Environmental Accounting in Managerial Practice: A Study of Awareness and Contemporary Trends

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Abstract - **Appropriate implementation and use of Environmental Accounting (EA) tools can induce major cost-saving opportunities for high energy-consuming businesses. The cost-saving opportunities include the use of energy-efficient equipment, a reduced rate of GHG emissions, and better accountability towards shareholders. This indicates a reflection of sustainable business operations that meet the social requirements of stakeholders. As Environmental Accounting (EA) performance influences environmental disclosures— including cost, performance indicators, and profitability trends—EA-based managerial awareness becomes a significant factor. This study with its secondary research and convenient sampling method finds out that gender (female) and education level (high) have a major positive impact on awareness. However, the implementation of environmental knowledge faces challenges such as resource, funding, and infrastructure gaps, especially in SMEs. Cost accounting standards also require some revisions.**

Keywords: **Managerial Awareness, EA, Circular Economy, Environmental Cost**

I. INTRODUCTION

The influence of industrialization and Foreign Direct Investment (FDA) is undeniable for the economic growth in developing countries. However, these two growth factors often conflict with the concept of sustainable economic growth policies (Sachdeva & Upadhyay, 2024). The past century has witnessed an increasing concentration of greenhouse gases (GHGs) in the atmosphere, with carbon dioxide—the key component—being responsible for 82% of the emissions (Ahmed et al., 2022). Notably, the major sources of such emissions—mostly man-made—include transportation, fossil fuel combustion, gas extraction, and improper waste management. The growing emission rate has caused an abnormal temperature rise with various extreme weather events. During the 2020 lockdown phase of Covid-19 (a comparison between April 2019 and April 2020) a 17% drop in the emission rate was observed in China and India (Ahmed et al., 2022). Unfortunately, the lifting of the lockdown led to a restoration of high emission rates. India and China contribute 7% and 10% of global emissions, respectively (Abood et al., 2022). The lockdown scenario

confirms that man-made sources can be controlled to monitor climate-related issues. Here, FDA and industrialization factors (policies, urbanization, resource types), while integrating trade and technology, work as major environmental degradation factors. Contextually, the Environmental Kuznets Curve (EKC) shows that components of economic growth, including Foreign Direct Investments (FDIs), intensify environmental degradation during the initial phases due to a lack of business and technological infrastructure. (Grossman & Krueger, 1991) further clarify that the 'scale effect' in the first phase damages land and other components of industrialization, while the 'composition effect' in the second phase promotes more environmentally friendly activities. In this context, the requirements for sustainable economic growth cannot overlook the role of environmental or green accounting (Yang, 2024). Environmental Accounting (EA) refers to an accounting model used to identify and report an enterprise's environment-specific costs, including those related to water, land, and waste management. (Schaltegger & Burritt, 2000) also considered this accounting model to analyze the eco-financial effect of enterprise activities on the environment. As enterprises are key sources of economic activity and have a significant impact on the environment, environment-friendly business practices, along with shareholder and managerial awareness of environmental factors, require proper Environmental Accounting (EA) infrastructure. Although the energy crises of 1970 started attracting enterprises' attention to EA, the practice faded in the 80s (Saremi & Moeinnezhad, 2014). Today, climate change and the rate of GHG emissions are once again attracting significant attention (Perera & Wickramasinghe, 2024). However, enterprise accounting professionals tend to focus heavily on quantifying environmental components, often ignoring the intangible aspects. This trend leads to challenges such as poor resource management and inadequate Environmental Management Systems (EMS). As a result, the CSR activities are not properly aligned with the required social dialogues (Saremi & Moeinnezhad, 2014). Moreover, the correct classification of items and appropriate cost allocation remain a challenge, even with the enterprise's

'freedom of action'. Here, the role of stakeholders and management becomes crucial in scaling cost-based frameworks, expense and cost ratios, and in linking costs with products and processes. Managerial awareness of Environmental Accounting (EA) can also contribute to government circular economy policies through standardized recycle-and-replace models (Scarpellini et al., 2020). A 2024 study observed that green accounting principles and practices enhance CSR strategies by inducing noticeable improvements in energy efficiency (Nithya & Narmatha, 2017). The same study found that only 18% of managers have a very high level of awareness of Environmental Accounting (EA), while most fail to recognize that reporting accuracy improves with its implementation. (Remya, 2024). Considering the role of managerial awareness of EA and its long-term effect on environmental factors, this paper has tried to measure different levels (senior, middle, lower) of EA-based managerial awareness (Thooyamani et al., 2014).

II. METHODOLOGY

This descriptive yet analytical study relies on secondary datasets collected from peer-reviewed articles, research papers, reports, and systematic reviews. The datasets cover a 24-year period (2000–2024) to narrow down the components of Environmental Accounting (EA). The availability of data was the primary criterion for selecting this time frame. Not all years within the target period were included, as some did not provide data suitable for the study. The study also employed 'convenience sampling' to identify fully available and accessible papers. For the study population, managers from three different levels of hierarchy—senior, middle, and lower—were selected. As environmental impact is a major consideration in this study, industries with a high impact quotient, such as energy, automobile, construction, food, agriculture, manufacturing, and fashion, were given preference. Most scholarly papers have employed various statistical tools such as ranking, weighted averages, and regression analysis. Therefore, managerial awareness rates are presented using diagrams, tables, and graphs. As women tend to prioritize environmental factors more than men, the awareness levels of women managers are specifically highlighted in this study.

