components. A quantitative research design was adopted, employing a structured questionnaire administered to 245 respondents comprising scavengers, government officials, NGO representatives, and community leaders across major towns in North-Eastern Nigeria. Of these, 245 valid responses were obtained, ensuring strong representativeness. Data were analyzed using STATA 15.0, applying both descriptive and inferential statistics. Reliability was established through Cronbach's Alpha, while regression models tested the hypothesized relationships among economic, environmental, and policy variables. Empirical analysis revealed that scavenging provides moderate but significant income, with over 60% of respondents earning between ₦31,000 and ₦50,000 monthly, indicating its role as a key informal employment source. Regression outputs showed weak but positive associations between scavenging perceptions and economic outcomes, suggesting that while scavengers value their contribution, institutional neglect limits measurable income gains. Conversely, environmental models demonstrated stronger significance: scavengers' experience significantly predicted awareness of hazardous waste prevention ($p < 0.05$), highlighting their tangible environmental contribution. However, government support programs displayed inconsistent effects across respondent groups, with only scavengers' perceptions showing marginal statistical significance ($p = 0.0312$). This underscores limited program visibility and weak policy coherence.

The significance of this study lies in its contribution to the discourse on informal waste economies as catalysts for sustainable development. By quantifying both economic and environmental outcomes and examining the

moderating effect of institutional support, the study provides empirical evidence for policy integration of scavenging into Nigeria's formal waste management system. The findings suggest that well-coordinated government programs—emphasizing training, infrastructure, and financial inclusion—could transform scavenging from a survivalist activity into a sustainable livelihood and environmental management model. In doing so, this research informs policymakers, development practitioners, and scholars seeking to align poverty alleviation with ecological sustainability in resource-constrained urban contexts.

2.0 LITERATURE REVIEW

2.1 Economic Impact of Scavenging Activities

Scavenging activities, often part of the informal economy, provide critical income and employment opportunities for marginalized and impoverished populations. Studies have shown that scavengers, or waste pickers, contribute significantly to their household incomes, often being the primary source of livelihood for many families. For instance, Msukwa, et al., (2023) point out that millions of individuals in various developing nations make their living through scavenging, with profits varied greatly according to the quantity and kind of things recovered. Kodiya, et al (2023) affirms that waste scavenging in Maiduguri, Borno State, contributes significantly to environmental sustainability, economic growth, and poverty reduction, but is currently undervalued by local authorities.

Consequently, the role of scavengers in reducing municipal waste management costs is well-documented. By diverting significant amounts of waste from landfills and reducing the burden on waste collection systems, scavengers contribute to substantial cost savings for local governments. According to Mapa et al. (2019), scavenging and other informal recycling methods can drastically lower the price of disposing of waste and the

Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs

demand for landfill area. Similarly, Mapa, et al (2023) posit that despite worries about safety and health, informal waste scavenging at disposal sites improves solid waste management and has positive environmental effects.

Scavengers play a vital role in providing raw materials to the recycling sector. Their efforts help to maintain a continuous flow of recyclables, which helps different industrial processes and lowers the need for virgin materials. Scavengers play a critical role in the recycling business by supplying necessary inputs at a cheaper cost (Al-Khatib, et al., 2020a).

2.2 Environmental Impact of Scavenging Activities

The reduction of waste and recycling initiatives are greatly aided by scavenging operations. Scavengers contribute to the reduction of waste going to landfills by gathering and classifying recyclables from waste streams. Scavenging operations in Brazil and other developing nations have reportedly been crucial in raising recycling rates and lowering environmental pollution (Fidelis et al., 2020). Natural resources are preserved as a result of scavengers' material gathering and recycling. Chen, et al (2021) and Jeswani, et al (2021) affirms that recycling minimizes the need to extract raw materials, which lessens resource depletion and environmental deterioration. Study by Igwe & Anaje (2022) affirms that scavenging has environmental advantages that go beyond waste supervision and encouragement of greater efforts to conserve resources.

Activities related to scavenging contribute to the decrease of greenhouse gas emissions caused by resource exploitation and waste breakdown. This is due to the fact that scavengers remove recyclables and organic waste from landfills, reducing the emissions of methane, a potent greenhouse gas, created by decomposing garbage (Harrison, et al., 2020). Furthermore, as

mentioned by Jeswani, et al. (2021), recycling operations typically produce fewer greenhouse gases than the manufacturing of items from virgin resources.

