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Mediating Roles of Environmental Factor in the Relationship between Solid Waste Management on Sustainable Development

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Abstract

Solid Waste Management holds immense importance for a country's growth and development, encompassing environmental concerns such as pollution control, social development, tourism, property value, and disease control, all of which directly and indirectly impact the economy. Developing countries, including Pakistan, grapple with substantial obstacles in effectively managing solid waste, as indicated by its incorporation as the 6th Sustainable Development Goal. This research seeks to investigate how solid waste management influences sustainable development, with particular emphasis on the mediating impact of environmental factor. To acquire relevant data, the researcher employed a cross-sectional survey approach, collecting primary data from municipal sector employees associated with seven Water & Sanitation Services Companies (WSSCs) in Khyber Pakhtunkhwa (KP), Pakistan. Results revealed that there is positive significant relationship between solid waste management, environmental factor and sustainable development. Furthermore, the mediating role of environmental factor partially influences the relationship between the study's predictors and predicted variables. Solid waste management plays a crucial role in achieving sustainable development by addressing environmental, social, and economic challenges associated with waste generation and disposal. Based on the findings of current study, it is recommended by the researcher that Strengthen Environmental Factor, Promote Digitalization in Waste Management, Integrated Approach, Capacity Building and Training, Public Awareness and Education, Collaboration and Partnerships, Continuous Monitoring and Evaluation, So by implementing these recommendations it is expected that solid waste management practices can be enhanced through the integration of environmental factor and digitalization, leading to more sustainable development outcomes.

***Keywords**: Solid Waste Management, Sustainable Development, Environmental Factor, Water & Sanitation Services Companies (WSSCs)*

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Introduction

Solid Waste management (SWM) is the most difficult challenge confronting modern developing economies, particularly in third-world countries (Momodu, Dimuna Ko & Dimuna Je, 2011). By 2050 globally due to urbanization, it is predicted that more than 6 billion peoples would live in cities (Ritchie and Roser, 2018). Iqbal, Naz & Naseem (2021) stated that waste generation and its management have become significant concerns in the modern world. Rapid urbanization and the conversion of rural land into housing societies generate a substantial amount of waste in a short period of time in any region. Increased waste is a topic of controversy in both rich and developing countries, and it may become the world's greatest problem in the near future as population growth continues. It is also said by Sharma, Bhardwaj, & Kaushik (2021) that in 2050, 3.40 billion metric tons of waste will only come from cities and towns. Rapid urbanization and industrialization have made waste management a prioritized issue in many countries throughout the world (Li, Lee and Lau 2023). The 2030 Agenda for Sustainable Development was first time introduced by the United Nations (UN) in the year 2015 (Cf,2015), which outlined 17 goals for global improvement in sustainable development that all countries might work towards.

Lee, He, & Yuan (2023) further stated that assuring sustainable consumption and recycling practices is one of the development goals, which high lights the significance and emphasis on waste reduction and in this regard Local governments and companies in various nations are encouraged to engage in sustainable practices such as prevention, reduction, recycling, and reuse. In this development strategy, ecologically sound technologies and management are identified as valuable tools for minimizing pollution and also can play a vital role in minimization of other negative effects of waste, generated by human activities. Due to non-implementation of practical concepts of municipal waste management, proper disposal of waste is becoming a growing problem in cities around the world, which not only adversely affecting the environment and general living conditions of the region but also creating obstacles in provision of better health to general public (Shala et all,. 2020) .