Objective and Questions:

Awareness in management refers to a mindful understanding of personal strengths and weaknesses, and their impact on situations, organizational culture, best practices, and society. The 'know yourself' theme must be aligned with the 'know the environment' theme to effectively address stakeholder and societal needs, expectations, and trends (Johnson, 2015). In this context, managerial awareness of Environmental Accounting (EA) can lead to the application of appropriate sustainable tools and foster meaningful dialogue with external stakeholders. EA tools are key instruments of sustainable management, enabling improved socio-environmental operations through Corporate Social Responsibility (CSR) activities. The standard application of an Environmental Management System (EMS) can identify

environmentally hazardous operations and related efficiency gaps, along with specific cost-saving opportunities (Johnson, 2015). However, tools alone cannot improve the environment-friendly performance of organizations. In this regard, managerial awareness, effective communication, and appropriate control mechanisms are essential. Since managerial awareness and socio-environmental (organizational) performance are highly correlated, the study examines the level of EA awareness in terms of green accounting concepts, green reporting practices, implemented CSR activities, and conflict resolution patterns related to green initiatives.

The study answers the following questions:

1. Does awareness level change with management levels (senior/middle/low)? If yes, what factors (gender, age, education level, income level) influence that change?

2. How does the level of managerial awareness at different management tiers affect EA-based reporting?

3. How does awareness level influence CSR activities and relevant environmental performance?

4. Does managerial awareness level vary industry-wise?

Scope of the Study:

The managerial awareness rate—giving special attention to women managers—from various high environmental impact industries reflects the current status of EA principles and practices. Moreover, the awareness rate indicates how well managers are aligned with the socio-economic needs related to CSR activities. Since CSR initiatives are directly linked to economic growth and Foreign Direct Investment (FDI) trends, the level of awareness can significantly influence the formulation of counter-degradation policies for environmental sustainability. The current level of awareness can also help identify areas for improvement and existing gaps, such as resource accessibility, inadequate education, organizational structure and culture, and employee policies. The 2024 study involved only 25% of the female managers (although convenient sampling was used) from the automobile industry (Remya, 2024). So, the gender-specific impact on the EA model and related CSR activity types are checked here for large and small firms with high energy consumption models. For future studies, the findings can open new channels to develop specific, inclusive policies to implement EA principles and models dynamically. Additionally, the awareness level can decide new paths for circular economy-aligned policy points.

III. FINDINGS

A 2015 study on corporate Indian "green accounting practices" highlights that the 2001 country-wide survey by Business Today and The Energy Research Institute found out that 75% of the firms have environmental policies, 70% of them have an environmental audit system and 60% (of them)

have environmental departments (Malik & Mittal, 2015). Table I The findings also indicate that 40% of Indian companies possess ISO 14001 certification, the management standard for environmental impact. This 2015 paper has mainly observed the (country-wide) EA practice environment and reporting model of the late 90s and early millennium which developed the ground for current EA trends. According to the study, very few organizations have adequate information on environmental issues. However, 80 executives (senior management level) from various industries (in the late 90s) had full awareness of environmental reporting requirements (Malik & Mittal, 2015). Interestingly, the awareness was not reflected in CSR and reporting practices as most of the reports were descriptive, missing the quantified parts (environmental costs, efficiency, and related profit). So, the paper indicates a good awareness level of

senior managers but other managerial levels are not mentioned. This paper seems too generalized to effectively assess the awareness levels across different managerial tiers, but it confirms that the concept of Environmental Accounting (EA) is well understood. Therefore, other papers were selected for more integrated, industry-specific findings related to EA-based awareness. Most studies on managerial awareness and engagement with Environmental Accounting (EA) mention the application of GRI standards for sustainability reporting. Among these, GRI 300 specifically focuses on the environmental aspects of business-specific sustainability reports. To understand the disclosure pattern and GRI 300-based reporting practices, a 2022 study formulated a set of keywords. A content analysis of annual reports from different industries examines 'keyword frequency' to analyze the disclosure patterns.