2.3 Government Support for Scavengers

Various support programs have been put in place by governments and non-governmental organizations to help scavengers' living and working conditions. These initiatives cover access to financial resources, infrastructure development, protective equipment supply, training, Safety Regulations and market access and pricing support (Jung & Feng, 2020; Branham, et al 2021). Fidelis et al. (2020) assert that efficient support programs can improve the safety, productivity, and access to formal markets of scavengers. Studies show that scavenging activities can have a substantial impact on the economy and ecology when governments intervene. Scavengers' pay, working conditions, and social standing have all improved in India as a result of the government's acknowledgement and backing of waste picker cooperatives (Gutberlet, 2021). Moreover, infrastructural support through the availability of recycling facilities and collection centers can boost the scope and effectiveness of scavenging operations (Fidelis et al., 2020; Mapa, et al., 2023).

However, the efficacy of government support programs is impeded by a number of obstacles, notwithstanding its possible advantages. Common challenges include social stigma, a lack of political will, inadequate money, and poor implementation (Reynolds, et al., 2020). In order to overcome these obstacles, a comprehensive strategy involving policy changes, community involvement, and capacity-building programs is needed, as noted by Sapienza et al. (2020).

2.4 Theoretical Framework

Sustainable Livelihoods Framework (SLF) is considered the most comprehensive and appropriate choice for this study. This framework

effectively captures the multi-dimensional nature of scavenging activities, linking economic and environmental aspects while considering the role of government support programs. The SLF allows for a holistic examination of how scavenging as a livelihood strategy can be optimized to contribute to both economic and environmental sustainability, especially in a region facing significant socio-economic and environmental challenges (Kabonga, 2020).

3.0 METHODOLOGY

The study on “Economic and Environmental Contributions of Scavenging Activities in Northeastern Nigeria” adopts a quantitative research design to examine how scavenging operations influence economic livelihoods and environmental sustainability, emphasizing the moderating role of government support initiatives. The research is conducted across major towns in Northeastern Nigeria, selected based on their diversity in waste management systems, the presence or absence of government support programs, and varying socio-economic contexts. The study population comprises scavengers, government officials, NGO representatives, and community leaders, estimated at approximately 10,250 individuals. Using Cochran’s sample size formula and proportionate sampling techniques, a total of 255 respondents were selected to ensure representativeness and reliability. Out of these, 180 questionnaires were filled and returned by scavengers, 25 by community leaders, 30 by government officials, and 10 by NGO representatives, representing a high response rate and wide stakeholder coverage.

Primary data were collected using a structured questionnaire, divided into sections on demographic characteristics, economic contributions, environmental benefits, government support programs, and perceived challenges. Responses were measured on a five-point Likert scale—ranging from Strongly

Disagree (1) to Strongly Agree (5)—to quantify perceptions and attitudes objectively. The instrument was validated through expert review and pilot testing, while reliability was confirmed using Cronbach’s Alpha. Data analysis involved both descriptive and inferential statistics, with mean used for data summarization and regression analyses applied to test hypotheses. This methodological design enabled the study to provide empirical insights into scavenging as both an economic livelihood strategy and an environmental management practice, offering practical recommendations for policy interventions and sustainable development initiatives in Northeastern Nigeria.

4.0 DATA ANALYSIS

This section presents regression results representing the perceptions of scavengers, community leaders, government officials and NGO representatives on the economic and environmental contributions of scavenging activities in Northeastern Nigeria and the moderating effect of government support programmes. The analysis was performed using STATA 15.0.

4.1 Descriptive Statistics

Descriptive statistics was used to summarize the demographic characteristics of scavengers, their economic contributions, and environmental impacts.

Table 1: mean Age

	Mean estimation			
Number of obs	=	180		
	Mean	Std.	Err.	
	[95% Conf.	Interval]		
Age	2.183333	.0927124		
	2.000383	2.366283		

Source: Generated by the researcher using STATA 15.0

Mean = 2.183 (category 2) with a relatively small standard error and a narrow 95% confidence interval. This suggest that the modal/central

tendency is firmly in the 21–30 bracket. Thus the scavengers sampled are predominantly young adults (mainly 21–30). This might be a good strategy for policy and program design interventions (training, cooperative formation, financial literacy) in order to achieve sustainable

result. Younger workers may be more adaptable to skills training and formalization efforts, and they may have different health and safety vulnerabilities compared with older workers.

Table 2: proportion AvgInc

Proportion estimation		Number of obs	=		180
_prop_1: AvgInc = Below ₦10,000					
_prop_2: AvgInc = ₦10,000–₦30,000					
_prop_3: AvgInc = ₦31,000–₦50,000					
_prop_4: AvgInc = Above ₦50,000					
		Logit			
		Proportion	Std. Err.	[95% Conf.	Interval]
AvgInc					
_prop_1	.1277778	.0249525	.0860732	.185586	
_prop_2	.2388889	.031871	.181729	.3072761	
_prop_3	.3222222	.0349297	.2574653	.3946109	
_prop_4	.3111111	.0346024	.2472148	.3831174	

Source: Generated by the researcher using STATA 15.0

Income categories are fairly spread, with the largest share in the ₦31k–50k band (32.2%) and a close share above ₦50k (31.1%). About 12.8% earn below ₦10k. Confidence intervals indicate these proportions are estimated with reasonable precision.

with many earn middling incomes. This underscores its economic relevance. However, the 12.8% are at very low income levels, showing heterogeneity.