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Rapid and vast production of waste occurs because of non-adoption of sustainable waste management practices by the households and it's mainly due to lack of awareness and civic sense (Das, Kumar & Bhattacharya 2019). Solid waste management plays a crucial role in sustainable development, as it directly affects environmental, social, and economic aspects on a global scale. The improper disposal of waste can have significant negative impacts on the environment, public health, and overall quality of life for communities. However, by effectively managing solid waste, with the mediating role of environmental factors and digitalization, sustainable development can be achieved (Gupta, 2022). Solid waste management has a profound impact on sustainable development globally. By considering the mediating role of environmental factors countries can adopt innovative and efficient waste management practices. Sustainable waste management not only protects the environment but also enhances social well-being and fosters economic growth, contributing to a more sustainable and resilient future for all (Caponi, 2022). The current research study examined many components of Solid Waste Management (SWM) in Khyber Pakhtunkhwa, Pakistan particularly keeping in view the seven public sector companies of Khyber Pakhtunkhwa at seven divisional headquarters known as WSSCs (Seven Water and Sanitation Services Companies), the current study investigates the impact of Solid Waste Management on Sustainable Development with mediating role of Environmental factor and Digitalization.

Objectives of Study

i. To check the relationship between solid waste management, environmental factors and sustainable development.
ii. To explore the impact of solid waste management on sustainable development.
iii. To check the mediating role of environmental factor between solid waste management and sustainable development.

Literature Review

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Solid Waste Management

The term "solid waste" refers to undesirable or worthless materials resulting from human operations. Although it is typically found in solid form, it may also exist in liquid form as sludge (Christensen, 2011). There is a global trend towards increasing the production of solid waste. The yearly generation of solid waste is projected to increase to 2.59 billion metric tonnes by 2030 and continue to rise to 3.50 billion metric tonnes by 2050 (Kaza et al,. 2018). Solid waste management (SWM) is the process of dealing with waste or objects that have the potential to become waste (Christensen, 2011). As per (Ziraba et al,. 2016) the entire procedure, from collecting to processing to transportation to disposal, is reminiscent of the product life cycle. Contamination of oceans, the spread of illness, and the danger of respiratory issues as a result of incorrect waste treatment are just a few of the negative outcomes that can occur from ineffective SWM. Solid waste management (SWM) became the most important public service that local governments had to offer. Solid waste management services were mostly regarded for municipal solid waste (MSW) at the time; thus, MSWM was a popular word with various definitions around the world. According to Hester and Harrison (2002), the concept of municipal solid waste might encompass some or all residential wastes, including hazardous wastes, bulky wastes, street sweepings and debris, park and garden wastes, and institutional, commercial, and office wastes.

Solid waste management is a crucial component of sustainable development as it entails control of waste in order to reduce negative effects. It causes to the environment in a manner that preserves natural resources and minimizes negative human impacts (Sharma et al, 2021). Solid waste management comprises several elements i.e. collection and processing, landfill diversion, transportation, reclamation and reusing (Das et al. 2019). Solid waste management has a direct impact on the environment as it generates huge volumes of greenhouse gasses which cause climatic variations. These gases absorb heat and thus bring changes in temperature (Ikhlayel & Nguyen 2017).

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Sustainable Development

Globally, sustainable development is a major problem for several governments and organizations (Caiado et al. 2018). The management of solid waste is one of the greatest obstacles to achieving sustainable development objectives (Pujara et al,. 2019). Improper waste disposal causes environmental contamination, health risks, and resource depletion. It also impacts economic growth and social welfare (Ahirwar & Tripathi, 2021). Therefore, it is crucial to investigate the effect of solid waste management on sustainable development, with environmental factor and digitalization serving as mediators (Fawehinmi et al. 2022).

Linkage of Solid Waste Management and Sustainable Development

Solid waste management plays a crucial role in sustainable development. Proper management of solid waste not only helps in protecting the environment but also contributes to the economic and social well-being of a community (Tong et al,. 2021). Solid waste management is closely linked to sustainable development (Hannan et al,. 2020). It plays a crucial role in protecting the environment, promoting economic growth, and improving the quality of life of people living in a community. Proper waste management practices can contribute to the achievement of the Sustainable Development Goals (SDGs) (Elsheekh et al. 2021).