TABLE I KEYWORDS FOR GRI-BASED GREEN REPORTING (GOLA ET AL., 2022)

Sustainable	Plastic	Carbon footprint	Ecology	Recycled material
Community	Water conservation	Environment friendly	Species	Bio diversity
Renewable	Ecosystem	Environmental impact	Pollutants	Energy conservation
Pollution	Waste management	Air quality	Water bodies/body	Environmental cost
Natural resources	Plantation	Carbon emissions	Non-renewable	Protected area

The 2022 study conducted a content analysis of annual reports from 29 companies across the automobile, energy, consumer goods, construction, pharmaceutical, cement, and fertilizer sectors. Table II According to the "keyword frequency" study, the words "sustainability" (38.31%) and "community" (28.36%) come with the highest percentages (Gola et al., 2022). A further sector-wise analysis using the same keyword set shows that the Energy, Metal, and Cement sectors have the highest frequency of the word

'sustainability,' while the Metal sector records the highest frequency for the word 'community'. Table III Interestingly, the word "carbon footprint" has quite a low frequency (1-3%) for all the sectors (Gola et al., 2022). This indicates a gap between concept and implementation, as sustainability should encompass low GHG emissions in all CSR activities. Although this paper states nothing about managerial awareness, the industry-specific organizational disclosure patterns confirm serious managerial awareness gaps.

TABLE II INDUSTRY-SPECIFIC KEYWORD FREQUENCY (GOLA ET AL., 2022)

Keywords	Total Frequency	Total Percentage
Sustainable	872	30.31
Community	816	28.36
Renewable	406	14.11
Pollution	161	5.60
Natural resources	104	3.61
Plastic	84	2.92
Water conservation	74	2.57
Ecosystem	68	2.36
Waste management	66	2.29
Plantation	60	2.09
Carbon footprint	31	1.08
Environmental friendly	25	0.87
Environmental impact	24	0.83
Air quality	22	0.76
Carbon emissions	15	0.52
Ecology	12	0.42
Species	12	0.42
Pollutants	8	0.28
Water bodies/body	7	0.24
Non-renewable	5	0.17
Recycled material	5	0.17
Bio diversity	0	0.00
Energy conservation	0	0.00
Environmental cost	0	0.00
Protected area	0	0.00

TABLE III INDUSTRY-SPECIFIC KEYWORD FREQUENCY (GOLA ET AL., 2022)

Consumer goods	Automobile	Energy	Pharma	Metals	C&CP	Construction	F&P
38	14	46	14	48	44	22	27
12	33	43	15	46	21	40	32
14	8	36	6	10	15	19	3
3	3	10	11	6	6	6	4
2	2	3	0	16	1	1	2
3	5	6	1	1	1	0	1
5	3	3	1	1	3	4	1
2	3	6	1	2	0	4	0
2	2	5	1	1	1	3	4
1	2	4	1	2	3	7	2
1	1	1	1	1	2	1	3
1	1	2	0	1	1	0	1
1	1	1	0	1	0	1	1
0	1	2	0	1	2	0	0
0	0	2	0	1	0	0	3
0	0	2	0	0	0	0	0
0	1	1	0	1	0	0	1
0	0	1	0	0	1	0	0
1	0	1	0	0	0	1	0
0	0	0	0	0	0	0	0
0	0	0	0	0	1	3	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
86	80	175	52	139	102	112	85

Another 2024 study to check managerial viewpoints on green accounting and CSR activities in the automobile sector has selected 13 municipalities in Thrissur. Table IV The managers are first classified based on age, gender, education, and income (Remya, 2024). Next, the classification types are matched with the level of awareness. The level of awareness ranges from 'very high' to 'very low'. Interestingly, 18% of managers have a 'very high' level of awareness, while none of the managers reported a 'very low' level of awareness. (Remya, 2024). Moreover, 50% of managers have a "high" level of awareness. The study also did surveys with questions on CSR promotional activities, green accounting adaptation, and implementation challenges.

TABLE IV A PART OF "LEVEL OF AWARENESS" SURVEY QUESTION SET (REMYA, 2024)

Level of awareness	F	Very high	High	Average	Low	Very low	Total	Weighted mean
	X	5	4	3	2	1		
I'm aware about the fact that green accounting helps in the reduction of pollution cost	F	14	24	17	4	1	60	3.77
	FX	70	96	51	8	1	226	
I'm aware about the fact that green accounting ensures long term survival of organisation	F	8	25	22	3	2	60	3.57
	FX	40	100	66	6	2	214	
I'm aware about the fact that green accounting helps to reduce adverse environmental impact	F	6	19	24	10	1	60	3.32
	FX	30	76	72	20	1	199	
I'm aware about the fact that green accounting improves accuracy of environmental reports	F	4	21	21	13	1	60	3.23
	FX	20	84	63	26	1	194	
I'm aware that adoption of green accounting will contribute to environmental sustainability	F	18	18	16	5	3	60	3.72
	FX	90	72	48	10	3	223	
I'm aware that adoption of green accounting helps to improve quality and productivity of staff working in organisation	F	12	10	28	7	3	60	3.35
	FX	60	40	84	14	3	201	

Table V A weighted average method and a ranking method are used, respectively, to assess managerial awareness and engagement levels. For instance, 'cost and resource constraints' is the highest-ranked challenge, while 'regulatory compliance' is the lowest-ranked challenge in environmental reporting and environmental accounting (EA) practices. (Remya, 2024). The 'level of awareness' survey questions include awareness of pollution cost reduction, long-term organizational survival, adverse environmental impact, accuracy of environmental reporting, contribution to sustainability, staff work quality, profitability, CSR agendas, projects, strategies, and initiatives as key outcomes of EA-based applications. The results of this study show that female managerial participation in EA-based activities is

comparatively low (only 25%) in the automobile industry. However, most managers with high EA awareness tend to hold higher qualifications, such as a postgraduate degree (36%). However, the salary amount deduces that low-middle income managers are targeted in this study as 54% (of the sample population) have a salary less than 10L, while 10% (of the sample population) have a salary between 10-20L.