A sizable proportion of scavengers earn moderate amounts (\geq ₦31k). This challenges a simplistic view of scavengers as uniformly extremely poor,

Thus, interventions could be targeted to help those at the low-income tail to improve earnings and scale programs that formalize income for the current middle-tier earners.

Table 3: proportion Edu

Proportion estimation		Number of obs	=		180
_prop_1: Edu = No Formal Education					
		Logit			
		Proportion	Std. Err.	[95% Conf.	Interval]
Edu					
_prop_1	.3111111	.0346024	.2472148	.3831174	
Primary	.1888889	.0292561	.1377556	.2534238	
Secondary	.4277778	.0369798	.3568567	.5017966	
Tertiary	.0722222	.0193478	.0421754	.1209717	

Source: Generated by the researcher using STATA 15.0

Most respondents have secondary education (42.8%), with 31.1% having no formal education. A small share have tertiary education (7.2%). Thus, the sample is moderately educated overall (dominant secondary education). This suggests training and capacity-building programs could be successful since many have at least secondary-level literacy. However, the significant no-education share signals the need for accessible,

possibly non-written or local-language training modules.

4.2 Inferential Statistics

Regression analysis was employed to assess the impact of government support programs on the economic and environmental outcomes of scavenging activities. This helps in identifying the most significant factors contributing to the success of scavengers and the effectiveness of support programs.

Table 4: Economic Contributions of Scavenging

Respondent group	Dependent variable	N	R ²	Adj R ²	F (df) (p-value)	Model fit (short)
Scavengers	Average income	179	0.0331	0.0065	F(7,171)=0.84, p=0.5589.	Essentially no explained variance.
Community (leaders)	Position (leadership)	25	0.2907	0.1040	F(5,19)=1.56, p=0.2198.	Moderate R ² but overall model not significant; one predictor significant.
Government (types)	(perception score)	29	0.1995	0.0254	F(5,23)=1.15, p=0.3649.	Low explanatory power; non-significant.
NGOs	(perception / program effect)	10	0.9450	0.8762	F(5,4)=1.073, p=0.0125.	Very high R ² (small N) — interpret with caution.

Source: Generated by the researcher using STATA 15.0

The regression results presented in Table 4 examined the perceived economic and environmental contributions of scavenging activities across four key respondent groups—scavengers, community leaders, government agencies and non-governmental organizations (NGOs) within Northeastern Nigeria. The aim was to identify whether perceptions of scavenging’s economic importance significantly predict economic outcomes, leadership engagement or institutional support and to determine how government support programs moderate these relationships.

The findings reveal substantial heterogeneity across respondent categories. Among the scavenger group (N = 179), the model recorded an R² value of 0.0331 and an adjusted R² of 0.0065, with an F-statistic of 0.84 (p = 0.5589), indicating that perceptions of economic contribution explained less than 4% of the variation in scavengers’ average income. None of the predictor variables were statistically significant. This suggests that although scavengers generally express positive views about the contribution of their activities to local economies, such perceptions do not translate into measurable improvements in income levels. The weak relationship implies that self-reported

Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs

attitudes are poor predictors of actual economic well-being, possibly due to informal market dynamics, lack of formal recognition or limited access to government or NGO support programs. For community leaders (N = 25), the regression model yielded an R² of 0.2907 and an adjusted R² of 0.1040 (F = 1.56, p = 0.2198), suggesting moderate explanatory power but an overall non-significant model. However, one item (Q4), which captures acknowledgment of scavenging's contribution to local recycling industries, was statistically significant (p = 0.044). This indicates that community leaders who recognize the industrial and environmental value of scavenging tend to occupy more influential positions within their communities. This finding underscores the potential of community-level awareness and acceptance in facilitating the integration of scavengers into the formal waste management system.

Among government respondents (N = 29), the regression results showed an R² of 0.1995 and an adjusted R² of 0.0254, with an overall F-value of 1.15 (p = 0.3649). None of the predictors were

significant, though the coefficient for Q4 (perceived support to recycling industries) was positive. This suggests that government respondents primarily view scavenging through the lens of its contribution to industrial recycling, rather than as a source of livelihood or poverty alleviation. The narrow policy orientation observed here reflects a gap in integrating scavenging into broader socioeconomic and welfare strategies.

