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Navigating Sustainability: A study on Waste Management Practices Adopted by the Tourism Industry in the Darjeeling and Kalimpong Districts

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Abstract

Regarding the waste management in Darjeeling and Kalimpong, the waste handling techniques majorly include burning and throwing the garbage into open space. Such irresponsible waste dumping and careless incineration are posing a serious risk to health in this region. Considering the volume, a single town of Darjeeling can generate 30-25 MT of waste per day, and this figure can double during the peak tourist season. Thus, this study understands the necessity to investigate the waste management practices in the tourism industry of this region. Further, the tourism industry, which largely supports the livelihood pattern of Darjeeling and Kalimpong, is not placed or studied under the waste management literature. So, intending to study the factors that affect sustainable waste management, this study includes variables such as attitude and literacy of waste management combined with firm-specific effects due to the existence of different types of enterprises serving the tourism industry. Gathering responses through a self-administered questionnaire from the enterprises engaged in the tourism industry of Darjeeling and Kalimpong, this study uses structural equation modeling to estimate the degree and direction of the relationships. The study finds that both waste management literacy and attitude towards waste management at the firm level have an extremely important role towards the adoption of sustainable waste management practices.

Further, the formal training programs attended by the enterprises also have a significant role towards the adoption of a sustainable waste management model. These findings have important theoretical implications, considering the sustainable waste management model and the tourism industry.

Keywords: Tourism, Darjeeling, Kalimpong, Waste Management, Sustainability

JEL Codes: Q53, L83, Z32, C39

1. Introduction

Waste management research is a focus area for several researchers, and such research

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indicates that waste management still has a significant scope for improvement, allowing for better results in daily life (Moustakas & Loizidou, 2018). The term "waste" is an outcome of "inadequate thinking" (Seadon, 2010); as such, many entities still follow the traditional 3Fs waste management approach of "flame, flush or fling". Gradually, proper waste handling measures were adopted as waste accumulation began to impact the environment and public health (Awasthi et al., 2021). However, the argument of whether the waste management practices are sustainable is still questionable. The problem lies in the entire system of waste management. The world understands that waste generation, waste collection, and waste disposal are three independent planned operations. Rather, they are interlinked, and such linkage is crucial for operating a sustainable waste management system. So, a sustainable waste management towards a zero-waste approach and sustainable development goals (SDGs) requires coordinated effort or nexus across stakeholders, including manufacturers, service providers, retailers, and consumers (Liu et al., 2018; Parajuly et al., 2020). Several industries still adhere to the traditional 3Fs waste management approach, and they are the primary source of commercial waste (Woodard, 2020). Even the tourism and hospitality industry are not out of this list. The tourism enterprises have little knowledge and awareness about solid waste management and its impact on the environment (Agyeiwaah, 2020). They are responsible as one of the emerging industries for the world's highest greenhouse gas emissions (Lenzen et al., 2018). Even the micro-hospitality enterprises, as in Agyeiwaah (2019), have unsustainable waste disposal practices with little or no waste minimisation effort. The only method of waste handling is collecting the waste in a plastic bag and throwing it away. Thus, the term sustainable tourism is not sustainable, as it usually exists in an environmentally sensitive area that cannot accommodate the current development rate (Butler, 2018). This similar scenario is prevalent in Darjeeling and Kalimpong, whose regional economy is heavily dependent on the tourism industry, and the region is itself an environmentally sensitive area where economic benefits are largely being exploited at the cost of environmental resources.

Even the rural community and economy in Darjeeling and Kalimpong now heavily rely on tourism. Tourism is the major contributor, after tea, towards the economic development of these two districts (Bhutia, 2014). This region is a well-liked base for experiencing the Eastern Himalayas (Kannegieser, 2015). However, with the growth of population and tourism, this region experienced a significant shift featured with the growth and construction of hotels, shops, stores, restaurants, homestays, tourism activities and rural tourism units (Bhattacharya et al., 2023).

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Such growth resulted in over-congestion, pollution, improper waste management and several other problems, some of which have a negative impact on the environment, which led to the path of becoming one of the most polluted cities in West Bengal (Singh, 2023). Based on the evidence, it can be argued that growth may not always bring prosperity, and development may not always lead to a sustainable outcome. Being the major livelihood source in Darjeeling and Kalimpong, it becomes very important to understand tourism units, especially how they incorporate environmental sustainability in their daily business practices. The commercial waste generation and waste handling techniques in this region majorly include burning and throwing the garbage into open space. Such irresponsible waste dumping and careless incineration are posing a serious risk to health in this region (Mazumdar, 2018). Considering the volume, a single town of Darjeeling can generate 30-25 MT of waste per day, and this figure can double during the peak tourist season (see Ghosh, 2019). Thus, this study understands the necessity to investigate the waste management practices in the tourism industry. Especially, the firm-level waste management practices should be explored (Agyabeng-Mensah et al., 2021; Zaman, 2015). So, it attempts to investigate which factors can drive the sustainable waste management practices in the tourism industry of Darjeeling and Kalimpong, which requires immediate rethinking. Does the waste management literacy and attitude towards waste management play a positive role towards sustainable waste management? If the positive role is affirmed, this study will suggest necessary policy recommendations to further strengthen the waste management literacy and attitude towards waste management in the tourism industry. The findings will cater to the immediate need for a sustainable waste management model in the tourism industry of Darjeeling and Kalimpong. This will result in understanding the sustainable waste management and its driving factors so that extensive attention can be provided towards efficient waste management practices, which have sufficient space for sustainability. But the tourism industry is categorised with several business units such as hotels, shops, retailers, homestays, restaurants, and tourism activities. To overcome this imbalance, firm-specific effects will be introduced.

