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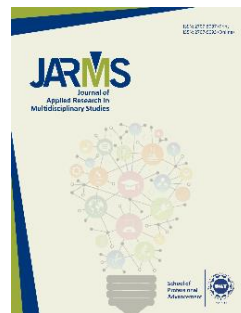|	
Title:	**Effects of Employees' Climate Change Awareness and Comprehension on Waste Management and Pollution Control in Selected Manufacturing Companies**
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DOI:	https://doi.org/10.32350/jarms.52.04
History:	Received: February 10, 2024, Revised: April 25, 2024, Accepted: October 22, 2024, Published: December 30, 2024
Citation:	Azeez, R. (2024). Effects of employees' climate change awareness and comprehension on waste management and pollution control in selected manufacturing companies. *Journal of Applied Research and Multidisciplinary Studies*, *5*(2), 57-77. https://doi.org/10.32350/jarms.52.04
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Conflict of Interest:	Author(s) declared no conflict of interest

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A publication of
School of Professional Advancements
University of Management and Technology, Lahore, Pakistan

Effects of Employees' Climate Change Awareness and Comprehension on Waste Management and Pollution Control in Selected Manufacturing Companies

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Abstract

Climate change poses significant global challenges, particularly in manufacturing sectors, where waste generation and pollution are prevalent. This study examines the impact of climate change awareness and comprehension on waste management practices and pollution control measures among employees in selected manufacturing companies in Lagos State, Nigeria. Using the descriptive research design, 1200 respondents were sampled from a population of 24,000 employees across three major firms in the food and beverages industry. Data were collected via structured questionnaires and analyzed using linear regression. The findings reveal that climate change awareness significantly influences waste management practices ($R^2 = 0.145$, $\beta = 0.381$, $p < 0.05$), accounting for 14.5% of the variance. Similarly, climate change comprehension significantly impacts pollution control effectiveness ($R^2 = 0.250$, $\beta = 0.500$, $p < 0.05$), explaining 25% of the variance. Based on these findings, the study concludes that environmental education is critical to promoting sustainable practices within the manufacturing sector. The study recommends implementing comprehensive awareness programs and continuous training to enhance employees' environmental knowledge and operational proficiency, thereby improving overall environmental performance and compliance with regulatory standards.

Keywords: climate change awareness, climate change comprehension, environmental education, pollution control, waste management

Introduction

Climate change is a significant global challenge that has far-reaching impacts on various sectors, including manufacturing. In this sector, where waste generation and pollution are inherent, understanding the implications

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of climate change is crucial for driving more sustainable practices and innovations (Pachauri & Meyer, 2014). The manufacturing industry is a major contributor to greenhouse gas emissions, resource depletion, and environmental degradation (Caliskan et al., 2022). As climate change exacerbates environmental issues, manufacturers face increasing pressure to adopt greener practices. This includes reducing carbon footprints, optimizing resource use, and implementing waste reduction strategies (Dubey & Bag, 2018). The transition towards sustainable manufacturing not only addresses environmental concerns but also improves operational efficiency and competitiveness in a market that increasingly values sustainability (Machingura et al., 2024). Moreover, regulatory frameworks and consumer demand are rapidly evolving towards greater environmental accountability. Governments worldwide are enacting stricter environmental regulations, while consumers are more inclined to support companies with sustainable practices (Usman et al., 2024). This shift necessitates that manufacturing firms not only comply with new regulations but also proactively engage their employees in sustainable innovation.

It is imperative to note that awareness and comprehension of climate change among employees play a critical role in shaping effective waste management practices and pollution control measures. Awareness of climate change involves recognizing the causes and effects of global warming, including the role of industrial activities in greenhouse gas emissions and environmental degradation. Employees who are aware of these issues are more likely to engage in practices that reduce waste and enhance sustainability (Katz et al., 2022). Studies have shown that increased climate change awareness can lead to better waste management practices, as employees adopt measures to minimize waste generation, promote recycling, and use resources more efficiently (Adjei et al, 2024; Gürçam, 2024; Raab, 2024). In the context of manufacturing companies, this awareness is critical for implementing effective waste management strategies that align with environmental regulations and corporate sustainability goals. Comprehension of climate change goes beyond awareness; it involves a deeper understanding of the mechanisms and impacts of climate change, as well as the effectiveness of various mitigation and adaptation strategies. Employees with a comprehensive understanding of climate change are better equipped to develop and implement effective pollution control measures (Adebisi & Adebisi-Adelani, 2023). They can identify the sources of pollution within manufacturing processes and apply

best practices to reduce emissions and environmental impact (Steg, 2023). This understanding is essential for ensuring that pollution control measures are not only implemented but are also effective in mitigating the adverse effects of industrial activities on the environment.