Solid waste management plays a crucial role in promoting sustainable development, as it can have significant impacts on the environment, economy, and social well-being. The one of the most important impact of solid waste management on sustainable development is known as environmental impact. Proper solid waste management can reduce environmental pollution, protect natural resources, and minimize the impacts of climate change. On the other hand, poor solid waste management can lead to soil, air, and water pollution, harm wildlife, and contribute to climate change. Another most important impact of solid waste management on sustainable development is known as Economic impact. Solid waste management can have a significant impact on the economy, both in terms of costs and benefits. Effective solid waste management can reduce costs associated with waste disposal and improve

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resource efficiency, while also creating jobs and supporting the development of recycling and waste management industries.

H1: There is positive significant relationship between solid waste management, sustainable development and environmental factors

H2: Solid Waste management significantly influence sustainable development.

Environmental Factor

The increasing population in cities is presenting a daunting challenge for governments worldwide with respect to managing waste. The copious production of waste has adversely affected the health of our environment. (Pervin et al., 2020). Improper disposal and combustion of waste result in the release of harmful chemicals, including dioxins that pose a threat to both human health and the environment. This results in contamination, such as air pollution, and can lead to significant negative consequences. (Akmal et al., 2021). Environmental factor plays a significant role in the management of solid waste. Effective solid waste management not only helps in controlling the spread of disease and reducing environmental pollution, but also conserves valuable resources, saves energy, and protects the ecosystem. According to Demirbas (2011), maintaining a safe environment is the primary goal of waste management. To address the environmental related challenges, it is important for solid waste management systems to be integrated into sustainable development planning, taking into account the impacts of climate change. This includes the development of more resilient waste management infrastructure, improved waste management practices, and increased investment in waste management and recycling programs. Additionally, efforts should be made to reduce waste generation and increase the efficiency of waste management systems, which can reduce greenhouse gas emissions and contribute to mitigating the effects of climate change.

Mediated role of Environmental factor

Solid waste management has a significant impact on sustainable development, both positively and negatively, through its impact on the environment and the surrounding community (Al-Khateeb et al. 2017). Environmental factor can play a mediating role

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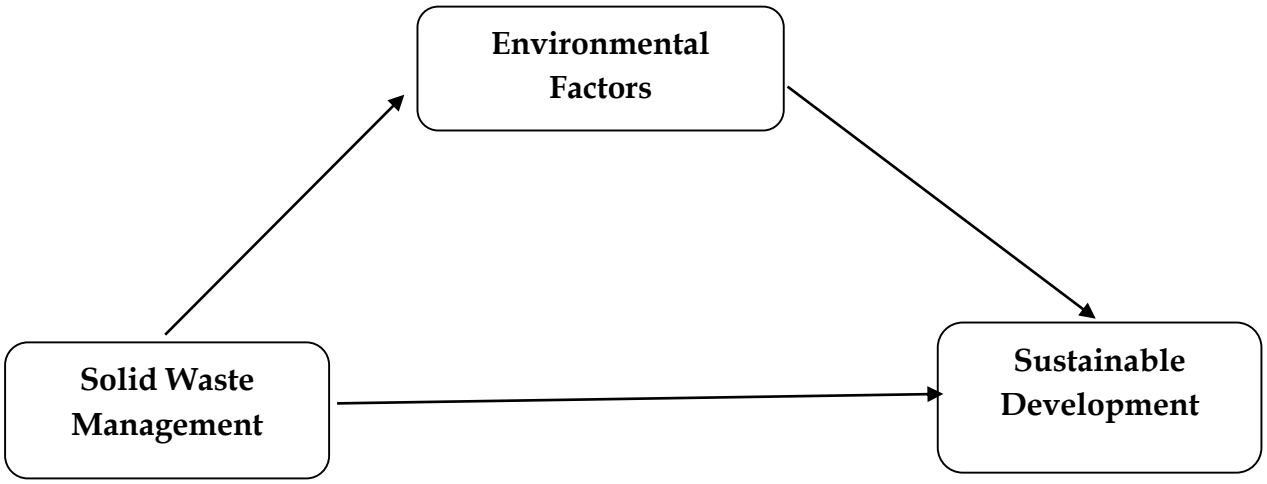
in determining the outcome of solid waste management practices (Solovida & Latan, 2017). On one hand, poor solid waste management practices, such as open dumping, can have negative impacts on the environment, such as soil and water pollution, greenhouse gas emissions, and the spread of diseases. These impacts can compromise human health and undermine sustainable development goals by reducing access to clean air, water, and food, as well as decreasing the quality of life for communities. On the other hand, effective solid waste management practices, such as recycling, composting, and energy recovery, can promote sustainable development by reducing waste, conserving natural resources, and mitigating climate change.