2. Related Works

Several studies have addressed the issues related to waste management in different sectors and industries. Now, to understand the existing body of knowledge on waste management in the tourism industry, relevant research works are surveyed and discussed in this section.

From the visitors' viewpoint, Han et al. (2018) studied waste reduction

techniques of hotels and their influence on the visitors' intention to participate in green practices. Such techniques have a positive influence on utilitarian and hedonic values and also promote visitors' pro-environmental intentions. In an exclusive study by Cervantes et al. (2018), they identified 377 indicators of waste management, of which the majority were related to recovery components that include recycling, incineration with energy recovery, composting, etc.

Understanding the challenge of sustainable solid waste management, Das et al. (2019) found that the geography and economic status of a region shape its waste management techniques. They argue that the most sustainable waste management technique, currently available, is the 3R technique of waste management, i.e., "*reduce, reuse, and recycle*". To study the environmental attitude and intention of the hotel employees to implement green practices, Okumus et al. (2019) used survey data from Turkey and found the moderating effect of the 'employees' intention to implement green practices' on the relationship between 'environmental awareness, concern and knowledge' and 'employees' ecological behaviours'. Using the Waste Aware model, which has several indicators to rank the waste management practices, Ali et al. (2019) studied season-wise waste management procedures by including several waste generation entities such as households (categorised income-wise), commercials, markets, institutions, parks, etc. Their study shows that the waste treatment scenario differs in every season, and the households with middle and high incomes generate more than half of the entire waste collected (Ali et al., 2019). In an important of Zhang et al. (2019), they investigated the intention and behaviour of waste sorting by the households and found no moderation effect of '*government motivation*' and '*facilities accessibility*' on intention and behaviour towards waste sorting, rather they found that it is the personal norm or personal attitude that directly impacts both the intention and behaviour towards waste sorting for a sustainable waste management.

To support sustainable waste management, Olay-Romero et al (2020) identified several indicators for improving waste management. Their study particularly highlights the need for increasing the collection effort and coverage of solid waste and improving waste disposal techniques for achieving sustainable waste management. Relating circular economy and waste management, Knickmeyer (2020) emphasises the necessity of active participation from every stakeholder of society, including households, to achieve good waste recycling practices. The study suggests that social factors largely influence stakeholders' behaviour towards waste management, where waste management literacy or knowledge is significant in

achieving better recycling results for sustainable waste management (Knickmeyer, 2020). The study further highlights that the waste management system must be tailored in accordance with the local context. The study by Luo et al. (2020) has shown the importance of social factors in determining sustainable waste management. Social interaction, social behaviour, social norms, social networks, and social attitudes play an important role in determining the indicators of sustainable waste management (Luo et al., 2020).

In an attempt to study the country-level integrated sustainable waste management, Azevedo et al. (2021) used waste awareness benchmark indicators along with a process flow diagram to show sustainable waste management. They discuss about the requirement for additional funding, which will improve waste management technologies, and also to conduct public campaigns to increase waste management literacy. Studying the current status of municipal solid waste management, Khan et al. (2022) suggest a few important techniques for sustainable waste management, such as 3R, composting, vermi-composting, biogas, and waste segregation. Through the theory of planned behaviour, Govindan et al. (2022) show that subjective norm and attitude have a positive influence on waste sorting intention, which in turn affects waste sorting behaviour. They used structural equation modeling to examine these relationships for sustainable waste management. Stating that the techniques such as land-filling and incineration as the most common techniques followed by developing economies for waste management, Hajam et al. (2023) reveal that these techniques have several drawbacks which including contamination of water and soil, air pollution, and negative impact on human health and hygiene. Regarding organic waste, vermi-composting is one of the most sustainable and eco-friendly methods of waste management (Hajam et al., 2023).

The existing literature has meticulously explored waste management and its sub-aspects. The majority of the studies have placed the 3R technique of waste management being a sustainable one. Also, many studies have discussed the negative impact of improper waste management. Some studies have shown multi-stakeholder efforts towards sustainable waste management practices. The past studies have also used structural equation modeling to understand the factors affecting the waste management practices. However, the importance of understanding the factors determining sustainable waste management to the tourism industry, which also has multi-stakeholder participation, is rarely attempted. Since the tourism industry is facilitated by several stakeholders, the effect of firm-specific factors on the waste management practices is not presented. Lastly, the tourism industry, which largely