The importance of these factors is well-documented, yet there remains a significant gap in understanding how these concepts specifically apply to employees in manufacturing companies of developing countries like Nigeria, and the economic hub like Lagos State. Existing literature focused on developed countries or broad organizational strategies, leaving a void in the detailed exploration of the cognitive and behavioural aspects of employees in manufacturing industries in these regions (Tang et al., 2023). However, the specific role of employee awareness and comprehension in shaping these practices within the manufacturing sector in Lagos State remains under-researched. This study aims to fill this gap by assessing how climate change awareness influences waste management practices and examining the effect of climate change comprehension on pollution control measures in selected manufacturing companies in Lagos State.

Literature Review

Awareness of climate change involves recognizing and understanding the causes, impacts, and potential mitigation strategies associated with global climate shifts. This awareness encompasses knowledge about human activities, such as fossil fuel combustion and deforestation, which significantly contribute to greenhouse gas emissions and global warming (Pachauri & Meyer, 2014). Individuals who are aware of these issues are more likely to engage in environmentally friendly behaviours, support sustainable policies, and advocate for actions that mitigate climate change effects. This basic level of awareness is critical in promoting a general public understanding and acceptance of the urgent need for climate action (Leiserowitz, 2006). In the context of the manufacturing sector, employee awareness of climate change can influence organizational practices. Moreover, increasing climate change awareness among employees requires targeted educational programs and consistent communication from management. Training sessions, informational campaigns, and the integration of climate topics into organizational culture can enhance employees' understanding and commitment to sustainability (Moser & Dilling, 2007). Such initiatives not only improve individual knowledge but also encourage a collective sense of responsibility toward environmental

stewardship (Molder et al., 2022). Therefore, raising awareness is a foundational element in driving sustainable industrial practices and achieving long-term environmental goals.

Comprehension of climate change goes beyond mere awareness; it involves a deep understanding of the scientific principles, mechanisms, and implications of climate phenomena. This includes knowledge of how greenhouse gases trap heat in the atmosphere, the feedback loops that exacerbate climate impacts, and the socioeconomic consequences of a changing climate (Stern & Kaufmann, 2000). A comprehensive understanding allows individuals to grasp the complexity of climate issues and the interconnections between various environmental, economic, and social systems. In the manufacturing sector, employees with a thorough comprehension of climate change are better equipped to contribute to effective environmental management strategies. They can identify the specific sources of greenhouse gas emissions within their operations and understand the importance of mitigating these emissions through various means, such as energy efficiency improvements, waste reduction, and the adoption of clean technologies (Dietz et al., 2009).

Waste management practices encompass the systematic administration of waste from its inception to its final disposal. This includes collection, transportation, treatment, and disposal of waste, along with monitoring and regulation to ensure that these processes are conducted in an environmentally responsible manner. Effective waste management aims to reduce the adverse impacts of waste on human health and the environment, promote recycling and resource recovery, and minimize the overall volume of waste generated (U.S. Environmental Protection Agency, 2020). In manufacturing companies, implementing robust waste management practices is crucial due to the significant volumes of industrial waste produced. These practices include the segregation of hazardous and non-hazardous waste, the adoption of recycling programmes, and the use of waste-to-energy technologies. Effective waste management not only helps in compliance with environmental regulations but also reduces costs associated with waste disposal and raw material procurement (Silva et al., 2017). On the other hand, pollution control measures refer to the strategies and technologies used to reduce or eliminate the emission of pollutants into the environment (Dube, 2023). These measures are essential for protecting air, water, and soil quality, and they play a critical role in mitigating the

environmental impacts of industrial activities. Common pollution control technologies include scrubbers, filters, and catalytic converters for air emissions; treatment plants for wastewater; and containment systems for hazardous waste (Sowjanya & Gayatri, 2024). In the manufacturing sector, effective pollution control measures are integral to maintaining compliance with environmental regulations and safeguarding public health. These measures help prevent the release of harmful substances, such as volatile organic compounds, heavy metals, and particulate matter, which can have severe health and environmental consequences.

