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SUSTAINABLE WASTE MANAGEMENT PRACTICES AND ITS PERCEIVED COST IMPLICATIONS - A DELVE INTO MANUFACTURING MICRO AND SMALL ENTERPRISES IN NORTHERN KERALA

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ABSTRACT

Waste generation and its proper management at the industrial level always poses challenges for both management and governments. The issue remains a persistent dilemma, especially in developing countries like India, which has no well-formulated guidelines and policy structures for waste management. One of the main hurdles the authorities face in industrial waste management is the unaffordability of the cost incurred. So, this study is a search to identify the sustainable waste management practices of manufacturing micro and small enterprises in Kerala and the cost implications of these practices. Additionally, this study examines the challenges of enterprises while processing industrial waste. The study used a structured interview schedule to consider the insights of 180 managers of enterprises in Kerala. The test results revealed that the waste management system of micro and small enterprises is sustainable and effective and, along with the majority of the managers, ensures that the cost associated with the sustainable waste management is not affordable by them. The study offers significant implications to the management of enterprises, encouraging the adoption of sustainable practices for waste management and the government, highlighting the need to provide support and assistance to these efforts.

KEYWORDS: Sustainability, Sustainable Waste Management, Cost Implications, Micro & Small Enterprises, Kerala.

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1. INTRODUCTION

Every year, the world produces 2.01 billion tons of solid waste, of which 33% is not managed in an environmentally safe manner. (Silpa Kaza, 2018). India is one of the top 10 countries generating solid waste in the world; almost 4 lakh tons of waste are generated daily, of which 10 to 15 percent is hazardous (Saptarshi Dutta, 2017). India produces 62 million tons (MT) of waste annually, of which only 43 MT is collected, 12 MT is treated before disposal, and the remaining 31 MT is discarded in wasteyards (Agnihotri, 2022). As statistics show, the amount of waste is increasing significantly, but it is not being managed properly. Therefore, it is important to study sustainable waste management practices. Sustainable waste management means reducing the amount of waste by using good material resources and managing the waste in a manner that contributes to the environmental, social, and economic goals of sustainable development (Mehta et al., 2018). Industrial waste is more hazardous than household waste because it contains a higher concentration of toxic substances (Ally, 2021). That is why this study was conducted among micro and small-scale enterprises to know their sustainable waste management practices and their cost implications. The study concentrated on micro and small-scale enterprises in the northern region of Kerala because Kerala is one of the main centres of MSMEs in India. This study unravelled the sustainable waste management practices of micro and small-scale enterprises and the major challenges faced by the managers during its implementation. Cost is treated as one of the important hurdles to sustainably managing waste, especially in a developing country like India. So, this study also reveals the perception of managers on the cost in connection with sustainable waste management.

2. THEORETICAL BACKGROUND

This section discusses the theoretical background of the study;

2.1 Wastes

“Wastes are substance or objects, which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law’’ (Basel Convention, 1989). Industrial waste is the waste produced by industrial activity, which includes any material that is rendered useless during a manufacturing process such as that of factories, mills, and mining operations. The waste may be different from industry to industry. According to (Neama Derhab, 2023) The metals, Plastic bottles, Polythene bags, Papers, Plastics, Packaging materials, Chemicals, Liquid/solid pollutants, Wood, Fabric, and Food were the various types of wastes within manufacturing MSMEs. (Parimala Gnana Soundari Arockiam JeyaSundar, 2020) identified solid, liquid, and gas wastes as the main types of waste within an industry, and also mentioned that wastes are different according to the nature of the industry in their study conducted to explore the waste treatment approaches for environmental sustainability. In the opinion of (Ria Millati, 2019), industrial wastes are different for mining and quarrying, energy, manufacturing and construction, and wastewater and chemical, food, paper, and

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textile are the major types of manufacturing wastes.