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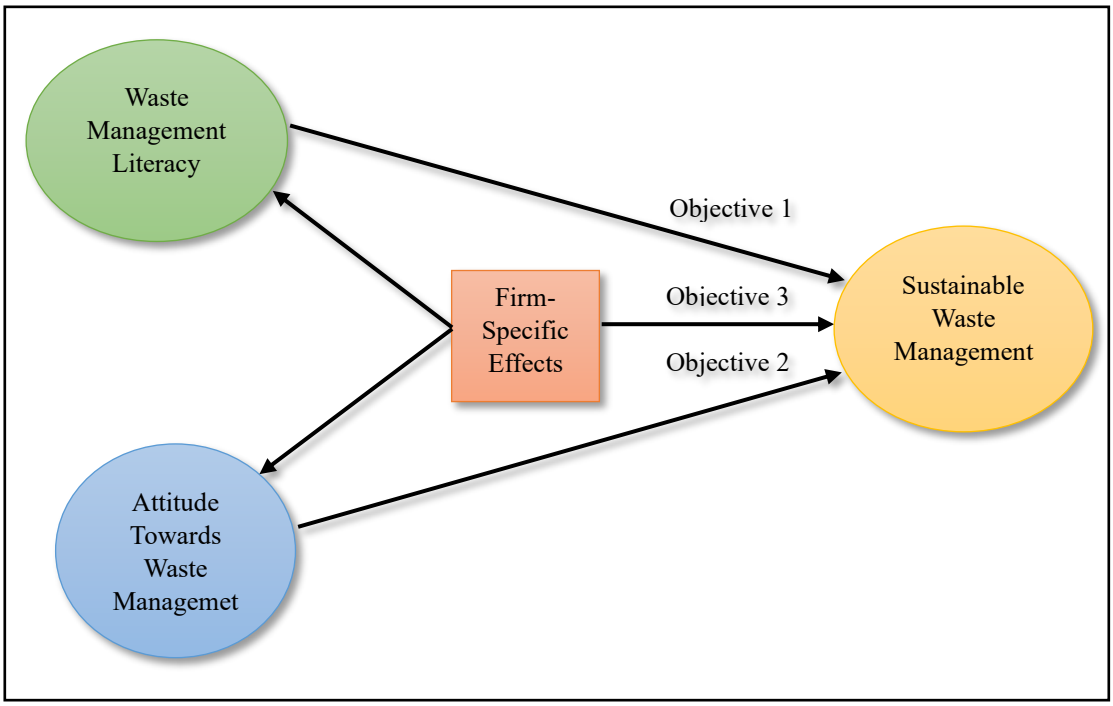
supports the livelihood pattern of Darjeeling and Kalimpong, is not placed or studied under the waste management literature. Considering these research gaps, this study aims to understand the existence of sustainable waste management practices in the tourism industry of Darjeeling and Kalimpong, and assess the factors that influence the sustainable waste management along with the rightful inclusion of firm-specific effects.

3. Objectives of the Study

To address the research gaps identified and discussed in the previous section, the precise objectives of this study would be-

- To assess the influence of 'waste management literacy' on 'sustainable waste management'.
- To assess the influence of 'attitude towards waste management' on 'sustainable waste management'.
- To assess the influence of firm-specific effects on 'sustainable waste management'.

Figure 1: Graphical Representation of the Objectives



Source: Authors' own work

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The graphical representation of the objectives has been presented in Figure 1. To meet these objectives, this study proposes to employ structural equation modeling as a statistical tool for quantitative analysis. For this purpose, its suitability in accordance with the research design, research method and sample design are discussed in the next section.

4. Research Methodology

In a quantitative research design, this study includes the three major entities in the tourism industry of Darjeeling and Kalimpong districts as respondents to capture the current waste management practices adopted by them. Such entities include food and beverage, lodging, and recreation/attractions. To determine the required sample size for this study, the 'simplified margin-of-error approach' is followed because no preceding data or detailed parameters are available on these major entities. The formula $n=1/e^2$ at 5% margin of error gives the approximate sample size of 400. However, the study attempted to include more than 400 enterprises so that the minimum sample size requirement is easily fulfilled. Regarding the questionnaire, the variables are sourced from studies relevant to waste management and tourism studies. Grouped into three main categories- "Sustainable Waste Management", "Attitude Towards Waste Management ", and "Waste Management Literacy", such variables are responsible for effectively measuring their related constructs in a 5-point Likert Scale as sourced from the relevant literature. Further, four firm-specific effects are also included in the questionnaire to capture any discrepancies arising due to the size and type of enterprise. Such firm-specific effects are the size of the enterprise, formal training, locality type, and registration. The details of such variables and firm-specific effects are provided in Table 1.

Table 1: List of Variables, Indicators and their Description

Latent Variables	Indicators	Description	Based on
Sustainable Waste Management (SWM)	SWM1	Enterprise avoids environmental problems and enhances social value by recycling, reducing, and reusing waste.	Chen et al. (2018); Gautam et al. (2022); Kasseeah (2020); Sohal et al. (2022); Hussain et al. (2020);
	SWM2	The enterprise reuses empty bags, papers, bottles and other reusable items.	
	SWM3	Enterprise collects and sells scrap that can be recycled, such as metals, plastics, bottles, packaging material, e-waste, etc.	

	SWM4	Food waste or wet waste generated from the enterprise is sent or collected for composting.	Sendawula et al. (2020)
	SWM5	The enterprise has put containers or bins for waste disposal category-wise.	
Attitude Towards Waste Management (ATWM)	ATWM1	Every enterprise should have a significant role towards waste management, support remanufacturing, and recycling.	Salvioni et al. (2021); Wu et al. (2021); Martínez and Poveda (2022); Higgs and Hill (2019); Caldera et al. (2019)
	ATWM2	Waste management is important for enterprises as it helps to bring positive outcomes.	
	ATWM3	Financial support from external entities should not be the only way for environmentally friendly actions, such as waste management in the enterprise.	
	ATWM4	Enterprises should be responsible towards the protection of the environment.	
	ATWM5	Waste should be reduced by recycling, reusing, and remanufacturing strategies.	
Waste Management Literacy (WML)	WML1	Waste can be categorised into dry and wet wastes or hazardous and non-hazardous wastes.	Bagire et al. (2021); Ahmed and Gideon (2021); Birara and Kassahun (2018); Elkhwesky (2022); Peña-Montoya et al. (2020); Singh et al. (2018); Derhab and Elkhwesky (2023)
	WML2	Plastic waste should be recycled as that brings destructive effects on the environment.	
	WML3	Solid waste always has a bad impact on public health, so it should be managed properly.	
	WML4	The uncollected and mismanaged liquid and solid waste can cause pollution of air, water, and soil.	
	WML5	A sustainable waste management avoids the harmful impact of waste on human health and the environment.	
Firm Specific Effects	Size of the Enterprise (SIZE)	Number of employees hired by the enterprise?	Author(s)
	Formal	Attended any formal training on solid	