Theoretical Review

The Theory of Planned Behaviour (TPB), proposed by Ajzen (1985) provides a comprehensive framework for understanding how individuals' intentions to perform certain behaviours are influenced by their attitudes, subjective norms, and perceived behavioural control. In the context of climate change awareness and comprehension, TPB explains how these cognitive factors shape employees' intentions and behaviours toward environmental sustainability. Awareness of climate change involves recognizing its causes and impacts, which fosters positive attitudes toward sustainable practices such as waste management and pollution control. Employees who are aware of the environmental consequences of their actions are more likely to support and engage in behaviours that mitigate negative impacts, aligning with the principles of TPB that emphasize the role of informed attitudes in shaping intentions (Ajzen, 1991).

Comprehension of climate change, which goes beyond basic awareness to a deeper understanding of climate mechanisms and impacts, further enhances employees' capacity to implement effective environmental practices. This comprehensive understanding strengthens perceived behavioural control, a core component of TPB, as employees feel more capable and confident in their ability to adopt and sustain waste management and pollution control measures. For example, employees with a thorough grasp of climate science are better equipped to identify pollution sources and apply best practices to reduce emissions, reinforcing the TPB concept that perceived ease or difficulty of performing a behaviour significantly influences intention and action (Dietz et al., 2009). The application of TPB to environmental practices in manufacturing companies highlights the importance of promoting both awareness and comprehension of climate change among employees. Through the reinforcement of positive

attitudes and enhancement of perceived behavioural control, these cognitive factors contribute to the successful adoption of waste management and pollution control measures. Also, subjective norms within the organization, such as a culture that values and prioritizes environmental sustainability, can enhance employees' commitment to these practices (Harris & Crane, 2002).

Empirical Review and Hypotheses Development

Research indicates that awareness of climate change significantly influences waste management practices within various sectors, including manufacturing. Leiserowitz (2006) found that individuals with a higher awareness of climate change are more likely to engage in behaviours that reduce waste and promote sustainability. This awareness often translates into practical actions, such as increased recycling, better resource utilization, and reduced waste generation, as employees understand the environmental impact of their actions. In the context of manufacturing companies, Kollmuss and Agyeman (2002) noted that awareness programs that educate employees about the environmental consequences of waste can lead to substantial improvements in waste management practices. These programs can help employees recognize the importance of reducing waste and encourage them to adopt more sustainable behaviours. For example, manufacturing plants that implemented awareness campaigns saw a significant reduction in waste production and an increase in recycling rates.

Extant studies also highlighted the role of organizational culture in reinforcing the link between climate change awareness and waste management. Companies that prioritize environmental sustainability and promote a culture of awareness tend to have more effective waste management systems. This is supported by the work of Karatepe et al. (2022), who argued that organizational commitment to environmental education enhances employees' understanding and promotes proactive waste management behaviours. Moreover, the integration of climate change awareness into corporate training programs has been shown to improve waste management practices. According to a study by Debrah et al. (2021) companies that provide regular training on environmental issues, including climate change, report better waste management outcomes. Employees who are regularly informed about the environmental impacts of their actions are more likely to engage in waste reduction and recycling activities. Based on the foregoing, we hypothesized that:

H₁: Employees' awareness of climate change influences waste management practices in selected manufacturing companies in Lagos State.