Considering the salary amount as the identification point for management level, it seems that low-middle level managers from the automobile industry may be aware of the links between CSR, sustainability, decision-making, profitability, and EA, however, they are least aware of the links between EA and improved environmental reporting (Remya, 2024).

TABLE V A PART OF CSR, AND EA SURVEY QUESTION SET FOR MANAGERS (REMYA, 2024)

Statements	F	S.A	A	N	D	S.D	Total	Weighted Mean
	X	5	4	3	2	1		
Green Accounting practices significantly influenced the organization's CSR Agenda	F	17	31	11	1	0	60	4.07
	FX	85	124	33	2	0	244	
The integration of green accounting principles led to development of CSR Projects	F	20	24	16	0	0	60	4.07
	FX	100	96	48	0	0	244	
Integrating Green accounting into CSR strategies enhance reputation of the company	F	12	25	18	5	0	60	3.73
	FX	60	100	54	10	0	224	
CSR initiatives developed from green accounting has increased energy efficiency and reduced waste generation	F	15	26	15	4	0	60	3.87
	FX	75	104	45	8	0	232	
The integration of green accounting into CSR initiatives gives innovations that enable organizations to act as leader in sustainability	X	13	24	18	2	3	60	3.7
	FX	65	96	54	4	3	222	

Table VI Although this paper focuses specifically on the automobile sector, it highlights that EA awareness among lower- to middle-level managers affects their contribution to CSR strategies, activities, promotion, and agenda. Moreover, a higher level of awareness is somewhat linked to higher educational qualifications and internal organizational engagement. The findings suggest that EA-aware CSR activities enhance a company's reputation. However, most managers agree that the major challenges include the high cost of EA-aware CSR activities and insufficient resources. Of course, integration, compliance, and stakeholder engagement issues are present. But, they are not as intensive as the cost and resource challenges (Remya, 2024).

TABLE VI CHALLENGES FACED BY MANAGERS WITH EA AWARENESS (REMYA, 2024)

Challenges	F	1st	2nd	3rd	4th	5th	Total	Weighted Mean	Rank
	X	5	4	3	2	1			
Non availability of Environmental data	F	10	25	8	10	7	60	3.13	2
	FX	50	100	11	20	7	168		
Cost & Resource Constraints	F	23	10	12	8	7	60	3.57	1
	FX	115	40	36	16	7	214		
Difficult to meet stakeholders expectations	F	10	12	15	12	11	60	2.97	3
	FX	50	48	45	24	11	178		
Complexity in integration	F	8	8	14	18	12	60	2.7	4
	FX	40	32	42	36	12	162		
Regulatory Compliance	F	9	5	11	12	23	60	2.42	5
	FX	45	20	33	24	23	145		

Table VII A previous study (2016) on Indian ICT companies examined professional attitudes toward EA and related CSR activities. This study tried to explore the attitude and awareness of the ICT professionals for both large (>1000) companies and SMEs (<1000). Interestingly, this study also confirm a higher level of female awareness of green activities (Chugh et al., 2014). Notably, the study has not mentioned managers directly but the demographic characteristics table indicates the study includes "managers". In terms of industry, company culture, and standard career progress rate, the majority of the age group 30-45 years are managers (Chinsky Matuson, 2011).

TABLE VII DEMOGRAPHIC FEATURES OF THE TARGET POPULATION (CHUGH ET AL., 2014)

Characteristics	N(%)
Age group	
20-24	10 (13.7%)
25-29	27 (36.9)
30-34	19 (26.0%)
35 and older	17 (23.2%)
Gender	
Male	58 (79.5%)
Female	15 (20.5%)
Number of employees in the organization	
Less than 1000	35 (48%)
More than 1000	38 (52%)

Table VIII Moreover, the survey results confirm that 89% of professionals are highly informed about GHG emissions and their impact, while 90.5% are willing to take personal responsibility for reducing e-waste. (Chugh et al., 2014). For sustainability practice, 44.6% are concerned about high energy consumption and related costs for desktops and servers while 90% prefer to shut down their computers after completing their work. The organizational practice scenario confirms that more than 50% have sustainable policies but only 31.1% share power consumption data (statistically). Additionally, the survey data confirmed that professionals >35 years are more informed about renewable energy, e-waste, and implementation paths for ICT sustainable policies (Chugh et al., 2014). Although this paper is not directly connected to EA practices, the awareness, and general sustainability practices reflect on the accounting model.