The NGO model (N = 10) exhibited a remarkably high R² value of 0.945 and an adjusted R² of 0.876, with F = 1.073 (p = 0.0125). While the small sample size warrants caution, the results reveal that one variable (Q5) was significantly negative (p = 0.010), suggesting that existing NGO interventions may not be achieving their intended economic impact. This negative association implies that NGOs perceive current support programs as either insufficient or poorly aligned with scavengers' actual needs. Given the very small sample size and possible overfitting, this interpretation should be treated as indicative rather than conclusive.

Table 5: Environmental Contributions of Scavenging Activities

Respondent Group	Dependent Variable	N	R ²	Adj. R ²	F (p-value)	Model Fit
Scavengers	Environmental Contribution (Scavenger perception)	180	0.1019	0.0708	F(6,173) = 3.27 (p = 0.0045)	Significant – model explains about 10% of variation; experience significantly predicts hazardous-waste prevention awareness
Community Leaders	Environmental Contribution (Community perception)	25	0.3453	0.1778	F(5,19) = 2.00 (p = 0.1242)	Not significant – moderate explanatory power; landfill reduction and cleanliness perceptions show marginal effects

Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs

Respondent Group	Dependent Variable	N	R ²	Adj. R ²	F (p-value)	Model Fit
Government Officials	Environmental Contribution (Government perception)	28	0.2346	0.0667	F(5,22) = 1.35 (p = 0.2813)	Not significant – weak but positive associations; landfill reduction perception marginally positive
NGO Representatives	Environmental Contribution (NGO perception)	10	0.6064	-0.0137	F(6,3) = 0.978 (p = 0.5501)	Unstable/Not significant – very small sample size; results statistically unreliable

Source: Generated by the researcher using STATA 15.0

The regression outcomes presented in Table 5 examine the perceived economic and environmental contributions of scavenging activities across four key respondent categories: scavengers, community leaders, government officials and representatives of non-governmental organizations (NGOs). The analysis provides an empirical basis for understanding how experiential and institutional factors influence perceptions of scavenging as an environmentally and socially beneficial activity within Northeastern Nigeria.

For the scavenger group, the model was statistically significant at the 1% level ($F(6,173) = 3.27, p = 0.0045$), with an R^2 value of 0.1019 and an adjusted R^2 of 0.0708, indicating that the explanatory variables accounted for about 10% of the observed variance in environmental contribution perceptions. Among the specific predictors, only the item on the prevention of hazardous materials from polluting the environment (q13) had a statistically significant positive effect ($\beta = 0.279, p = 0.015$). This suggests that more experienced scavengers are significantly more aware of their role in preventing environmental pollution through the recovery and reuse of waste materials. Other variables in the scavenger model (q8–q12) were not statistically significant, though their positive

signs suggest a generally favourable perception of scavenging’s environmental role.

For community leaders, the regression model had an R^2 of 0.3453 and an adjusted R^2 of 0.1778, indicating a relatively higher explanatory power, though the overall model was not statistically significant ($F(5, 19) = 2.00, p = 0.1242$). Two variables reduction in landfill waste (q6) and community cleanliness improvement (q8) showed marginal significance ($\beta = 0.494, p = 0.066$ and $\beta = 0.337, p = 0.062$, respectively). This outcome implies that experienced community leaders tend to recognize the environmental value of scavenging, even if their perceptions vary across communities.

The government officials’ model revealed an R^2 of 0.2346 and an adjusted R^2 of 0.0667 ($F(5, 22) = 1.35, p = 0.2813$), indicating weak but positive relationships. The coefficient for landfill waste reduction (q6) was marginally significant ($\beta = 0.570, p = 0.089$), suggesting that longer-tenured officials are somewhat more appreciative of scavenging’s contribution to environmental management.

Conversely, the NGO regression results, though suggestive, were statistically unstable due to the small sample size ($n = 10$) and yielded a negative adjusted R^2 . Collectively, these findings indicate that exposure and experience across all respondent categories are positively associated

with a higher recognition of scavenging as an activity with tangible environmental benefits,

particularly in the reduction of landfill waste and prevention of hazardous pollution.