Comprehension of climate change, which involves a deeper understanding of its mechanisms and impacts, significantly affects the effectiveness of pollution control measures. Employees with a thorough comprehension of climate change are better equipped to implement and maintain effective pollution control strategies. Stern and Kaufmann (2000) emphasized that a comprehensive understanding of environmental science enables employees to identify pollution sources accurately and apply appropriate mitigation techniques. Also, employees' comprehension of climate change correlates with the successful implementation of advanced pollution control technologies (Asghar et al., 2021; Akasha et al., 2023; Tang, 2023). For instance, Dietz et al. (2009) found that individuals who understand the scientific principles behind climate change are more proficient in operating and maintaining pollution control equipment. This proficiency reduces emissions and improves overall environmental performance in manufacturing settings. Empirical research also indicates that ongoing education and training are critical for enhancing employees' comprehension of climate change. Lambrechts et al. (2013) highlighted that continuous learning opportunities, such as workshops and seminars on climate science, significantly improve people's ability to manage pollution effectively. These educational initiatives help employees stay updated on the latest pollution control technologies and best practices. Moreover, the role of management in promoting a deeper comprehension of climate change cannot be overstated. Harris and Crane (2002) found that managerial support for environmental education and comprehension greatly influences the effectiveness of pollution control measures. Managers who prioritize and invest in their employees' environmental education create a knowledgeable workforce capable of implementing effective pollution control strategies. As noted by Ali et al. (2023), companies that embed environmental science comprehension into their standard operating procedures and decision-making processes report more successful pollution control outcomes. This integration ensures that all employees, regardless of their role, contribute to the organization's overall environmental goals. Based on this line of thoughts, we hypothesized that:

H_2: *Employees' comprehension of climate change will have a significant influence on the effectiveness of pollution control measures in selected manufacturing companies in Lagos State.*

Research Methodology

This study adopts a descriptive research design to assess how employees' awareness and comprehension of climate change influence waste management practices and the effectiveness of pollution control measures in the manufacturing sector in Lagos State, specifically within the food and beverage industry. This design is well-suited for providing a detailed description of the environmental practices within the selected manufacturing firms and exploring the relationships between employees' climate change knowledge and their environmental management behaviours. The population for this study consists of employees from three large multinational and quoted manufacturing firms in Lagos State, Nigeria. These firms are Cadbury Nigeria Plc, Guinness Nigeria Plc, and Flour Mills of Nigeria Plc. These companies were selected due to their significant presence in the food and beverage industry and their established environmental management practices. The population of the three companies combined is about 24,000 according to their websites and 2023 annual reports. Using Raosoft online sample size calculator, 1200 research subjects were selected as sample size and 400 respondents were drawn from each of the companies using the convenience sampling technique.

For data collection, a structured questionnaire was used through the development of questions from existing research works. To measure, awareness of climate change by employees, an 8-item scale was developed based on the work of Lorenzoni et al. (2007), a 5-item scale was developed based on the work of Bodzin (2008) to measure comprehension of climate change, a 5-item scale was developed to measure waste management practices based on the work of Miliute-Plepiene et al. (2016), and a 5-item scale was developed to measure the effectiveness of pollution control measures based on the work of Henri and Journeault (2010). All these scales were measured using the five-point Likert scale from *strongly disagree* (1) to *strongly agree* (5). In this study, all 4 scales were found to have acceptable internal consistency with the Cronbach Alpha (α) ranging from 0.78 to 0.83. Data collection was carried out for five weeks with the aid of trained research assistants. At the end of the data collection, 936 returned copies of the questionnaire were accessed for completion and 13 copies

were dropped because they were not filled properly. In all, 923 copies of the research instrument were found fit and used for final analysis. The data were analyzed using descriptive and inferential statistics with the aid of the Statistical Package for the Social Sciences (SPSS) version 27. Descriptive statistics were used to summarize the demographic characteristics of the participants and linear regression was used to test the stated hypotheses. This LASU Research Ethics Policy (2020) guided this study by guaranteeing participants' rights, upholding research integrity, and maintaining confidentiality.

Results and Discussion

Table 1

Analysis of Demographic Variables

Variable	Category	Frequency (%)
Gender	Male	827 (89.6%)
	Female	96 (10.4%)
Age	20-30	267 (28.9%)
	31-40	419 (45.4%)
	41-50	138 (15.0%)
	51-60	99 (10.7%)
Marital Status	Single	151 (16.4%)
	Married	657 (71.2%)
	Separated	92 (10.0%)
	Widowed	23 (2.5%)
Educational Qualification	SSCE/NABTEB/TRADE TEST	86 (9.3%)
	NCE	184 (19.9%)
	BSc/B.Ed	462 (50.1%)
	Master's Degree	191 (20.7%)
Years of Experience	0-5	183 (19.8%)
	6-10	278 (30.1%)
	11-15	275 (29.8%)
	16-20	151 (16.4%)
	21 and above	34 (3.7%)
Department	Production/Operations	677 (73.3%)
	Commercial Function	99 (10.7%)
	Supply Chain & Transportation	138 (15.0%)
	Legal	9 (1.0%)