As high industrial impact contributes to climate change and extreme weather events, climate change disclosure has become a major focus of environmental reporting. In light of this, a 2019 study attempted to link reporting factors with the number of women in senior management positions (directors/other board positions). Notably, this paper has developed a "carbon disclosure index" to quantify the disclosure (Charumathi & Rahman, 2019). So, the dependent variables include GHG emission, energy use, trading, strategy, and reporting period while the independent variables are board size, annual meeting count, % of women, and other senior management positions. Additionally, market

capital, organizational energy usage rate, and investment returns work as control variables (Charumathi & Rahman, 2019).

TABLE VIII CARBON DISCLOSURE INDEX (CHARUMATHI & RAHMAN, 2019)

	Subcategories	No. Of Variable	Score
A	Reporting Period	4	4
B	Risks and Opportunities	6	6
C	GHG Emissions	23	23
D	Energy Use	10	10
E	Trading	4	4
F	Targets and Initiatives	2	2
G	Governance and Strategy	7	7
	Carbon Disclosure Index	56	56
	CDI Score		100%

Note- Developed by authors based on Climate change disclosure to CDP

Table IX The two most important things make this study special. First, it has compared before and after the Paris agreement (2015-16) data for the disclosure. Second, it examined whether the number of women in senior management positions has any significant effect on the level of disclosure. A company, sector, and year-wise ANOVA and p-value<0.05 confirm that "Climate Change Disclosure" (CCD) significantly varies company, sector, and year-wise considering "Climate Change Project" (CDP) a standard (Charumathi & Rahman, 2019).

TABLE IX ANOVA FOR THE CCD (CHARUMATHI & RAHMAN, 2019)

	Sum of Squares	df	Mean Square	F	Sig.	
Company-Wise ANOVA						
Between Companies	35224.693	51	690.680	3.693	.000	
Within Companies	34228.954	183	187.043			
Total	69453.647	234				
Year-Wise ANOVA						
Between Years	11994.133	5	2398.827	9.560	.000	
Within Years	57459.514	229	250.915			
Total	69456.647	234				
Sector-Wise ANOVA						
Between Years	6445.065	8	805.633	2.890	.004	
Within Years	63008.582	226	278.799			
Total	69453.647	234				

Note- Results computed using SPSS 25

However, the Climate Change Disclosure (CCD) pattern or style does not differ between BSE Sensex and non-Sensex companies. Interestingly, a period-wise comparison—before and after SEBI introduced Business Responsibility Reporting in the financial year 2012–13—shows a significant difference in disclosure levels. More specifically, the mean Climate Disclosure Index (CDI) for the financial year 2011–12 was 29.4517, while the mean CDI for the period 2013–16 was 37.0971. (Charumathi & Rahman, 2019). This indicates that governance and regulation influence a more structured reporting model with improved environmental disclosure. Although CEO duality has no impact on disclosure, a larger board size with greater diversity and inclusiveness contributes to better disclosure, according to the regression results. Furthermore, an independent sample test regarding

women in senior management positions confirms that the presence of a single woman in senior management does not influence the style or pattern of disclosure. However, three or more women as a "critical mass" definitely increase the rate of climate change disclosure (Charumathi & Rahman, 2019). Although this study is important for highlighting women's connection to EA-based reporting, the sectors and companies are not clearly identified. This limitation confuses whether the findings involve both high and low energy consumer companies.

In terms of sector-wise, higher energy consumption rate, the fashion industry offers significant environmental damages with its pre and post-consumption services. Especially, the "fast fashion practice" (the trend of mass but cheap

production) has been inducing major environmental challenges. The 2018 statistics witnessed 2.1 billion metric tons of GHG emissions by the fashion industry (Thinakaran et al., 2022). Moreover, the "fast fashion practice" has directly increased the volume of fashion waste which is moved, landfilled, and sent for incineration in countries like India (De Oliveira et al., 2022). Annually, $92 million of toxic textile waste is dumped by the society. This trend was projected to increase by 60% during the period 2015–2024. (Mishra et al., 2021). Unfortunately, 75% of the fashion waste remains untreated (absence of recycling/reuse