	Training (TRAI)	waste management? (Yes=1; No=0)	
	Locality Type (LOC)	Rural=1; Semi-urban=2; Urban=3	
	Registration (REGD)	Enterprise registered under any policy or act? E.g., UDYAM or West Bengal Tourism Policy. (Yes=1; No=0)	

Source: Compiled by Author(s).

With such indicators and variables included in the questionnaire, a convenience sampling technique was used to collect the data from potential respondents. The questionnaires embedded in *Google Forms* were circulated across the region for six months so that every unit had an equal opportunity to be included in the final sample size. After analysing the responses received, 468 samples were found to be fit for further analysis. Such responses were then sent to the next step, where the relationships between the constructs and variables were assessed using partial least squares structural equation modeling (PLS-SEM).

The PLS-SEM is recommended by Sarstedt et al. (2017) and several other studies as an alternative to covariance-based structural equation modeling. It assesses the variance-based relationships across the constructs simultaneously on several models (AlNuaimi et al., 2021; Hair et al., 2020). It can perform the estimation of the measurement model with the ability to control the bias of a common factor model, thereby perfectly handling both reflective and formative models (Hair et al., 2012, 2020; Sarstedt et al., 2014, 2017, 2020).

Regarding the selection of PLS-SEM as a proper statistical tool for analysis, the objectives of this study set its direction, i.e., theory development through the prediction of the relationship between variables and constructs. PLS-SEM is the most appropriate method if the objective is focused on the prediction of the relationships or theory development, having multiple models and involving the measurement of mediation effects (Dash & Paul, 2021; Hair et al., 2012; Henseler et al., 2015; Sarstedt et al., 2017). Further, the PLS-SEM can also undertake null hypothesis significance testing through its basic bootstrapping procedures, which is necessary in this study to test the impact of firm-specific effects on sustainable waste management (Henseler et al., 2014; Ringle et al., 2022; Sarstedt et al., 2017). Thus, this study understands the capacity of PLS-SEM to attain the objectives set by this study.

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5. Analysis and Discussion

This section presents the statistical findings and a discussion of the study's objectives. As discussed, this study has employed PLS-SEM as an appropriate statistical method to justify the proposed relationship between the variables, as shown in the objectives of the study. The results from PLS-SEM are presented in three sub-sections. Firstly, the measurement model, where the construct validity and reliability, convergent validity, discriminant validity and the model fit indices are checked. The second sub-section starts only when the measurement model is found to be fit for further analysis. Such further analysis means the development of a structural model as shown in the objectives of the study, which is then run through the path analysis using the PLS-SEM algorithm. Such an algorithm provides the estimate for path coefficients, specific indirect effects and direct effects. Lastly, the third sub-section is about bootstrapping the results obtained from the PLS-SEM algorithm for null hypothesis significance testing and also for making the path coefficients more robust to justify the relationship being significant.

5.1 Measurement Model

The establishment of internal consistency is eminently important to judge the construct reliability, convergent validity, and discriminant validity of the constructs used in the study. It measures the ability of the scale items to indicate how well the set of indicators measures its underlying constructs (Hair et al., 2020).

Table 2: Construct Reliability Matrix

	Cronbach's Alpha	Composite Reliability
SWM	0.908	0.932
ATWM	0.827	0.878
WML	0.797	0.859
SIZE	1	1
TRAI	1	1
LOC	1	1
REGD	1	1

Source: Author(s).

Table 2 provides the parameters to measure the construct reliability. Both the estimated parameters, i.e., the ‘Cronbach’s Alpha’ and ‘Composite Reliability’, overhead the threshold limit of 0.800 for all the constructs, indicating a reliable

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composition of all the relevant constructs (Hair et al., 2012; Sarstedt et al., 2014).

Table 3: Outer Loadings Matrix for Convergent Validity

	SWM	ATWM	WML
SWM1	0.854		
SWM2	0.873		
SWM3	0.915		
SWM4	0.868		
SWM5	0.763		
ATWM1		0.797	
ATWM2		0.726	
ATWM3		0.741	
ATWM4		0.805	
ATWM5		0.772	
WML1			0.769
WML2			0.772
WML3			0.706
WML4			0.727
WML5			0.733
AVE	**.732**	**.591**	**.550**

Source: Author(s).

For establishing the convergent validity, the outer loading matrix along with the average variance explained (AVE) is reported in Table 3. The outer loading matrix is higher than 0.700 for all the items under each construct, along with an AVE above 0.500 for the same constructs is sufficient to establish the convergent validity (Andersson et al., 2022; Hair et al., 2020; Vinzi et al., 2010). This indicates that the items satisfactorily explain their convergence through the average variance explained to create their respective construct.