Table 1 presents the demographic data of the respondents, providing significant insights into the workforce composition. The gender distribution reveals a significant disparity, with 89.6% of the participants being male and only 10.4% female. This indicates a male-dominated workforce, which may influence the perspectives and engagement levels regarding environmental issues within the companies. The age distribution of the employees is relatively balanced, with a substantial portion falling within the 31-40 age bracket (45.4%), followed by those aged 20-30 (28.9%), and a smaller representation of older employees, particularly those above 60. This suggests a workforce that is largely young to middle-aged, potentially more adaptable and open to new environmental practices, given their likely exposure to modern education and media on climate change. Regarding marital status, data shows that the majority of the employees are married (71.2%), followed by single (16.4%), separated (10.0%), and widowed (2.5%). This demographic aspect could impact their environmental awareness and practices, as family responsibilities might influence their attitudes towards sustainability and waste management practices both at home and in the workplace.

The educational qualifications of the employees reveal that a significant majority hold higher education degrees, with 50.1% having a BSc/B.Ed and 20.7% holding M.Ed./MSc. degrees. This high level of education suggests that the workforce is well-informed and potentially more capable of understanding and implementing effective waste management and pollution control measures. The presence of a highly educated workforce is crucial for driving environmental initiatives within organizations. The years of experience within the company show a diverse range, with the largest groups being those with 6-10 years (30.1%) and 11-15 years (29.8%) of experience. This mix of relatively seasoned employees indicates a stable workforce with substantial experience and knowledge about the company's operations, which can be advantageous when introducing and sustaining environmental initiatives. However, the relatively small percentage (3.7%) with over 21 years of experience suggests limited representation from highly experienced veterans who might possess deeper institutional knowledge. Lastly, the departmental distribution indicates that a vast majority of the workforce is engaged in production/operations (73.3%), with smaller representations in commercial functions (10.7%), supply chain and transportation (15.0%), and legal (1.0%). The dominance of the production/operations department highlights the critical area where waste

management and pollution control efforts need to be focused, as this is likely where most environmental impacts originate.

Test of Hypotheses

To test the stated hypotheses, the results of the preliminary diagnostic analysis of the skewness and kurtosis for the variables indicate that the data distributions are approximately symmetrical and normal. The skewness values for climate change awareness (0.20), comprehension of climate change (0.10), waste management (0.15), and pollution control (0.25) are close to zero, suggesting minimal asymmetry in the data. The kurtosis values for climate change awareness (0.3), comprehension of climate change (0.4), waste management (0.2), and pollution control (0.5) are within the acceptable range of 0 to 1, indicating that the data do not exhibit extreme deviations in terms of peakedness or tails. Furthermore, the VIF values for climate change awareness (1.5), comprehension of climate change (2.0), waste management (3.5), and pollution control (1.7) are all below the threshold of 10, confirming that multicollinearity is not a significant issue among the predictor variables, ensuring their independence. These statistical measures collectively validate the appropriateness of using linear regression to analyze the stated hypotheses.

H_1: Employees' awareness of climate change influences waste management practices in selected manufacturing companies in Lagos State.

Table 2

Model Summary of Regression Analysis

R	R^2	Adjusted R^2	SE	Durbin-Watson
.381[a]	.145	.144	1.01667	1.949

Table 3

ANOVA of Regression Analysis

	Sum of Squares	df	Mean Square	F	Sig.
Regression	161.336	1	161.336		
Residual	953.005	922	1.034	156.087	.000
Total	1114.341	923			

Table 4

Coefficients of Regression Analysis

	B	SE	β	t	p
(Constant)	2.424	.108		22.482	.000
Awareness of Climate Change	.363	.029	.381	12.493	.000