These practices can also create job opportunities, promote economic growth, and improve public health. Environmental factor, such as climate, geography, and socio-economic conditions, can mediate the impact of solid waste management practices on sustainable development. For example, in areas with high rainfall, poorly managed solid waste disposal sites can lead to increased runoff and leaching of pollutants into water bodies, while in arid regions, waste management practices may need to focus on preventing wind-borne litter and controlling fires.

H3: Environmental Factors Significantly mediates the relationship between solid waste management and sustainable development.

Theoretical Framework



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3. Methodology

This study in hand used cross-sectional data collected through well-structured questionnaire using survey approach. To check the mediating role of environmental factors in the relationship between solid waste management and sustainable development.

Population & Sample of the Study

The population of this research comprises of KP seven water and sanitation companies registered on Securities and Exchange Commission of Pakistan, includes all the 6944 employees of WSSC Khyber Pakhtunkhwa, Pakistan. In accordance with the objectives of this study a pooled sample of n=6944 valid responses up to 406 from employees of seven water and sanitation services companies were collected in light of table of Morgan and Krejcie (1970) which suggested total sample size up to 361 and as per Gpower software sample size suggestion up to 158, but researcher distributed 411 questionnaires and in return received the 406 questionnaires in filled form.

Research Instrument

In accordance with Zikmund, Babin, Carr, and Griffin (2010), questionnaires are regarded as a robust data-gathering tool that yields reliable and credible information, as the responses are characterized by uniformity, objectivity, and consistency. A total of 411 questionnaire sets were distributed for data acquisition, of which 406 were received. These were completed in all respects, and the whole process was completed with the approval of the supervisory authority. Feedback was obtained from participants during visits to the respective organizations, while a portion of the responses was acquired through the organizations' media cell branches.

Questionnaire Structure

The researcher meticulously crafted the survey to be clear and comprehensible, enabling participants to readily grasp its content and respond based on their individual perceptions of the posed inquiries. The questionnaire comprised two distinct segments: the first section concentrated on gathering the respondent's personal details, whereas the second delved into topics such as solid waste

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management, sustainable development, environmental factor. Trondillo et al. (2018) devised a scale to assess Solid Waste Management by examining the awareness and implementation of solid waste management programs. This scale encompasses 13 items, assessing attitudes towards solid waste management practices. This nine-items scale was measured, to judge the status of the Solid Waste Management Program and same were adopted in current study.

This scale comprises 16 items, each adapted to conform to the study's context and measured through a seven-point Likert scale. Scales developed by Asiri (2017) and Sola & Sunny (2019) were employed to assess sustainable development. This 13-item scale was quantified utilizing a seven-point Likert scale. An instrument devised by Asiri (2017) was adapted to evaluate environmental factor. This 14-item scale was assessed using a seven-point Likert scale.