2.2 Sustainable Waste Management Practices

Waste management is the process and actions required to manage waste from its inception to its final disposal (UN Statistics Division, 2017). Sustainable waste management means using material resources efficiently to cut down on the amount of waste produced and, where waste is generated, dealing with it in a way that actively contributes to the economic, social, and environmental goals of sustainable development (nic). Waste management practices are different according to the nature of waste, like solid wastes, liquid wastes, and gas wastes. Some commonly adopted practices were identified from previous studies. (Parimala Gnana Soundari Arockiam JeyaSundar, 2020) classified waste treatment approaches into three they are conventional treatment (processing, Coagulation, sedimentation, filtration), thermal treatment (Incineration, Pyrolysis/gasification, Landfills), and biological treatments (Microbial mediated and Plant mediated) that industry can adopt to maintain environmental sustainability. (European Commission, 2014) introduced a five-phase waste hierarchy (prevention, minimization, reuse, recycling, energy recovery, and disposal) as a part of its environmental legislation. According to (Kan, 2009) landfills, bio-renewable gas house fuels, anaerobic conversion processes, and incineration were identified as the main disposal methods.

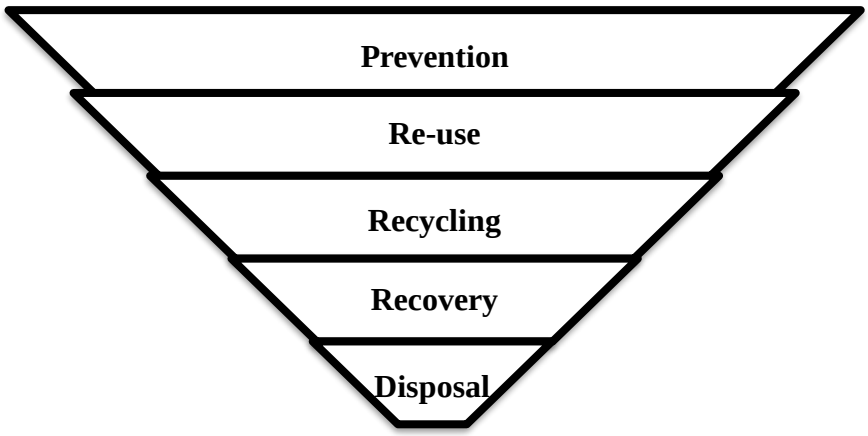

Fig. 1: Waste management hierarchy

2.3 Barriers to Waste Management Practices

The major barriers to sustainable waste management practices are low financial incentives and increases in cost within the small-scale construction industry (Turner, 2011). Identified cost, lack of knowledge, sorting material, is not viable, space, time, and willingness of staff as internal barriers and cannot even give away, cannot recycle, shire does not recycle all products, lack of facilities, advice of bin supply, lack of government support, lack of bins and/or bin space, no notification of shire

recycling, locating a suitable contractor, unreliable storage as external barriers to waste management (Janice Redmond, 2008). Lack of financial resources, lack of awareness and knowledge, lack of time, lack of policies and legislation, lack of government support, lack of infrastructure and resources, high cost, attitude of management, and attitude of employees were found as the barriers to waste management (Neama Derhab, 2023). Economic barriers, technological barriers, human resource barriers, and information barriers are the main barriers to waste management practices (Naidu, 2008).

2.4 Sustainable Waste Management and Cost Implications

Sustainable waste management is not cost-effective, according to the perception of entrepreneurs (Turner, 2011). Waste-to-energy facilities and landfills are cheaper waste management practices than other methods, and the major portion of waste is sent to mechanical biological treatment facilities, and higher costs are incurred for the same (Foggia, 2020). (K. E. Lasaridi, 2006) studied each element in total cost in connection with waste management like collection and transportation cost, operational cost, and labor cost, and found landfilling cost is the main source of the cost incurred for waste management.