The linear regression analysis presented in Tables 2, 3, and 4 evaluates the influence of employees' awareness of climate change on waste management practices in selected manufacturing companies in Lagos State. The R^2 value of 0.145 suggests that 14.5% of the variance in waste management practices can be explained by employees' awareness of climate change. The Durbin-Watson statistic of 1.949 is close to 2, indicating that there is no significant autocorrelation in the residuals, which means the model's predictions are reliable over time. The ANOVA table (Table 3) provides further insights into the regression model's statistical significance. The *F*-value of 156.087, with a significance level (Sig.) of 0.000, indicates that the model is statistically significant. This implies that the interplay between employees' awareness of climate change and waste management practices is unlikely to be due to chance. The large *F*-value relative to the critical value suggests that the model provides a good fit for the data, reinforcing the idea that awareness of climate change plays a meaningful role in influencing waste management practices in these companies. Table 4 details the coefficients of the regression model. The unstandardized coefficient (β) for the constant is 2.424, indicating the expected value of waste management practices when awareness of climate change is zero. The unstandardized coefficient for awareness of climate change is 0.363, meaning that for each unit increase in awareness, waste management practices improve by 0.363 units. The standardized coefficient (Beta) of 0.381 further emphasizes the moderate strength of this relationship. The *t*-values for both the constant (22.482) and the awareness of climate change (12.493) are highly significant ($p < 0.05$). Therefore, the stated alternate hypothesis is accepted.

The results are supported by existing literature. The moderate positive influence and the significant *F*-value (156.087) suggest that increased climate change awareness among employees leads to better waste management practices. This is consistent with Leiserowitz (2006) who found that individuals with higher climate change awareness are more likely to engage in behaviours that reduce waste and promote sustainability. These

behaviours include increased recycling, better resource utilization, and reduced waste generation, demonstrating the practical actions employees take when they understand the environmental impact of their actions. Furthermore, the study by Kollmuss and Agyeman (2002) supports the findings by highlighting the effectiveness of awareness programs in improving waste management practices. When employees are educated about the environmental consequences of waste, they are more likely to adopt sustainable behaviours. Manufacturing plants that have implemented such awareness campaigns have seen substantial improvements in waste production reduction and recycling rates. This aligns with the positive influence of climate change awareness on waste management practices observed in the regression analysis, indicating that educational initiatives are crucial for promoting sustainable practices in manufacturing firms.

The role of organizational culture in reinforcing the link between climate change awareness and waste management is also emphasized in the findings. Karatepe et al. (2022) argued that companies prioritizing environmental sustainability and promoting a culture of awareness tend to have more effective waste management systems. This is reflected in the current study, where climate change awareness significantly affects waste management practices, thereby highlighting the importance of a supportive organizational culture. When companies commit to environmental education, they enhance employees' understanding and promote proactive waste management behaviours, leading to improved environmental performance. Finally, Debrah et al. (2021) highlighted the benefits of integrating climate change awareness into corporate training programs. Companies that provide regular training on environmental issues report better waste management outcomes. The tested hypothesis aligns with this, as the significant t-values for awareness of climate change (12.493) suggest that informed employees are more likely to engage in waste reduction and recycling activities.

H_2: Employees' comprehension of climate change will have a significant influence on the effectiveness of pollution control measures in selected manufacturing companies in Lagos State.

Table 5
Model Summary of Regression Analysis

R	R^2	Adjusted R^2	SE	Durbin-Watson
.500[a]	.250	.249	1.02190	1.763

Table 6

ANOVA of Regression Analysis

	Sum of Squares	*df*	Mean Square	*F*	*p*
Regression	320.569	1	320.569	306.978	.000
Residual	962.821	922	1.044		
Total	1283.390	923			

Table 7

Coefficients of Regression Analysis

	B	*SE*	*β*	*t*	*p*
(Constant)	1.736	.110		15.735	.000
Comprehension of Climate Change	.512	.029	.500	17.521	.000

The regression analysis presented in Tables 5, 6, and 7 evaluates the influence of employees' comprehension of climate change on the effectiveness of pollution control measures in selected manufacturing companies in Lagos State. The model summary in Table 5 brings to the fore R^2 value of 0.250 suggesting that approximately 25% of the variance in pollution control effectiveness can be explained by employees' comprehension of climate change. The Durbin-Watson statistic of 1.763, which is close to 2, suggests that there is no significant autocorrelation in the residuals, ensuring the reliability of the model's predictions over time. Equally, the ANOVA table (Table 6) provides further insight into the regression model's statistical significance. The F-value of 306.978, with a significance level (Sig.) of 0.000, indicates that the model is statistically significant. This means that the interplay between employees' comprehension of climate change and the effectiveness of pollution control measures is highly unlikely to be due to chance. The large F-value relative to the critical value reinforces the conclusion that the model provides a good fit for the data, indicating a meaningful effect of climate change comprehension on pollution control effectiveness. Also, Table 7 details the coefficients of the regression model. The unstandardized coefficient (β) for the constant is 1.736, which represents the expected value of pollution control effectiveness when comprehension of climate change is zero. The unstandardized coefficient for comprehension of climate change is 0.512, indicating that for each unit increase in comprehension, pollution control effectiveness increases by 0.512 units. The standardized coefficient (Beta) of 0.500 further emphasizes the moderate to strong strength of this