strategies) and India, alone produces 1 million tons of fashion waste (Moazzem et al., 2021). However, public awareness and governmental push have promoted the circular economy (CE) practices. Contextually, CE practice is a major, dynamic tool for EA which can transform any industry into a reduced-waste, cost-effective, and carbon-neutral producer. As the demand for fashion materials is expected to triple by 2050, Circular Economy (CE) infrastructure and Industry 4.0 components can significantly complement EA practices. (Brar & Singh, 2022).
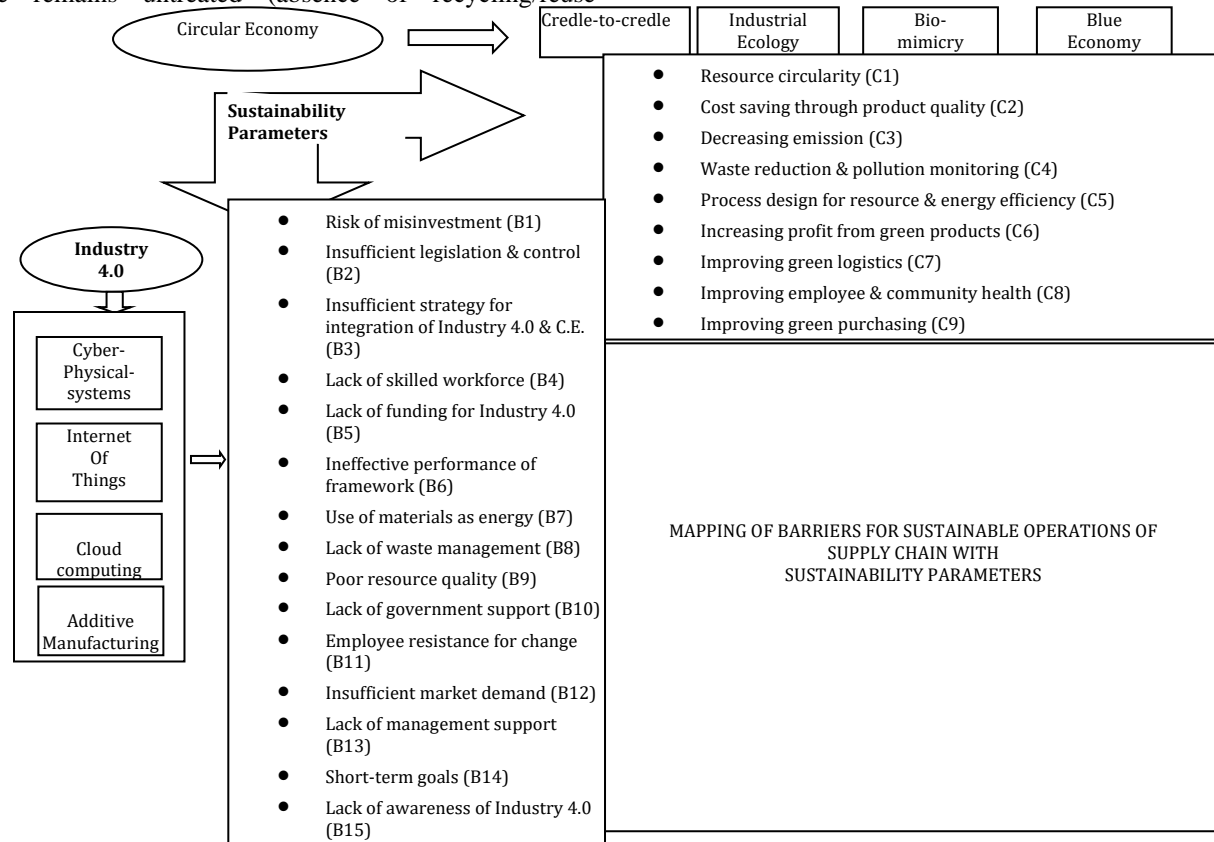

Diagram 1. Barrier mapping for CE practice (Kumar et al., 2021)

Table X Notably, a 2021 paper (to identify industry-specific barriers to CE practices) confirms that "a poorly skilled workforce, lack of managerial support, and resistance to change" are some key barriers. This study has used multi-criteria decision-making (MCDM) tools like AHP and ELECTRE for barrier identification (Kumar et al., 2021). The 'managerial support' barrier indicates that senior management is hesitant to implement CE-based sustainable operations due to limited vision, inadequate infrastructure, and insufficient funding. Moreover, automation and other advanced technologies create uncertainty among managers, making them doubtful about rapid changes and unable to keep pace with them. Although the management of larger enterprises (LEs) has good awareness of EA and CE practices, SME management tends to overlook EA research criteria. As a result, the SMEs are still responsible for 70% of the global pollution (Revell et al., 2010). Additionally, the 'management style' is completely different in SMEs and LEs. Senior

managers in LEs strictly monitor sustainable principles, prompting middle-level managers in the supply network to implement and report accordingly (Ghadimi et al., 2019). For SMEs, the strict hierarchical levels blurr and the middle management is somewhat fragmented. The fashion industry statistics for increasing waste also confirm inadequate management awareness and intervention for EA practices.

TABLE X CHALLENGE FACTORS FOR MANAGEMENT TO PRACTICE CE (THINAKARAN ET AL., 2022)

Challenges	Category
Inefficient performance evaluation system(B1)	Industrial Management (C1)
Reluctance to new business model (B2)	
Lack of traceability(B3)	