3. RESEARCH METHODOLOGY

It is an empirical and descriptive research. It is an empirical study because its major findings are derived from direct experience, and it is also a descriptive study because it describes the sustainable waste management practices of manufacturing micro and small-scale enterprises in Kerala. The population of the study consists of manufacturing micro and small-scale enterprises in Kerala, and the managers of selected enterprises were the sample units of the study. A multi-stage random sampling technique was employed to select the sample. In the first stage, two districts (Malappuram & Kozhikode) were selected as they have the largest number of registered micro and small enterprises in northern Kerala. In the second stage, manufacturing micro and small enterprises engaging in food processing, brick manufacturing, and pharmaceuticals were selected randomly. Data was collected from 223 enterprises by using a structured interview schedule, and the sample size was confined to 180 by considering the reliability and validity of responses. The collected data was analyzed by using SPSS 26 with tools like mean, standard deviation, ANOVA, and one-sample t-test.

4. RESEARCH OBJECTIVES AND HYPOTHESIS

Following are the research objectives and the underlying hypothesis behind the study:

4.1 Objectives

1. To study the sustainable waste management practices of manufacturing micro and small-scale enterprises in Kerala
2. To identify the challenges of following sustainable waste management practices of micro and small-scale enterprises.

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3. To know the perceived cost implications of sustainable waste management practices

3.2 Hypotheses

H1: There exists an effective sustainable waste management system in micro and small manufacturing enterprises.

H2: The manager's perception of the cost for sustainable waste management is different according to their entrepreneurship level.

5. DATA ANALYSIS AND DISCUSSION

The collected data were analysed by using IBM SPSS Statistics 26. The researcher used various presentation and statistical tools such as frequency tables and descriptive statistics such as mean and standard deviation. A detailed analysis of the study is given below:

5.1 SUSTAINABLE WASTE MANAGEMENT PRACTICES

Reliability Assessment

To ensure the reliability of items, Cronbach's alpha is used in the present study. The Cronbach's alpha value obtained here is .700 for 21 items related to sustainable waste management, and the same is considered sufficiently reliable.

Confirmatory Factor Analysis

Table No. 5.1.1 shows that the resulting models of sustainable waste management practices were found to be a good fit as they are within acceptable limits with the recommended indices, i.e., Chi-square significance, CMIN/DF, GFI, AGFI, RMSEA, and PCLOSE.

TABLE NO: 5.1.1

SL.No.	**Achieved Fit Indices**	**Responsibility**
1	Chi-square significance	0.237
2	CMIN/DF	1.357
3	Goodness of fit index (GFI)	0.984
4	Comparative Fit Index (CFI)	0.980
5	Adjusted goodness of fit index (AGFI)	0.952
6	RMSEA	0.045
7	PCLOSE	0.465

Source: Primary data

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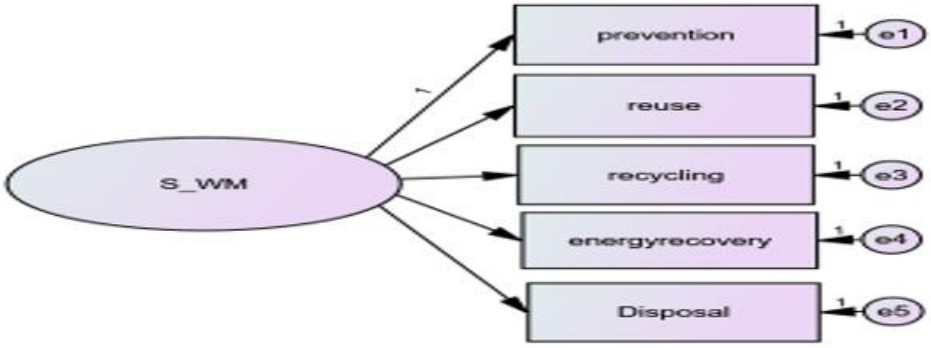

TABLE NO: 5.1.2
SUSTAINABLE WASTE MANAGEMENT PRACTICES

Practices	Mean	SD
Prevention/Minimization		
P/M 1: The Production process was redesigned	3.67	1.219
P/M 2: Use waste minimization techniques	4.06	.827
Re-use		
RU 1: Using disposable containers	3.32	1.310
RU 2: Other users are found for waste	3.41	1.513
RU 3: Priority given to refilled and reused items	3.61	1.179
RU 4: Donating unwanted goods to others	3.25	1.298
Recycling		
RC 1: recyclable waste kept separately	4.84	.388
RC 2: Product/packaging is recyclable	4.12	.690
RC 3: Company has its own system for recycling	4.12	1.337