relationship. The *t*-values for both the constant (15.735) and the comprehension of climate change (17.521) are highly significant ($p < 0.05$). Thus, the stated alternate hypothesis is accepted.

The findings of the study are well-supported by extant literature. Research by Asghar et al. (2021), Tang (2023), and Akasha et al. (2023) further corroborate these results, demonstrating that employees' comprehension of climate change correlates with the successful implementation of advanced pollution control technologies. Individuals who understand the scientific principles behind climate change are more proficient in operating and maintaining pollution control equipment, which reduces emissions and improves overall environmental performance. Also, ongoing education and training are critical for enhancing employees' comprehension of climate change, as highlighted by Lambrechts et al. (2013). Continuous learning opportunities, such as workshops and seminars on climate science, significantly improve employees' ability to manage pollution effectively. The findings align with this perspective, suggesting that companies should invest in comprehensive training programs to keep employees updated on the latest pollution control technologies and best practices. This approach not only enhances employees' proficiency but also ensures the sustained effectiveness of pollution control measures. The role of management in promoting a deeper comprehension of climate change is also crucial. Harris and Crane (2002) found that managerial support for environmental education significantly influences the effectiveness of pollution control measures. Managers who prioritize and invest in their employees' environmental education create a knowledgeable workforce capable of implementing effective pollution control strategies. This is consistent with the current study, which indicates that integrating environmental science comprehension into standard operating procedures and decision-making processes leads to more successful pollution control outcomes. Companies that embed this understanding into their organizational culture, as noted by Ali et al. (2023), report better environmental performance, reinforcing the importance of comprehensive climate change education across all levels of the organization.

Conclusion and Recommendations

The results of the regression analyses confirm that employees' awareness and comprehension of climate change significantly influence waste management practices and the effectiveness of pollution control

measures in selected manufacturing companies in Lagos State. The analysis demonstrates that 14.5% of the variance in waste management practices can be explained by employees' awareness of climate change, while 25% of the variance in pollution control effectiveness is attributed to employees' comprehension of climate change. These findings emphasize the importance of educating employees about climate change to enhance their ability to implement sustainable waste management and pollution control practices. Furthermore, the statistical significance of the models and the positive influence observed indicate that promoting a deeper understanding of climate change among employees can lead to meaningful improvements in environmental performance. This is consistent with existing literature, which highlights the role of environmental education and organizational culture in promoting sustainable behaviours.

Based on these findings, this study recommends that to improve waste management practices, manufacturing companies should implement robust climate change awareness programs. These programs should focus on educating employees about the environmental impacts of waste and the benefits of sustainable practices. Regular training sessions, workshops, and seminars can be effective in enhancing employees' understanding and encouraging them to adopt waste reduction and recycling behaviours. Additionally, manufacturing companies should create incentive structures that reward employees for engaging in sustainable waste management practices, further motivating them to contribute to environmental goals. On the other hand, to enhance the effectiveness of pollution control measures, it is recommended that companies invest in continuous education and training programs focused on climate change and environmental science. This should include hands-on training with advanced pollution control technologies and techniques, ensuring that employees are proficient in operating and maintaining equipment that reduces emissions. Managers should prioritize environmental education and support initiatives that promote a deeper comprehension of climate change.

As suggestions for further studies, future research could explore the long-term impacts of climate change education programs on waste management and pollution control outcomes in various industries and regions. Longitudinal studies would provide insights into how sustained educational efforts influence environmental performance over time. Additionally, examining the specific components of successful training

programs and organizational practices that enhance climate change comprehension and its practical application could offer valuable guidance for developing more effective environmental education strategies.

Conflict of Interest

Data Availability Statement

The data associated with this study will be provided by the corresponding author upon request.

Funding Details

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