Table: 3.1 the Origin of Constructs

Construct	**Adopted from**
Awareness and Practice of Solid Waste Management Programs	Sarbassov et al. (2019) and Trondillo et al. (2018).
Attitude Toward Solid Waste Management	Trondillo et al. (2018)
Status of Solid Waste Management Program	Trondillo et al. (2018) and Mgwebi (2013)
Sustainable Development	Asiri (2017) and Sola & Sunny (2019)
Environmental Factor	Asiri (2017)

Data Analysis Tools

Study in hand used various descriptive and inferential tools to analyze the data. Descriptive tools include instrument reliability and data normality. However, in order to test hypotheses researcher applied Pearson's Product Moment Correlation, Simple linear regression and Multiple Hierarchical Regression using process macro file.

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4. Results and Discussions

The initial phase in data analysis entails the meticulous cleansing of collected data, which encompasses the identification and rectification of any flaws, discrepancies, or inaccuracies. Descriptive statistics facilitate the distillation of crucial data components into concise summaries, while inferential statistics enable the extrapolation of conclusions pertaining to broader populations (Harper, Turvey, & Bramley, 1978). To ensure the assumptions requisite for executing diverse statistical examinations are satisfied, data is appraised for attributes such as reliability, validity, dependability, and linearity (Pallant, 2007).

Data Normality

The concept of data normality is a pivotal aspect of descriptive statistics, as it ensures the validity and reliability of the results obtained from parametric statistical tests that necessitate a normal distribution of the data.

Table: 4.1 Descriptive Statistics

Variables	SWM	SD	EF	DG
N	406	406	406	406
Minimum	2.97	2.77	2.29	2.85
Maximum	5.00	5.00	5.00	5.00
Mean	4.4631	4.5207	4.3951	4.4401
Std. Deviation	0.66556	0.86913	0.83445	0.76546
Skewness	-0.095	0.173	0.211	0.250
Std. Errorof Skewness	0.121	0.121	0.121	0.121
Kurtosis	-0.493	-0.600	-0.155	-0.493
Std. Error of Kurtosis	0.242	0.242	0.242	0.242

The above table 4.6 is indicating that the value of Skewness and kurtosis i.e. (-0.095,-0.493,), (0.173, -0.600), (0.211, -0.155) and (0.250, -0.493) respectively for solid waste management, sustainable development, environmental factor and digitalization are in given range i.e. +3 to -3 (Pallant and Manual, 2010). Here the data is normally

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distributed. Upon examination, the findings indicated that the variable solid waste management (SWM) (Mean=4.4631, Std. Deviation=0.66556) exhibited the lowest Skewness (-0.095). Conversely, the variable sustainable development (SD) (Mean=4.5207, Std. Deviation=0.86913) demonstrated the lowest kurtosis (-0.600), and the variable environmental factor (EF) (Mean=4.3951, Std. Deviation=0.83445) presented the highest kurtosis (-0.155). Consequently, the results substantiated that the data collected from the scale under investigation adhered to normality, in accordance with the guidelines provided by Kline (2005). Hence the findings indicate that the gathered data has been extensively distributed. In this investigation, the average, highest, and lowest values, together with the standard deviation, are calculated for each variable. These outcomes are depicted in Table 4.1.

Scale Reliability (Solid Waste Management)

Table 4.2

Reliability Statistics

Cronbach's Alpha	N of Items
.846	38

Item Statistics

	Mean	Std. Deviation	N
Awareness and Practice	4.0739	2.07143	406
Awareness and Practice	4.3621	1.77345	406
Awareness and Practice	3.8276	1.61163	406
Awareness and Practice	4.8103	1.65730	406
Awareness and Practice	4.9483	1.35165	406

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Awareness and Practice	4.1478	1.77300	406
Awareness and Practice	4.3177	1.82980	406
Awareness and Practice	4.8744	1.49451	406
Awareness and Practice	4.8744	1.65298	406
Awareness and Practice	4.3793	1.84965	406
Awareness and Practice	4.0887	1.97566	406
Awareness and Practice	4.4015	1.30105	406
Awareness and Practice	4.4236	1.72786	406
Attitude	3.8966	2.14859	406
Attitude	4.4236	1.54371	406
Attitude	4.2044	1.62696	406
Attitude	4.7414	1.80250	406
Attitude	4.9212	1.34208	406
Attitude	4.0985	1.64509	406
Attitude	4.2020	1.81723	406
Attitude	5.0296	1.72394	406
Attitude	4.9163	1.71064	406
Status	3.9926	1.85458	406
Status	4.4803	1.77176	406
Status	4.5419	1.21593	406