Table 4: Heterotrait-Monotrait Ratio Matrix for Discriminant Validity

	SWM	ATWM	WML	SIZE	TRAI	LOC	REGD
SWM							
ATWM	0.645						

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WML	0.617	0.776					
SIZE	0.051	0.059	0.024				
TRAI	0.112	0.114	0.077	0.33			
LOC	0.038	0.038	0.028	0.006	0.176		
REGD	0.048	0.058	0.054	0.121	0.042	0.006	

Source: Authors' own calculation

Next, to establish the discriminant validity, the Heterotrait-monotrait ratio (HTMT) is estimated, and the matrix is presented in Table 4. The discriminant validity, when established, confirms that the items only load onto their respective constructs and have little or no factor loading with other constructs. So, it is the test of unidimensionality of the indicators. The HTMT ratio is usually checked between the two constructs to assert that such two constructs are different from each other, thus unidimensional. HTMT ratio below 0.85 indicates a low correlation (Henseler et al., 2015; Sarstedt et al., 2017) thereby confirming the establishment of discriminant validity between two constructs. Table 4 also shows the HTMT ratio below 0.85 for all the constructs. Hence, the discriminant validity is established for the variables used in this study.

Thus, using the construct reliability, convergent validity, and discriminant validity, the internal consistency is checked and satisfactorily established. Now, Table 5 shows the model fit summary to confirm that the model is fit for path analysis. At first, the standardised root mean squared residual or SRMR is below the threshold limit of 0.08, along with non-significant values for both the distance indices (i.e., d_ULS and d_G) and normed fit index or NFI higher than 0.800 (Hair et al., 2012; Henseler et al., 2015; Zhang et al., 2022).

Table 5: Fit Summary

	Saturated Model	**Estimated Model**
SRMR	0.061	0.061
d_ULS	0.718	0.718
d_G	0.271	0.271
Chi-Square	732.735	732.735
NFI	0.818	0.818

Source: Author's own calculation

Thus, these model fit indices confirm that the model is fit and appropriate to proceed

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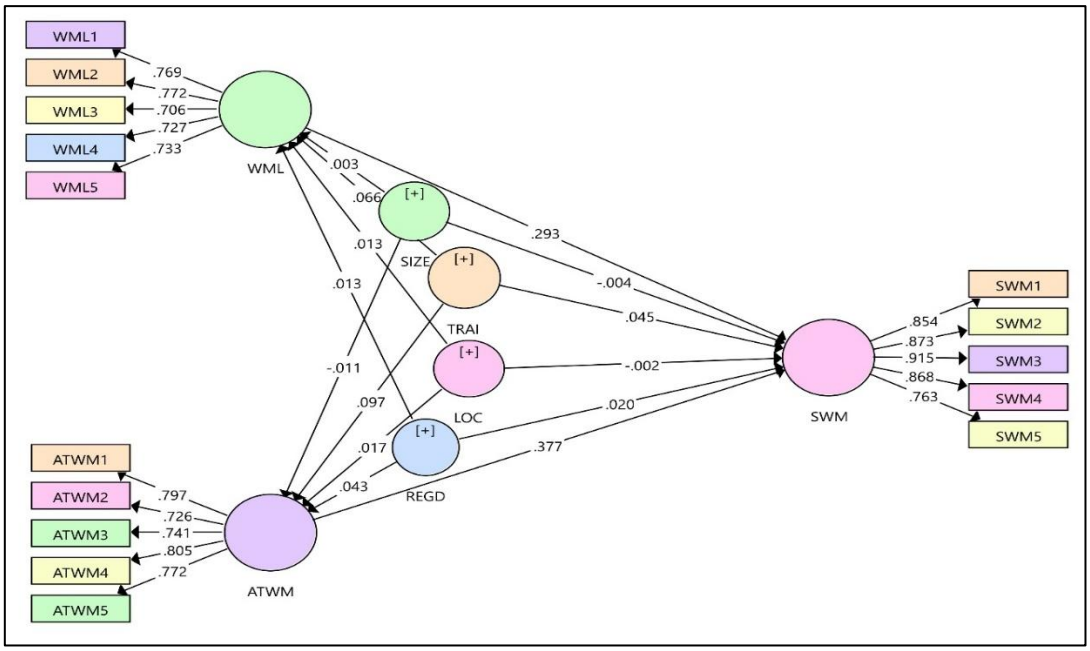
with the path analysis and estimate the parameters of the structural model.

5.2 Structural Model

The estimation of the structural model begins with the path analysis, and the path diagram is portrayed in Figure 2. It shows the path of the relationship between waste management literacy (WML), attitude towards waste management (ATWM), sustainable waste management (SWM) and several other firm-specific effects, as previously shown in the graphical representation of the objectives.

Figure 2: Path Diagram



Source: Authors' own work

The path coefficients between such relationships are shown clearly in Table 6. It shows the direct relationships between such constructs and variables where ATWM has a direct effect of 0.377 and WML has a direct effect of 0.293 on SWM, respectively. Among the four firm-specific effects, the size of the enterprise (SIZE) and location (LOC) have a negative effect on SWM, while formal training (TRAI) and registration (REGD) have a positive impact on SWM. It is also to note that the size of the enterprise has a negative impact on ATWM but a positive impact on WML. However, the location of the enterprise has a positive impact on both ATWM and WML. Similarly, TRAI and REGD have a positive impact on all three constructs.