Table 6: Government Support Programs

Respondent Group	Dependent Variable	N	R ²	Adj R ²	F (p-value)	Model Fit
Scavengers	Perceived government support (q11–q20) moderated by education	180	0.0845	0.0472	F(7, 172) = 2.27 (p = 0.0312)	Significant (Weak Fit)
Community Leaders	Perceived government support (q11–q15) moderated by education	25	0.0625	-0.1838	F(5, 19) = 0.25 (p = 0.932)	Not Significant (Poor Fit)
Government Officials	Perceived government support (q11–q15) moderated by experience	30	0.2008	0.0343	F(5, 24) = 1.21 (p = 0.3363)	Not Significant (Weak Fit)
NGOs	Perceived government support (q11–q15) moderated by experience	10	0.4012	< 0 (Negative)	F(5, 4) = 0.54 (p = 0.7454)	Not Significant (Unreliable Fit due to small n)

Source: Generated by the researcher using STATA 15.0

For the scavenger model, the regression result shows a statistically significant overall model fit, $F(7, 172) = 2.27, p = 0.0312$. Although the explanatory power is modest ($R^2 = 0.0845$; adjusted $R^2 = 0.0472$), this indicates that about 8.5 percent of the variance in scavengers' perceptions of government support is explained by the selected predictors. None of the individual predictors reached conventional significance levels ($p < 0.05$), though q16 (government provides training) showed a positive and suggestive coefficient ($\beta = 0.136, p = 0.106$), followed by q18 (support improves income and working conditions, $\beta = 0.103, p = 0.159$). The positive direction of these coefficients implies that educational attainment among scavengers slightly enhances awareness and perceived benefits of government support, especially

regarding training and income-related interventions.

The community leader model recorded an $F(5, 19) = 0.25 (p = 0.932)$, indicating no statistically significant overall fit. The model explains only 6.3 percent of the variance ($R^2 = 0.0625$; adjusted $R^2 = -0.1838$). None of the predictors show significance, suggesting that differences in education do not substantially influence community leaders' perception of government support to scavengers. The uniformity of responses may reflect limited visibility or engagement of community structures in program implementation.

Among government respondents, the model produced $F(5, 24) = 1.21 (p = 0.3363)$, $R^2 = 0.2008$ and adjusted $R^2 = 0.0343$. Although the overall model is not statistically significant, one

predictor q13 (provision of infrastructure for scavenging) recorded a near-significant positive coefficient ($\beta = 0.53$, $p = 0.056$). This suggests that infrastructural support (such as recycling centers, collection points or waste-sorting facilities) is the most tangible form of government intervention recognized by officials. The NGO model, with a small sample size ($n = 10$), returned $F(5, 4) = 0.54$ ($p = 0.7454$), $R^2 = 0.4012$ and a negative adjusted R^2 . Despite the

relatively high unadjusted R^2 , the insignificant F-statistic and large standard errors indicate no reliable explanatory relationship between the tested variables and NGO perceptions. Taken together, the results across all models demonstrate weak and inconsistent effects of educational or experiential differences on perceptions of government support, underscoring the limited reach or visibility of such programs across stakeholder groups.

Table 7: Challenges and Perceptions

Respondent Group	Dependent Variable	N	R ²	Adjusted R ²	F (p-value)	Model Fit
Scavengers	Experience (Exper)	180	0.1765	0.1480	F(6,173) = 6.18 (p < 0.0001)	Good fit – Model statistically significant; predictors explain ~17.6% of variation in experience.
Community Leaders	Years (Leadership Tenure)	25	0.2348	0.0335	F(5,19) = 1.17 (p = 0.362)	Weak fit – Model not significant; low explanatory power due to small sample.
Government Officials	Organizational Index	29	0.2357	0.0695	F(5,23) = 1.42 (p = 0.255)	Weak fit – Model not significant; moderate R ² but low adjusted R ² .
NGO Representatives	Focus of Engagement	10	0.7638	0.4686	F(5,4) = 2.59 (p = 0.189)	Moderate fit – High R ² but small sample; interpret cautiously.

Source: Generated by the researcher using STATA 15.0

The scavenger model produced the most statistically robust results, with an $R^2 = 0.1765$ and Adjusted $R^2 = 0.1480$, indicating that approximately 17.6 percent of the variance in scavengers' experience is explained by the explanatory variables. The model is statistically significant ($F(6, 173) = 6.18$, $p < 0.0001$). Among the predictors, lack of safe working spaces and infrastructure (q23) showed a strong negative relationship with scavengers' experience ($\beta = -0.179$, $p = 0.003$), suggesting that less-experienced scavengers face greater exposure to

unsafe environments. Similarly, demand for more training opportunities (q26) exhibited a marginally significant negative effect ($\beta = -0.140$, $p \approx 0.06$), indicating that those with limited experience express stronger need for skills development. Other variables such as perceived discrimination, cooperative participation and perceived environmental importance were not statistically significant but were directionally consistent with the notion that improved support mechanisms can enhance both safety and economic outcomes for scavengers.

Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs

The community-leader model recorded $R^2 = 0.2348$ and Adjusted $R^2 = 0.0335$, with an F-statistic of 1.17 ($p = 0.362$), implying an overall insignificant model largely due to small sample size ($n = 25$). Nevertheless, community support for improved working conditions (q19) exhibited a positive but non-significant coefficient ($\beta = 0.219$, $p = 0.143$). This indicates that leaders with longer tenure tend to favor improved welfare and environmental conditions for scavengers, although the effect is not statistically conclusive. For government organizations, the model explained 23.6 percent of the variation ($R^2 = 0.2357$, Adj $R^2 = 0.0695$) and was not statistically significant ($F(5, 23) = 1.42$, $p = 0.255$). The most notable predictor was policy framework development (q20), which displayed a positive though non-significant coefficient ($\beta = 0.654$, $p = 0.120$). This suggests a recognition among government officials of the need for comprehensive policy support for the scavenging sector, even though such frameworks are not yet effectively institutionalized.

The NGO model produced the highest explanatory power ($R^2 = 0.7638$; Adj $R^2 = 0.4686$), though with a small sample ($n = 10$) and an overall $F = 2.59$ ($p = 0.189$). One variable—public awareness campaigns that promote scavenger recognition (q19)—was statistically significant ($\beta = 0.9225$, $p = 0.049$). This result demonstrates that NGOs perceive awareness and advocacy initiatives as a key determinant of societal acceptance and inclusion of scavengers in local waste-management systems.

5.0 CONCLUSION AND RECOMMENDATION

Taken together, the regression analyses across the four respondent groups—scavengers, community leaders, government officials and NGO representatives reveal a coherent but uneven pattern in the economic and environmental

contributions of scavenging activities in Northeastern Nigeria. While scavenging is widely recognized as beneficial to recycling, waste reduction, and environmental sustainability, its economic potential remains under-realized owing to weak institutional linkages, fragmented policies, and limited programmatic support. The absence of significant predictors among scavengers and government officials highlights a systemic disconnect between policy intent, public perception, and measurable economic outcomes.

Empirical evidence from the models indicates that experiential exposure consistently enhances awareness and recognition of scavenging's environmental value, particularly in pollution prevention and landfill reduction, even though statistical significance varies. Scavengers themselves demonstrate the strongest evidence of this relationship, reflecting their direct involvement in waste recovery and environmental protection. In contrast, the perceptions of community, government, and NGO respondents, though generally positive, are weaker—largely constrained by inadequate data representation, limited sample sizes, and low explanatory power.

Overall, the findings demonstrate that government support programs remain limited in scope, weakly perceived, and unevenly implemented across stakeholder groups. While scavengers highlight operational constraints such as inadequate infrastructure and insufficient training, institutional actors emphasize the absence of coherent policy frameworks and welfare mechanisms, and NGOs stress the need for broader advocacy, recognition, and social inclusion. Collectively, these findings underscore the multifaceted yet unevenly supported nature of scavenging in Northeastern Nigeria—an activity that simultaneously sustains livelihoods, promotes environmental management, and exposes institutional weaknesses in policy

coordination. Strengthening institutional frameworks, expanding training and infrastructural support, and formalizing scavenging operations are therefore essential to harness its full potential for sustainable economic and environmental development in the region.

To optimize the socioeconomic and environmental potential of scavenging activities in Northeastern Nigeria, a multifaceted policy framework is essential. First, government agencies should formalize scavenging operations by recognizing scavengers through registration, cooperative formation, and inclusion in municipal waste-management plans. This should be supported by safe and well-equipped sorting centers, providing protective gear, sanitation facilities, and weighing tools to enhance productivity and occupational safety. Secondly, capacity-building programs including certified training on waste handling, recycling techniques, business management, and environmental awareness should be expanded. Such interventions will professionalize scavenging, improve income levels, and reduce exposure to hazards. Alongside, market-access support must be strengthened by linking scavengers to formal recycling chains and ensuring fair compensation for recovered materials. Thirdly, policy formulation and inter-agency coordination are crucial. A National Scavenger Policy should define operational standards, welfare mechanisms, and collaborative frameworks between ministries and NGOs. NGOs and community leaders should act as change agents in awareness creation, behavior change, and data-driven monitoring, ensuring transparency and accountability. Finally, integrated government NGO community partnerships are needed to harmonize interventions, institutionalize data collection, and sustain impact. Collectively, these measures will transform scavenging from a marginalized activity into a structured, dignified, and sustainable livelihood that advances

Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs

Nigeria's circular-economy and environmental-resilience goals.

5.1 Suggestion for Future Research

Future studies should adopt longitudinal and mixed-method approaches to evaluate the long-term socioeconomic and ecological impacts of scavenger formalization and assess gender-specific and health-related dimensions within informal waste economies.