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Status	4.2660	1.80347	406
Status	4.1305	1.76809	406
Status	4.3374	1.57195	406
Status	4.4286	1.48026	406
Status	4.7685	1.84474	406
Status	4.5419	1.62449	406
Status	4.4039	1.73970	406
Status	4.3424	1.89698	406
Status	4.8744	1.68552	406
Status	4.7438	1.85083	406
Status	4.6084	1.81267	406
Status	4.5764	1.79790	406
Status	4.5985	1.83354	406

Table 4.2 presents the reliability coefficients for different scales, including the SWM scale. The table shows that the SWM scale has a Cronbach's alpha value of 0.846, which is considered to be a good level of internal consistency reliability (Koo, 2007).

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Reliability Statistics

Cronbach's Alpha	N of Items
.736	13

Sustainable Development

Table 4.3

Item Statistics

	Mean	Std. Deviation	N
Sustainable Development	4.0961	2.01062	406
Sustainable Development	4.5493	1.64693	406
Sustainable Development	4.3892	1.60132	406
Sustainable Development	4.5099	1.86552	406
Sustainable Development	4.4631	1.51775	406
Sustainable Development	4.1133	1.61382	406
Sustainable Development	4.0049	1.84189	406
Sustainable Development	4.8941	1.72308	406
Sustainable Development	5.0025	1.60169	406
Sustainable Development	4.8695	1.74277	406
Sustainable Development	4.3473	2.03551	406
Sustainable Development	4.8695	1.74418	406
Sustainable Development	4.6601	2.01910	406

The results of the statistical tests suggest that the sustainable development variable is reliable and can be used to measure the construct of interest. As the value of Cronbach's Alpha is greater then acceptable range (Koo, 2007).

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Reliability Statistics

Environmental Factor

Cronbach's Alpha	N of Items
.753	14

Item Statistics

	Mean	Std. Deviation	N
Environmental Factor	3.9212	1.87609	406
Environmental Factor	4.5443	1.76293	406
Environmental Factor	4.4631	1.37252	406
Environmental Factor	4.1478	1.84667	406
Environmental Factor	4.0222	1.67538	406
Environmental Factor	4.2759	1.49988	406
Environmental Factor	4.4975	1.38911	406
Environmental Factor	4.8941	1.94393	406
Environmental Factor	4.5123	1.68467	406
Environmental Factor	4.1502	1.70680	406
Environmental Factor	4.4409	1.63909	406
Environmental Factor	4.8227	1.56128	406
Environmental Factor	4.4680	2.03493	406
Environmental Factor	4.3719	1.82360	406

The tables 4.4 related to the reliability of a mediating variable Environmental Factor (EF) in a current research topic. This table shows the Reliability Statistics, which

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displays the value of Cronbach's Alpha which equal to = 0.753 is considered acceptable.

Table: 4.5 Summary of Reliability Statistics

Constructs' Measurement Scale	Items	Cronbach's Alpha
Solid waste management	38	.846
Sustainable development	13	.736
Environmental factor	14	.753

Correlation Analysis

Table 4.6 Correlation Analysis

H1: There is significant relationship among solid waste management, Sustainable development and environmental factor.