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Table 6: Path Coefficient Matrix

	SWM	ATWM	WML	SIZE	TRAI	LOC	REGD
SWM	1						
ATWM	.377	1					
WML	.293	-	1				
SIZE	-.004	-.011	.003	1			
TRAI	.045	.097	.066	-	1		
LOC	-.002	.017	.013	-	-	1	
REGD	.020	.043	.013	-	-	-	1

Source: Authors' own work

Considering the specific indirect effects of the other constructs and effects on SWM, which is the only endogenous variable in the model, all except SIZE through ATWM have a negative impact on SWM, as shown in Table 7.

Table 7: Specific Indirect Effects

Path	Specific Indirect Effects
SIZE → WML → SWM	.001
SIZE → ATWM → SWM	-.004
TRAI → WML → SWM	.019
TRAI → ATWM → SWM	.036
LOC → WML → SWM	.004
LOC → ATWM →SWM	.006
REGD → WML → SWM	.004
REGD → ATWM → SWM	.016

Source: Author(s).

Now, combining both direct and indirect effects, the total effects matrix provides a more informative picture regarding the relationships in the model. The total effects matrix is presented in Table 8. Through this matrix, it is precisely understood that all the constructs and variables have a positive impact on SWM, except for the size of the enterprise, which has a negative impact on both SWM and ATWM.

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Table 8: Total Effects Matrix

	SWM	ATWM	WML	SIZE	TRAI	LOC	REGD
SWM	1						
ATWM	.377	1					
WML	.293	-	1				
SIZE	-.008	-.011	.003	1			
TRAI	.101	.097	.066	-	1		
LOC	.009	.017	.013	-	-	1	
REGD	.040	.043	.013	-	-	-	1

Source: Author(s).

Next, to assess the p-value for null hypothesis significance testing of the direct effects and also to make the total path coefficients more robust, the bootstrapping procedure is performed through the PLS-SEM algorithm.

5.3 Bootstrapping Results

Bootstrapping is a nonparametric procedure that allows testing the statistical significance of various PLS-SEM results, including path coefficients. In this study, a basic bootstrapping procedure is performed with 500 subsamples to obtain the basic set of results for total effects.

Table 9: Null Hypothesis Significance Testing of Total Effects through Bootstrapping

	Total Effects (I)	Std. Dev (II)	T-Stats. (|I/II|)	P Values
ATWM → SWM	0.377	0.048	7.782	0.000
WML → SWM	0.293	0.051	5.745	0.000
SIZE → ATWM	-0.011	0.049	0.225	0.822
SIZE → SWM	-0.008	0.050	0.153	0.879
SIZE → WML	0.003	0.049	0.051	0.959
TRAI → ATWM	0.097	0.054	1.803	0.072
TRAI → SWM	0.101	0.050	2.020	0.044
TRAI → WML	0.066	0.051	1.295	0.196
LOC → ATWM	0.017	0.051	0.336	0.737
LOC → SWM	0.009	0.047	0.182	0.856
LOC → WML	0.013	0.049	0.258	0.797
REGD → ATWM	0.043	0.046	0.932	0.352
REGD → SWM	0.040	0.047	0.858	0.391
REGD → WML	0.013	0.048	0.280	0.779

Source: Author(s).

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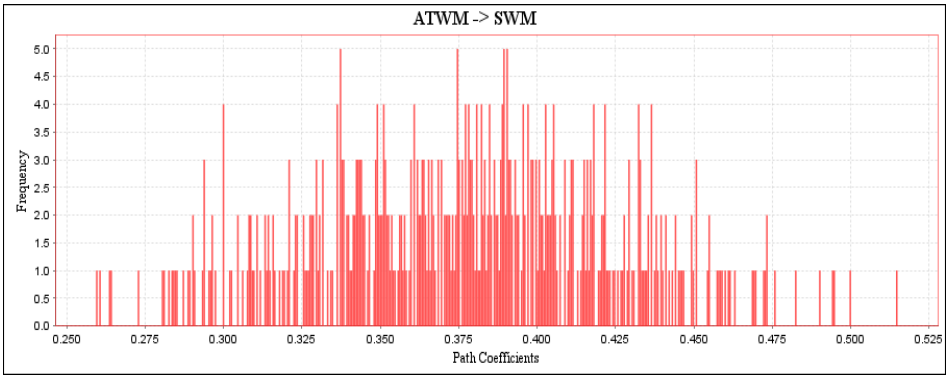
The results of bootstrapping procedures for null hypothesis significance testing of total effects are presented in Table 9. The results show that the total effect of ATWM on SWM is statistically significant at 1% level. Similarly, the total effect of WML on SWM is also statistically significant at 1% level, while the total effect of TRAI on SWM is statistically significant at 5% level. Since the total effect of TRAI on both WML and ATWM is statistically insignificant, it can clearly be stated that there is no mediation effect in the model amongst the significant relationships. Only, TRAI from the firm-specific effects has a direct, significant and positive impact on SWM. This indicates that both waste management literacy and attitude towards waste management at the firm level have an extremely important role towards the adoption of sustainable waste management practices. They signal their position as an important part of the sustainable waste management model. Further, the formal training (TRAI), which indicates the 'formal training programs attended by the enterprise', also has a significant role towards the adoption of a sustainable waste management model. These findings have important theoretical implications, considering the sustainable waste management model and the tourism industry. And to make these findings more robust, where the three variables, i.e., ATWM, WML, and TRAI, were found to have a significant impact on SWM, the total effects histogram is presented sequentially to make the direct path coefficient more robust and reliable.