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Energy Recovery		
ER 1: Landfill gas capture	1.37	1.013
ER 2: Anaerobic digestion & gasification hybrid treatment system	1.15	.454
ER 3: Liquid biofuel	1.44	1.047
ER 4: Incineration & heat-capturing system	1.16	.450
ER 5: Pyrolytic cogeneration	1.12	.376
Disposal		
D1: Landfill	4.81	.550
D2: Incineration	1.97	1.189
D3: Recycling	4.34	.940
D4: Composing	2.58	1.542
D5: Anaerobic digesting	1.23	.437
D6: Dewatering	1.19	.406
D7: Sedimentation	1.62	1.188

Source: Primary data

The above table 5.1.2 shows the sustainable waste management practices of manufacturing micro and small-scale enterprises. From the above table, it is clear that enterprises are good in their prevention or minimization practices, reuse, and recycling practices since the mean score is above 3. At the same time, enterprises are backward in the energy recovery practices as the mean score obtained is below 3. Landfill and recycling are identified as the most common disposal methods adopted by the enterprises as their mean score is above 3. It means that micro and small-scale enterprises in northern Kerala are good in their waste minimization, re-use, and recycling practices and slow in the energy recovery and disposal practices.

Hypothesis 1

The sustainable waste management practices adopted by enterprises are different according to their nature of manufacturing. In this study, waste management practices are studied in 5 dimensions, and it is essential to know whether the sustainable waste management system of micro and medium-level enterprises in northern Kerala is effective or not. The following hypothesis is used to know its effectiveness.

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H1: There exists an effective sustainable waste management system in micro and small manufacturing enterprises.

To test the hypothesis, the researchers used a one-sample t-test. The result of the hypothesis is described in Table 5.1.3 as follows:

TABLE NO: 5.1.3
ONE SAMPLE t-TEST SUSTAINABLE WASTE MANAGEMENT PRACTICES

Hypothesis	Test Statistic	P value	Inference
There is an effective Sustainable waste management system	-11.802	0.000	**Significant**

Source: Primary data

From Table 5.1.3, the result of the testing hypothesis at the 5% level shows that there is an effective sustainable waste management system since the P value is 0.000, which is less than 0.05. Hence, hypothesis H1 is accepted. So, to put it into a nutshell, it is clear from the study that there is a satisfactory waste management system followed by the micro and small-scale manufacturing enterprises in Northern Kerala.

5.2 CHALLENGES TO SUSTAINABLE WASTE MANAGEMENT PRACTICES

The challenges faced by micro and small-scale enterprises are comparatively more, and some challenges identified by the researchers from the previous studies in the management of waste. The mean and standard deviation found for the challenges are as follows:

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TABLE NO: 5.2.1 CHALLENGES TO SUSTAINABLE WASTE MANAGEMENT PRACTICES

Challenges	Mean	SD
High cost	4.91	.339
Lack of financial resources	4.67	.548
Lack of time	2.62	1.079
Lack of attitude & knowledge	3.59	1.373
Attitude of management	3.88	1.240
Attitude of employees	2.99	1.191
Lack of government support	4.58	.761
Technological barriers	3.98	.858
Lack of infrastructure & resources	3.82	1.063
Lack of Policies and Legislation	2.98	1.416

Source: Primary data

The above table no.5.2.1 shows the challenges to sustainable waste management of micro and small-scale enterprises. As the mean values obtained are greater than 3, high-cost lack of financial resources, lack of attitude and knowledge, attitude of management, lack of government support, technological barriers, and lack of infrastructure and resources are recognized as the main challenges to sustainable waste management and lack of time, attitude of employees and lack of policies and legislation is not significant challenges to sustainable waste management.