Contextually, a 2022 paper on "CE practice challenges" in the Indian fashion industry observes that a linear supply chain network, poor strategy, and absence of performance

measures are the key barriers to green accounting practice. Senior and middle management are reluctant to apply innovative tools for sustainability. Furthermore, there is no standardized value recovery and recycling strategy to support EA practices. (Thinakaran et al., 2022). Very few organizations use the "reverse supply chain" model for waste management (Thinakaran et al., 2022). The paper has categorized the "CE practice challenges" and confirmed that the "industrial management" challenge depends on three major factors. They are "insufficient performance evaluation system", "lack of traceability", and "resistance to change" (Thinakaran et al., 2022). All the factors are common themes

for poor awareness levels as aware managers can build trust with change management modules. In terms of large organizational models and integrated awareness, a 2020 comparative paper must be mentioned. This research study tried to compare the EA practices between Larsen & Toubro (construction and engineering industry) and Tech Mahindra (IT industry). It is observed that both companies have industry-specific EA practices and environmental policies. Both companies have successfully measured environmental factors with quantifiers like energy consumption rate and conservation cost (Chavarkar, 2020).
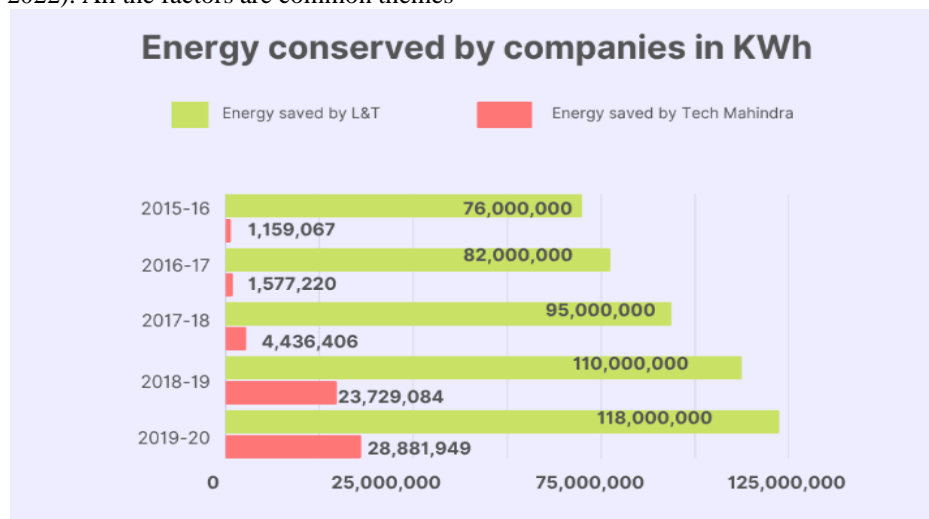
Graph 1. Company-Wise Comparison Of Energy Conservation Rate (Chavarkar, 2020)

However, the "material management" for the companies demonstrates some differences. For example, L&T's recycling rate is rapidly increasing. The rate for steel increased by 81.54% in 2019–20 compared to 2015–16, while the rate for zinc rose by 217.87% over the same period (Chavarkar, 2020). Tech Mahindra as an IT company does not have to deal with such material waste. However, the direct GHG emission rate is decreasing in Tech Mahindra significantly while its increasing in L&T. The reporting structure of the companies shows that Tech Mahindra

provides more details about conversation costs mentioning the investment and expenditure nodes (Chavarkar, 2020). Tech Mahindra's direct energy consumption rate is more efficient than L&T. Waste, water, and solar management systems have better strategies in Tech Mahindra. Although there is no standard EA disclosure model, both companies regularly report sustainable activities. They also consider "environmental reporting" a key part of corporate reporting (Chavarkar, 2020).
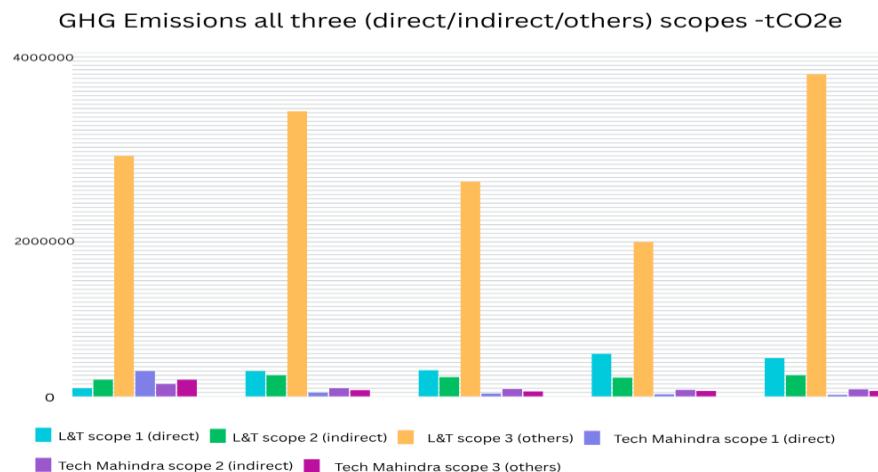
Graph 2. L&T vs Tech Mahindra GHG Emission Rates (Chavarkar, 2020)