Figure 3: Total Effects Histogram of ATWM to SWM



Source: Author(s).

Since the histogram clusters around 0.375 to 0.400 for ATWM to SWM, it indicates that this range holds the most common estimated path coefficient (ATWM → SWM = 0.377). Further, there is a moderate variability in the strength of the path coefficient because the majority of the high-frequency bootstrapped coefficients hover around the centre (narrow central clustering) in a range between 0.325 to

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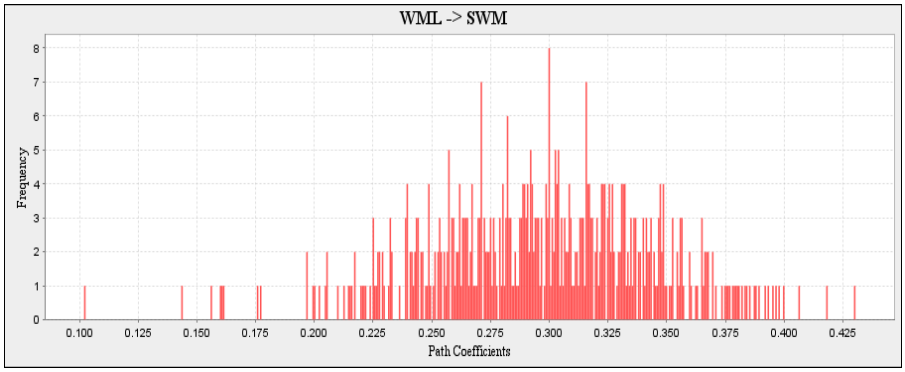
0.425, with no extreme outliers and the entire distribution being above zero. This statistically implies that the relationship between ATWM and SWM is consistently predicted with positive and moderately strong bootstrap samples, indicating a robust, statistically significant relationship between ATWM and SWM.

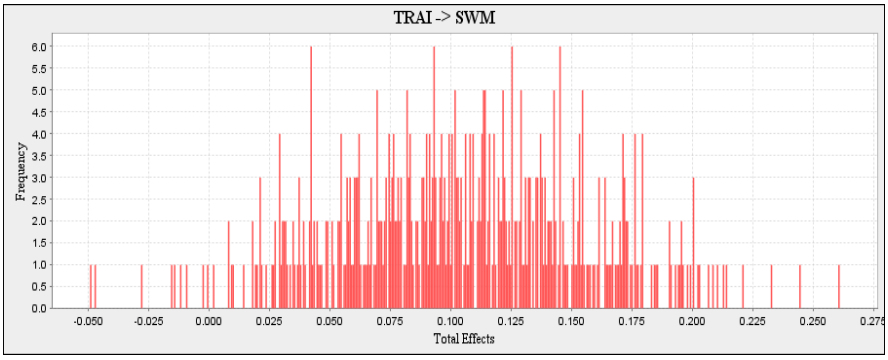
Figure 4: Total Effects Histogram of WML to SWM



Source: Author(s).

With the bar frequency largely clustered between 0.275 to 0.325, the majority of bootstrap repetitions yielded coefficients near 0.30, signifying the existence of a common path coefficient near this value (WML → SWM = 0.293). The coefficients are moderately spread with values largely residing between 0.20 to 0.40. With only a few outliers beyond this range, all the coefficients are positive and non-zero. This indicates the finding is precise and reliable, with relatively little variability, confirming that WML → SWM is consistently estimated as positive and moderate in strength, and the relationship is robust and statistically significant according to the bootstrapping procedures.

Figure 5: Total Effects Histogram of TRAI to SWM



Source: Author(s).

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The histogram shows highly clustered frequency bars between the effect sizes of 0.075 to 0.125, indicating the common path coefficient within this range; as such, TRAI → SWM = 0.101 with a significant p-value at 5% level. However, this relationship has a few outliers, although uncommon. Such outliers reside on and around zero, with few negative coefficients. But the common path coefficient is positive, and other bar frequencies show a narrow central clustering around 0.100 where the common path coefficient lies. This indicates the finding is reliable, with moderate variability, confirming that TRAI → SWM is estimated as positive and moderate in strength, and the relationship is statistically significant at 5% level.

6. Summary of Findings

This study factually examined the determinants of sustainable waste management practices among tourism enterprises in Darjeeling and Kalimpong, mainly focusing on literacy of waste management, attitude towards waste management and industry specific effects. The analysis was made using Partial Least Squares Structural Equation Modelling (PLS-SEM) which demonstrated a statistically robust model with high construct reliability, construct validity and discriminant validity. The model fit indices are estimated with statistical test, (SRMR = 0.061; NFI = 0.818) which portrayed the indices to be fit with supportive test result suggesting a good model fit. The path coefficient analysis revealed that ATWM has a direct, significant, and positive effect of 0.377 and WML has a direct, significant, and positive effect of 0.293 on SWM, respectively. These results suggest that enterprises having higher literacy about waste management and stronger environmental attitudes are more efficient in implementing sustainable waste management practices. Among the four firm-specific effects enterprise size (SIZE), formal training (TRAI), locality type (LOC), and registration status (REGD) only formal training (TRAI) showed positive and significant direct effect on SWM, indicates the intervention of structured integrated training directly enhance the adoption of sustainable waste management practices. Locality Type and Registration status revealed small, non-significant positive effects on SWM. The analysis of indirect effect displayed nominal mediation effect in the model, the impact of firm-specific variables on SWM was mostly undeviating, with ATWM and WML attending as principal explanatory constructs rather than mediators. Bootstrapping procedure is performed with 500 subsamples to obtain the basic set of results for total effects, confirmed the stability of key path coefficients, with narrow clustering of effect sizes for the three variables, i.e., ATWM, WML, and TRAI, were found to have a significant impact on SWM. Overall, the environmental attitude, literacy on waste management, and participation in formal training resulted to be the significant drivers of sustainable waste

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management in the tourism sector. The other frim-specific attributes, while being contextually relevant were not statistically significant in explaining the adoption of sustainable waste management.