5.3 PERCEIVED COST IMPLICATIONS OF SUSTAINABLE WASTE MANAGEMENT

The following tables show the cost implications of sustainable waste management practices in the perception of managers of micro and small-scale enterprises**.**

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TABLE NO: 5.3.1 MAIN COST IN WASTE MANAGEMENT (RANKING ANALYSIS)

COSTS	MEAN	RANK
Cost of waste collection	2.13	6
Cost of waste separation	4.65	2
Cost of waste disposal	3.11	4
Cost of transportation of waste	2.41	5
Labor cost	3.83	3
Electricity and maintenance cost	4.84	1

Table 5.3.1 shows the main costs incurred in sustainable waste management. As a result of ranking analysis, electricity and maintenance costs are the main costs incurred in connection with sustainable waste management. Followingly, the cost of waste separation and labour cost are in the second and third positions as they hold second and third ranks in the analysis. The cost of waste collection and transportation is comparatively low, according to the opinion of managers.

TABLE NO: 5.3.2
COST IMPLICATIONS

Statements	Mean	SD
Initial cost affordable	1.97	1.000
A significant portion of the total cost is occupied by waste management cost	1.95	.742
Waste management cost reduces profitability	2.98	1.362
Waste management cost is beneficial for future	4.33	1.148

The above table 5.6 shows the perception of managers on the cost in connection with the sustainable management of waste. In the opinion of managers, the initial cost required for waste management is not affordable for micro and small-scale enterprises, as its mean score obtained is 1.97. The waste management cost has no significant role in the total cost of enterprises, as the managers opined and the corresponding mean score attained is 1.95. The majority of managers opined that the cost incurred for waste management is not reducing their profitability as its mean score is 2.98, which is less than

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3. However, almost all respondents agreed that the current cost incurred for waste management is beneficial for the future of the enterprise.

Hypothesis 2

Cost is considered an important barrier to becoming a sustainable enterprise. The capacity to afford the cost is different among enterprises according to their size. Normally, large organizations can incur more costs than small enterprises. Like, their perception regarding cost also may be different. To know if there is any difference in the managers' perception regarding the cost of sustainable waste management, the following hypothesis is used:

H2: There is a difference in the managers' perception of the cost of sustainable waste management with regard to their entrepreneurship level.

TABLE NO: 5.3.3
ONE WAY ANOVA
COST PERCEPTION AND ENTREPRENEURSHIP LEVEL

Hypothesis	F value	P value	Significance
Cost perception and entrepreneurial level	4.701	0.31	**Not significant**

From Table 5.3.3, the result of the testing hypothesis at the 5% level shows that there is a difference in the perception of managers on the cost of sustainable waste management about their entrepreneurship level since the P value is 0.31, which is greater than 0.05. Hence, hypothesis H1 is rejected. So, it is clear from the study that there is no difference in the manager's perception regarding the cost of sustainable waste management practices.

6. CONCLUSION

Rapid industrialization resulted in the generation of huge amounts of industrial waste, and it necessitates the sustainable management of waste. The study is descriptive and describes the sustainable waste management system of micro and small-scale enterprises in northern Kerala. Data was collected from 180 enterprises in the selected region with a structured interview schedule, and the collected data was analyzed with the help of SPSS 26. This study revealed the sustainable waste management practices of micro and small-scale enterprises in northern Kerala. As a result of the study, it is identified that enterprises are good at following prevention, reuse, and recycling practices and backward in energy recovery practices. Landfills and recycling were identified as the most common waste disposal methods. Moreover, high cost, lack of financial resources, lack of knowledge and

attitude, the attitude of managers, lack of government support, and technological barriers were identified as the main challenges to sustainable waste management practices. The present study has also gone through the perception of managers regarding the cost of sustainable waste management. In the opinion of managers, the cost of electricity is the main cost incurred in connection with waste management. Besides, they opined that the initial cost of waste management was not affordable to them and the cost incurred now for sustainable waste management will be beneficial for the future of enterprises. As waste is different among enterprises, its management is also different from enterprise to enterprise, state to state, and even nation to nation. This study is limited to the northern region of Kerala, and the same study can be done with other regions of Kerala and in other geographical areas. The sustainable waste management practices of other types of industries other than micro or small can also be done in the future.

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