		MeanSWM	MeanSD	MeanEF
MeanSWM	Pearson Correlation	1		
	Sig. (2-tailed)			
	N	406		
MeanSD	Pearson Correlation	.762**	1	
	Sig. (2-tailed)	.000		
	N	406	406	
MeanEF	Pearson Correlation	.781**	.504**	1

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Sig. (2-tailed)	.000	.000	
N	406	406	406

Results elaborated that the correlation value of environmental factor is maximum. So, it is clear from the results that if proper knowledge and skills regarding environmental factor is provided to municipal sector of Pakistan by government agencies than their level of solid waste management will be boosted and as the correlation value of sustainable development is also maximum the ultimately the goal of sustainable development will be achieved. Furthermore, table 4.6 presents the correlation analysis conducted to examine the hypotheses. The results in the table reveal a significant positive relationship between solid waste management and sustainable development and environmental factor. A positive correlation between sustainable development and solid waste management is indicated by an r-value of 0.762 and a p-value of less than 0.05. Similarly, the r-value of 0.781 and a p-value less than 0.05 demonstrate a positive association between solid waste management and environmental factor. Furthermore, an r-value of 0.717 and a p-value less than 0.05 indicate a positive relationship between solid waste management and digitalization. In nutshell results elaborated that solid waste management is directly and significantly proportional to sustainable development. Based on findings H1 is accepted.

Regression Analysis (Simple linear regression (Model-I)

H2: There is a significant effect of solid waste management on sustainable development.

Table 4.7Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig
1	.762[a]	.581	.580	.56359	559.168	.000[b]

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a. Predictors: (Constant), Mean SWM

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Table 4.8ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	177.608	1	177.608	559.168	.000[b]
	Residual	128.322	404	.318		
	Total	305.930	405			

a. Dependent Variable: Mean SD

b. Predictors: (Constant), Mean SWM

Table 4.13 presents a summary of the regression analysis conducted to evaluate the second hypothesis. The findings in the table reveal that the R2 value, which represents the coefficient of determination or goodness of fit, is 0.581. This suggests that 58.1% of the variation in sustainable development can be attributed to solid waste management practices. The model's statistical significance is demonstrated by a p-value of 0.000, which is below the 5% confidence level threshold. Additionally, an F-value of 559.168 supports the model's fit, leading to the acceptance of the second hypothesis. The findings indicate that enhancing solid waste management practices helps in sustainable development of nations and ultimately contributes to economic growth. Consequently, Hypothesis 2 is supported by the results.

Table 4.9Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.080	.190		.421	.674
	Mean SWM	.995	.042	.762	23.647	.000

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a. Dependent Variable: Mean SD

The findings presented in Table 4.15 demonstrate that the beta value is 0.762, indicating a 0.762-unit increase in sustainable development due to solid waste management. This positive relationship is statistically significant, as evidenced by a p-value of less than 0.05 (p=0.000).

Mediation Analysis

In this study, the PROCESS macro developed by Hayes (2013) is employed to conduct mediation regression analysis, which facilitates the examination of mediation-related hypotheses. Hayes's (2013) statistical mediation methods are favored over alternatives such as those proposed by Baron and Kenny (1986). To assess the importance of mediation outcomes, we employed Model 4 as proposed by Hayes (2013), in which sustainable development serves as the dependent variable, solid waste management as the independent variable, and environmental factor and digitalization as mediators, as outlined in the accompanying table.

H3: There is significant mediating role of Environmental factor between management of solid waste and sustainable development

Table: 4.10 Mediation Analysis Model # 4

Environmental Factor (Model Summary)

R	R-Sq	MSE	F	Df1	Df2	*p*
.7815	.6107	.2717	633.7828	1.0000	404.0000	.0000

Table: 4.11 Environmental Factor (Co-efficients)

Model 1

	coeff	se	t	p	LLCI	ULCI

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Constant	.0854	.1851	.4614	.6448	-.2785	.4494
Mean EF	-.2456	.0524	-4.6824	.0000	-.3487	-.1425
Mean SWM	1.2356	.0658	18.7905	.0000	1.1063	1.3649

Mediation Analysis results revealed that environmental factor partially mediates the relationship between solid waste management and sustainable development with the R-square 0.61, $p<0.05$ of the model as well as $P<0.05$ for each variable as well.