7. Conclusion

The tourism industry in the Darjeeling and Kalimpong districts plays a vital role in the regional economy, attracting thousands of visitors each year with its rich cultural heritage, diverse biodiversity, and stunning scenic landscape. The increasing number of visitors also brings with it a rising volume of waste, which poses severe environmental and social concerns if not dealt with sustainably. This study has highlighted the waste management system adopted by the tourism industry in this region, which requires a more effective and sustainable approach.

Sustainable waste management is a vital component for preserving the environmental capital of hilly terrain with a fragile ecosystem, and it is not just a logistical obligation. Darjeeling and Kalimpong are situated in ecologically sensitive zones, where even minute disturbances to the ecosystem can result in impacts for decades. The inappropriate management of waste, mainly the multi-layered plastics, plastic packaging, food waste, and non-biodegradable waste, has led to soil degradation, river pollution, degradation of environmental capital, and harm to wildlife. For regions dependent on natural beauty and environmental quality to attract visitors, waste not only threatens biodiversity but also affects the very foundation of the tourism industry. The accumulation of unmanaged waste affects local communities, both economically and socially. Teeming bins, scattered waste along tourism sites, and unregulated dumping are common issues that contribute to visual pollution, significant public health risks, and ecocide, resulting in a decline in overall tourist experience. Introducing sustainable waste practices by source segregation, recycling, up-cycling, composting, and substituting single-use plastics can substantially improve the hygiene and environmental quality for both residents and visitors. This study revealed that few enterprises are adopting eco-friendly measures; these efforts remain isolated and lack coordination. To create a sustainable waste management system, all stakeholders in the sector should work collaboratively. Initiatives such as awareness campaigns, policy enforcement, training, and incentives for sustainable practices can drive widespread change. Creating peer-to-peer learning networks and community-led waste management models can further encourage knowledge sharing and best practice adoption. Sustainable waste management is expressly significant in tourism because of its direct relationship to visitor perception, destination branding, and long-term

competitiveness. Tourists are increasingly seeking environmentally responsible destinations, and the adoption of sustainable practices reflects the region's positive image. Thus, adopting sustainable practices is not only an ethical and logistical obligation but also a strategic investment in the long-term feasibility and reputation of the tourism industry in Darjeeling and Kalimpong. Sustainable waste management within the tourism industry is important to safeguard the natural environment, protect public health, enhance visitor satisfaction, and ensure the long-term economic strength of Darjeeling and Kalimpong. As tourism in these districts continues to expand, integrating sustainable principles into waste practices is a bridge to matching development with environmental conservation, laying the groundwork for a cleaner, healthier, and more resilient future for both people and nature.

8. Recommendations

The major policy recommendations from this study are towards waste management literacy, attitude towards waste management and development of a sustainable waste management model. This recommendation will significantly influence the ability of business owners to adopt environmentally friendly, responsible practices, reduce waste, and contribute to the circular economy.

To bring a meaningful behaviour change, the adoption of a new curriculum at the primary and secondary levels is essential by introducing waste management as a mandatory subject for tourism-dominated regions, which can help to build early awareness among the students. The educational departments, in collaboration with environmental agencies of the region, should develop and introduce the age-appropriate modules on sustainable waste management practices to create a foundation for future business owners.

The multimedia campaigns designed by a behavioural psychologist and environmental communicator should highlight the economic and environmental benefits of sustainable waste management. Implementation of such a campaign will shift the attitude and will inspire business owners to adopt sustainable waste management practices. The local authority should establish peer-to-peer learning networks to help people in the same industry share knowledge and experiences. Here, the business owners can communicate their sustainable waste management practices on digital platforms, which are managed by local administration in collaboration with environmental agencies.

To ensure compliance with sustainable waste management practices, the enforcement of regulations with educational supports paired with strict waste

management regulations and mandatory training sessions, the regulatory bodies in support of waste management consultants should offer workshops to help owners understand and implement sustainable practices effectively. The decentralised collection and monitoring bodies guided by industry-specific waste management guides for sectors like hospitality, retail, and manufacturing should provide actionable steps to improve literacy and encourage sustainable practices.

The integration of waste management into licensing requirements by developing an accreditation system with the help of local authority and environmental institution, where the waste management practices adopted by the enterprise should cover waste hierarchy principles and legal obligations to ensure foundational literacy.

Offering micro-learning modules for time-constrained business owners practising sustainable waste management in their day-to-day business but are not up to the mark, the modules will provide practical tips for waste reduction and recycling, which will improve both behaviour and attitude. The local bodies should also pass the regulation and sign the memorandum of understanding with the companies whose products are audited for being the top polluter in the reports of waste audit done by the bodies for implementing extended producer responsibility (EPR) and treating and managing their waste as per the regulation of EPR.

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