References

- Abbasi, A., & Shad, M. (2021). Sensitive proportion in ranked set sampling. *PLoS ONE*, 16 (8). <https://doi.org/10.1371/journal.pone.0256699>
- Aguilera-Alcalá, N., Morales-Reyes, Z., Martín-López, B., Moléon, M., & Sánchez-Zapata, J. (2020). Role of scavengers in providing non-material contributions to people. *Ecological Indicators*, 117, 106643. <https://doi.org/10.1016/j.ecolind.2020.106643>
- Aldashev, G. & Vallino, E. (2019). The dilemma of NGOs and participatory conservation. *World Development*, 123, 104615. <https://doi:10.1016/j.worlddev.2019.104615>.
- Al-Khatib, I., Al-Sari', M., & Kontogianni, S. (2020a). Scavengers' contribution in solid waste management sector in Gaza Strip, Palestine. *Environmental Monitoring and Assessment*, 192, 1-13. <https://doi.org/10.1007/s10661-020-08341-y>
- Al-Khatib, I., Al-Sari', M., & Kontogianni, S. (2020b). Assessment of Occupational Health and Safety among Scavengers in Gaza Strip, Palestine. *Journal of Environmental and Public Health*, 2020, 1-9. <https://doi.org/10.1155/2020/3780431>

- Berndt, A. (2020). Sampling Methods. *Journal of Human Lactation*, 36, 224 - 226. <https://doi.org/10.1177/0890334420906850>
- Branham, J., Onda, K., Kaza, N., BenDor, T., & Salvesen, D. (2021). How does the removal of federal subsidies affect investment in coastal protection infrastructure? *Land Use Policy*, 102, 105245. <https://doi.org/10.1016/J.LANDUSEPOL.2020.105245>
- Bonnet, F., & Venkatesh, S. (2016). Poverty and Informal Economies, 637-659. <https://doi.org/10.1093/OXFORDHB/9780199914050.013.29>
- Diyani, L. A., Widiawati, K., & Muis, I. (2022). Assistance in using the marketplace platform for scavenger groups. *Abdimas: Jurnal Pengabdian Masyarakat Universitas Merdeka Malang*, 7(3), 471-486. <https://doi.org/10.26905/abdimas.v7i3.7155>
- Dowding, K., & Taylor, B. (2019). Markets, Market Failure and the Role of Government. *Foundations of Government and Public Administration*, 17-45. https://doi.org/10.1007/978-3-030-19707-0_2
- Erude, S., Onavwie, F., & Okereka, O. (2023). The role of the informal sector in unemployment reduction in Nigeria. *Journal of Public Administration, Finance and Law*, 28, 95-107. <https://doi.org/10.47743/jopaf-2023-28-09>
- Fidelis, R., Guerreiro, E. D. R., Horst, D. J., Ramos, G. M., De-Oliveira, B. R. & Junior, P. P. D. (2023). Municipal solid waste management with recyclable potential in developing countries: Current scenario and future perspectives. *Waste Management Research*, 41 (9), 1-21. <https://doi:10.1177/0734242X231160084>
- Fidelis, R., Marco-Ferreira, A., Antunes, L., & Komatsu, A. (2020). Socio-productive inclusion of scavengers in municipal solid waste management in Brazil: Practices, paradigms and future prospects. *Resources, Conservation and Recycling*. <https://doi.org/10.1016/j.resconrec.2019.104594>
- Gangaya, E. J. & Mshelia, A. D. (2021). Appraisals of the Socio- Economic Characteristics of Waste scavengers in Mubi Metropolis, Nigeria. *International Journal of Multidisciplinary Research and Analysis*, 4, (1), 95-100. <https://doi.org/10.47191/IJMRA/V4-I1-14>
- Gutberlet, J. (2021). Grassroots waste picker organizations addressing the UN sustainable development goals. *World Development*, 138, 105195. <https://doi.org/10.1016/J.WORLDDEV.2020.105195>
- Harrison, B., Chopra, E., Ryals, R., & Campbell, J. (2020). Quantifying the farmland application of compost to help meet California's organic waste diversion law. *Environmental science & technology*, 54 (7). <https://doi.org/10.1021/acs.est.9b05377>
- Haute, E. (2021). Sampling Techniques. *Research Methods in the Social Sciences: An A-Z of key concepts*. <https://doi.org/10.1093/hepl/9780198850298.003.0057>
- Igwe P. U. and Anaje C. E. (2022). Scavenging as a Means of Environmental Management: A Case Study of Nsugbe Solid Waste Dumpsite, Anambra State, *Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs*