Total Effect, Direct Effect, And Indirect Effect

Table: 4.12 Total Effect

Total effect of X on Y

n=406

Model Summary

Effect	SE	T	P	LLCI	ULCI
.9950	.0421	23.6467	.0000	.9123	1.0777

In the mediation analysis Model 4 of Hayes, researcher examining the total effect of an independent variable (X) on a dependent variable (Y) through a mediator variable (M). In this specific case, the independent variable is Solid Waste Management (Mean SWM), the dependent variable is Sustainable Development (Mean SD), and the mediator variable is Mean EF.

Table: 4.13 Direct Effect

Direct effect of X on Y

n=406

Model Summary

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Effect	SE	T	P	LLCI	ULCI
1.2356	.0658	18.7905	.0000	1.1063	1.3649

In the mediation analysis Model 4 of Hayes, the current study in this table examining the direct effect of an independent variable (X) on a dependent variable (Y), controlling for the mediator variable (M). In this specific case, the independent variable is Solid Waste Management (Mean SWM), the dependent variable is Sustainable Development (Mean SD), and the mediator variable is Mean EF (Environmental Factor).

Table: 4.14 In-Direct Effect

Indirect effect of X on Y

n=406

Model Summary

	Effect	Boot SE	Boot LLCI	Boot ULCI
Mean EF	-.2406	.0585	-.3599	-.1299

In this study, the researchers aim to investigate the indirect effect of solid waste management (SWM) on sustainable development (SD) through the mediating role of the environmental factor (EF). They have used the mediation analysis model 4 of Hayes and conducted the analysis on a sample size of 406. The results from the mediation analysis are presented in a table with values for the indirect effect (Effect), Bootstrapped standard error (Boot SE), Bootstrapped lower-level confidence interval (Boot LLCI), and Bootstrapped upper-level confidence interval (Boot ULCI). Let's discuss each of these values and their interpretations in detail.

Mediation Analysis Summary

The study assessed the mediating role of environmental factor in the relationship between solid waste management and sustainable development. The total effect and

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direct effect of environmental factor is significant in the relationship between solid waste management and sustainable development. Hence, it is concluded that environmental factor partially mediates the relationship between solid waste management and sustainable development.

Discussion

Scholars like Rodic and Wilson (2017) proposed that good solid waste management practices are necessary for sustainable development and also play an integral role in controlling the environmental factor that contribute to the betterment of humans. The main objectives of the current research were to explore the impact of solid waste management on sustainable development as well as to investigate the mediating role of Environmental Factor. Results of correlation analysis explained positive and significant relationship among independent and dependent variables. Hence it is interpreted from findings that solid waste management along with environmental factor increase the sustainable development in the country. Based on findings H1 is accepted. Results of simple linear regression revealed that solid waste management having significant influence on sustainable development. Based on findings H2 of the study is accepted. Hypothesis 3 was related to mediation of environmental factor i.e. There is significant mediating role of Environmental factor between management of solid waste and sustainable development. In short, the results of the mediation analysis suggest that the Environmental Factor (Mean EF) plays a significant mediating role in the relationship between Solid Waste Management (Mean SWM) and Sustainable Development (Mean SD).

Conclusion

The implementation of robust waste management strategies, guided by environmental factor is essential in steering countries toward sustainable development. These strategies not only address the existing problems and societal evils stemming from improper waste management but also pave the way for new approaches to cope with future challenges. Moreover, these initiatives have the potential to create employment opportunities, boost economic growth, and foster a

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healthier environment worldwide, contributing to the betterment of society as a whole. In conclusion, effective waste management, with a focus on solid waste, through the utilization of environmental factor, holds the key to sustainable development. It is an imperative step towards resolving the problems faced by the modern world, promoting a healthier society, and fostering a more sustainable and prosperous future for all.

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