IV. DISCUSSION

From the above findings, it is clear that awareness of senior management has a better impact on EA practices and relevant CSR activities. In the case of large enterprises, the management hierarchy follows the environmental vision and goals of the senior managers and executives. Moreover, large organizations have standard rules for environmental reporting, and senior managers are flexible in introducing innovative tools—such as EMS and CE practices—without hesitation over funding. However, SME managers have less awareness of environmental reporting. Even if they are aware, funds and innovative tools are their key challenges. SME managers are also reluctant to apply EA practices overriding the traditional practices. In terms of awareness factors such as gender, age, education, and income level, gender and education appear to have a significant impact. Regarding the automobile industry study, it can be said that "higher education" levels like post-graduation are directly proportional to the higher awareness level (Remya, 2024). On the other hand, Charumathi and Rahman (2019) confirm that a higher number of women in senior management significantly improves environmental reporting, with better exposure to relevant data. As this paper includes sector-, industry-, and year-wise analysis, the 'higher number of women in senior management' emerges as a consistent awareness factor across industries. The study on ICT professionals also seconds the "higher female awareness" factors (Chugh et al., 2014). Interestingly, in both studies, the female participation rates (25% and 20.5%) are quite low. Even if females are minority participants, they still show a higher level of awareness.

According to the findings, senior management's awareness influences the selection of sustainable goals, the choice of EA tools and reporting formats, and the types of CSR activities undertaken. Middle and low-level management is more about the implementation of the tools and activities. The automobile industry study and its income factor demonstrate that resource and cost constraints are the key reason behind the low implementation of sustainable tools. However, the fashion industry shows a more concerning managerial attitude. The statistics confirm that senior management somewhat ignores the "fast fashion waste" (not large firms) or they are helpless with poor or no environmental infrastructure (Thinakaran et al., 2022). Overall, awareness across different management levels is inconsistent, which affects reporting and related activities.

A low level of awareness leads to resistance to change, whereas a high level of awareness fosters acceptance of innovative tools and relevant changes. Naturally, welcoming innovation means a more integrated EA environment with special attention to CSR activities, cost, and profit. Resistance offers a push-pull situation between traditional accounting and modern EA models. Even higher awareness cannot do anything if the knowledge is not applied (sustainability policies, CSR activities). However, the intention to adopt EMA (aims for environmental cost

tracking and related managerial decision-making) or EMS (focuses on policies, functions, and monitoring) also faces local statutory challenges. Contextually, Japan as a neighboring country has successfully implemented MFCA (an EMA tool) to measure material and energy efficiency (Debnath, 2017). However, Japan was strongly supported by government funds and policymakers. In the case of India, the concept of EMA is still conflicting with the economic features and waste-based hidden costs. Modern EA tools have to make inferences from traditional accounting data. So, the "opportunity cost" continues to mix traditional accounting requirements. For example, the GACAP considers "pollution cost" real and classifies it as "future remediation cost". On the other hand, Cost Accounting Standard-14 states that 'future remediation costs' should be excluded from general-purpose cost statements in order to fulfill social obligations. (Debnath, 2017). That means it cannot be included in emission costs. Performance indicators are overly quantitative. So, confusion with environmental cost identification is still a major (performance) challenge. Higher awareness levels can detect this issue, but cannot help until policymakers pay attention.

It seems managerial awareness level varies industry-wise. For instance, the fashion industry is not working seriously with the "fast fashion" waste. However, the energy industry is quite serious about emission rate, CSR, and reporting and that is reflected in their reports. Additionally, the IT industry is highly aware of e-waste, energy consumption controls (for desktops and servers), and relevant sustainable policies. Two studies (2014 and 2019) confirm that the IT industry has a high level of EA awareness. Contextually, industries have different sustainability goals based on their product and service specifications. For example, L&T's (construction, engineering) material-based pollution is absent in Tech Mahindra's (IT) service (Chavarkar, 2020). Naturally, managers from different industries will have sector-specific awareness. However, general awareness must include GHG emission rate, carbon neutrality, pollution and energy consumption rate, and their environmental cost. More or less all industry managers know about the said. However, the awareness is not reflected in their actions due to infrastructure, resource, and funding challenges.

V. CONCLUSION

Environmental degradation is rapidly intensifying due to high GHG emissions, pollution, and extreme weather events. Policymakers, environmental advocates, and regulators often criticize enterprises for their uncontrolled, environmentally damaging industrial actions and activities. Contextually, EA, as a sustainable accounting practice, can identify and measure the environmental costs of business operations. However, managers are the key implementers of business policies and CSR activities both internally and externally within an organization. However, standard implementations need a good knowledge of relevant infrastructure, operations, tools, and their effectiveness. Considering the role of managers in the implementation and monitoring of EA tools, this paper

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has conducted secondary research on EA-based managerial awareness. The study observes that female managers are more aware of EA-based tools and practices than male managers. Moreover, the awareness level varies industry-wise and managers often cannot implement the tools due to resource and funding challenges. The challenges are more intense in small and medium organizations. Education level, particularly higher education level has a positive connection with a high level of awareness. In terms of performance, the cost accounting standards and, legislations need reforms to align with the EA models. The definition of "environmental cost" seems conflicting and needs more explanation for the performance indicators. Overall, managerial awareness is good but managers cannot apply the knowledge fully with the fragmented mixture of traditional accounting and EA-based models. As large enterprises are dealing better with EA tools and reporting, therefore, government and policymakers should pay attention to the EA challenges for the SMEs.

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