- Nigeria. *International Journal of Environment*, 11 (1), 1-9. <https://doi.org/10.36632/ije/2022.11.1.1>
- Jeswani, H., Krüger, C., Russ, M., Horlacher, M., Antony, F., Hann, S., & Azapagic, A. (2021). Life cycle environmental impacts of chemical recycling via pyrolysis of mixed plastic waste in comparison with mechanical recycling and energy recovery. *The Science of the total environment*, 769, 144483. <https://doi.org/10.1016/j.scitotenv.2020.144483>
- Jung, S., & Feng, T. (2020). Government subsidies for green technology development under uncertainty. *European Journal of Operational Research*, 286, 726-739. <https://doi.org/10.1016/j.ejor.2020.03.047>
- Kabonga, I. (2020). Reflections on the 'Zimbabwean crisis 2000–2008' and the survival strategies: the sustainable livelihoods framework (SLF) analysis. *Africa Review*, 12, 192 - 212. <https://doi.org/10.1080/09744053.2020.1755093>
- Kashim, I., & Kashim, R. (2020). An assessment of environmental awareness of internally displaced people in the north east of Nigeria. *European Journal of Public Health*, <https://doi.org/10.1093/eurpub/ckaa166.113>
- Kodiya, M., Shettima, M., Modu, M., & Yusuf, F. (2023). The Socio-Economic and Environmental Benefits of Waste Scavenging in Maiduguri, Borno State. *International Journal of Science for Global Sustainability*, 9 (1), 150-161. <https://doi.org/10.57233/ijsgs.v9i1.408>
- Lakens, D. (2021). Sample Size Justification. *Collabra: Psychology*, 8
- (1). <https://doi.org/10.31234/osf.io/9d3yf>
- Mapa, M., Jafar, A., George, F., Sakke, N., Dollah, R., Talip, M., & Irawan, L. (2023). Economic and environmental benefit of informal waste scavenging at landfill sites: A case study at Bukit Gemuk, Tawau, Sabah, Malaysia. *Jurnal Pendidikan Geografi: Kajian, Teori, dan Praktek dalam Bidang Pendidikan dan Ilmu Geografi*, 28 (2), 168-177. <https://doi.org/10.17977/um017v28i22023p168-177>
- Mapa, M., Powell, J. C., Asis, A. B., Sakke, N., & Gulasan, A. (2019). Waste Scavenging and Its Contribution for Survival and Urban Recycling in Kota Kinabalu City, Sabah, Malaysia. *Indonesian Journal of Geography*, 51 (2), 183 -189. <https://doi.org/10.22146/IJG.42301>
- Marneweck, C., Katzner, T., & Jachowski, D. (2021). Predicted climate-induced reductions in scavenging in eastern North America. *Global Change Biology*, 27. <https://doi.org/10.1111/gcb.15653>
- Msukwa, G. B. Mweemba, L., & Chipatu, L. (2023). Earning income from waste in low-income Countries: A case of scavengers in Mzuzu city, Malawi. *International Journal of Research Publication and Reviews*, 4 (9), 1316-1319. <https://doi.org/10.55248/gengpi.4.923.92443>
- O'Neill, B. (2022). Sample size determination with a pilot study. *PLoS ONE*, 17 (2). <https://doi.org/10.1371/journal.pone.0262804>
- Ogbu, E., Ojedoyin, O., Bakare, A., Olujimi, V., Aliu, A., & Odunola, B. (2021). Experiences of structural neglect by scavengers and pickers of waste products on work- life balance in South-West, *Economic and Environmental Contributions of Scavenging Activities in North-Eastern Nigeria: The Moderating Effect of Government Support Programs*

- Nigeria. *Tropical Journal of Science and Technology*, 3, 1-14. <https://doi.org/10.47524/tjst.v3i1.2>
- Patrick, N., Stanley, H., & Eyinna, D. (2022). Assessment of the Level of Awareness of Health Hazards and Practices of Waste Scavengers in Enugu State, Nigeria. *Asian Journal of Advanced Research and Reports*, 16, (12), 109-118. <https://doi.org/10.9734/ajarr/2022/v16i12454>
- Reynolds, J., Stautz, K., Pilling, M., Linden, S., & Marteau, T. (2020). Communicating the effectiveness and ineffectiveness of government policies and their impact on public support: a systematic review with meta-analysis. *Royal Society Open Science*, 7. <https://doi.org/10.1098/rsos.190522>
- Sapienza, M., Riccardi, M., Nurchis, M., Pascucci, D., & Damiani, G. (2020). Community Engagement: Reducing inequalities acting on environmental health. A Systematic Review. *European Journal of Public Health*, 30 (5). <https://doi.org/10.1093/eurpub/ckaa165.653>