Enhancing Environmental Performance through EMA and Accountability in Pakistan

[1] Muhammad Siddique, [2] Kamran Ali

[1]Associate Professor, Department of Commerce, University of the Punjab, Gujranwala Campus
Email:dr.siddique@pugc.edu.pk
[2]Assistant Professor, Department of Commerce, University of the Punjab, Gujranwala Campus
Email:kamran.ali@pugc.edu.pk

ABSTRACT

The paper explores the relationship between Environmental Management Accounting (EMA) and the Environmental Performance (EP) in the manufacturing industry of Pakistan with the dimensions of accountability (answerability, responsibility and transparency) serving as mediators. The analysis of the data was conducted with the help of Partial Least Squares Structural Equation Modeling (PLS-SEM) through Smart PLS 4. The Measurement model proved to be reliable and valid whereas structural model proved important hypothesized relationships. The Findings showed that EMA directly and significantly impacts EP and high strengths of effect on answerability, responsibility, and transparency. Moreover, the dimensions of accountability were identified to improve EP and mediate between the relationship between EMA and EP, which shows that the impact of EMA on the sustainability outcomes is both direct and indirect. These findings concur with the stakeholder and accountability theories, which emphasize that stronger sustainability results are attained when EMA practices are coupled with accountability mechanisms. The study contributes to the limited empirical literature from developing countries by highlighting how accountability amplifies EMA's role in achieving sustainability. Practical implications recommend that managers and policymakers should not only focus on adopting EMA but also cultivate accountability practices to optimize sustainability performance. This study also addresses limitations and directions for future research.

Keywords: *Environmental Management Accounting, Environmental Performance, Accountability, Pakistan.*

INTRODUCTION

The problem of environmental sustainability has gained particular importance in the modern world, as adverse consequences of industrialization and economic activities have impacted natural ecosystems (Rahman, Saha, & Hoque, 2024). As a result of the increasing pressure of the stakeholders on the organizations, including the governments, consumers, and environmentalists, there is additional demand to adopt strategies that would enable the economic growth and the protection of the environmental integrity (Burritt, Schaltegger, & Christ, 2023). In this regard, environmental management accounting (EMA) has emerged as the system that assists the organizations to encompass the elements of the environment in their accounting and decision-making system (Gunarathne, Lee, & Hitigala Kaluarachchilage, 2023).

EMA is a comprehensive model encompassing both physical and monetary information on environmental performance (EP) (Amir, Rehman, & Khan, 2020; Chaudhry & Amir, 2020). his dual approach will help organizations to quantify the effects that they have on the environment in

monetary terms thereby making superior and more sustainable choices. It is also possible to identify and manage environmental costs to make organizations more efficient with resources, less wasteful, and more environmentally performing (Abbas & Ul Hassan, 2017; Adomako, Ning, & Adu-Ameyaw, 2021; Ali, Kausar, & Amir, 2023).

The issue of the environment is critical in Pakistan. With the high rates of industrialization, urbanization and population increase, pollution is now very serious and the quality of air and water is deteriorating. Deforestation and the decline of biodiversity are a growing problem (Ali et al., 2023). Despite having a number of environmental policies which have been implemented, they are not uniform in their application and enforcement of the policies. This scenario highlights why organizations should be proactive in their response to environmental issues, e.g., through the use of EMA.

Although the role of EMA in facilitating sustainability is rising to prominence in many settings, it is largely unexplored in the Pakistani context. To begin with, there is a lack of empirical studies that investigate the impact of EMA on EP in Pakistani organizations (Ahmad, 2018; Alam, Rehman, & Butt, 2011; Amir & Chaudhry, 2019; Awan, Kraslawski, & Huiskonen, 2017). The bulk of available literature has been focused on the developed economies that are not representative of the regulatory and business environment present in the developing economies, such as Pakistan. This leaves a blind spot on the role and performance of EMA practice in regulatory environments where environmental regulations might be less rigorous and enforcement capacities weaker. Secondly, the mediating role of accountability on the effectiveness of EMA has been noted, but little research has been conducted to determine its value. More precisely, how transparency, responsibility, and answerability lead to the effective EMA and, consequently, to enhanced EP is not explored (Rahman et al., 2024; Schaltegger & Burritt, 2010; Thoradeniya, Lee, Tan, & Ferreira, 2022). This is especially pertinent in Pakistan, where there is a governance and accountability problem that can have a big impact on organizational practice.

Nevertheless, in order to make the EMA initiatives successful, effective accountability mechanisms are required. It covers transparency, responsibility, and answerability (Rahman et al., 2024). Nevertheless, in order to make the EMA initiatives successful, effective accountability mechanisms are required. It covers transparency, responsibility, and answerability (Burritt et al., 2023; Rahman et al., 2024). Environmental management accountability holds organizations responsible towards conducting environmental activities and they ought to be open about reporting their performance. It entails an attitude to environmental care, disclosure, and systems of holding the organizations accountable in regard to their environmental impact. Such accountability mechanisms have the potential to improve the performance of EMA to a great degree because they encourage a culture of accountability and transparency (Ahmed, Ahmed, & Najmi, 2018; Azzahra, Ihdina, Muda, & Kesuma, 2023; Bresciani, Rehman, Giovando, & Alam, 2023).

Although the strength of EMA has been acknowledged in augmenting EP, its implementation and impact in Pakistan have not been studied. Although an environmental regulatory framework exists in Pakistan, it has been accused of being weakly enforced and not accountable. Organizations can employ EMA practices, but they may not reap the benefits of EP unless there are accountability mechanisms in place. Besides, the emphasis put on accountability as the intermediary of EMA and EP correlation has not been researched in an appropriate manner. The study tries to address the gap by investigating how EMA practices influence EP and how the accountability mechanisms can better this relationship in Pakistan. The most important aim of the

research is to explore the role of EMA on EP in Pakistan and one of the mediating variables of accountability. The study aims to:

- Assess the impact of EMA on EP.
- Find out the mediating effect of transparency of EMA and EP.
- Find out the mediating role of the responsibility exists between EMA and EP.
- Examine the mediating effect of answerability between EMA and EP.

The research is significant in the sense that it fills key gaps in the literature since it explores the correlation between EMA, accountability, and EP in the Pakistani context. The findings provide valuable data to policy makers, managers and practitioners in the environmental field on the way to enhance EP through effective EMA practices and good accountability systems. The current study can be practically implemented using practical recommendations since it presents empirical data on the impact of EMA on EP as well as describes how accountability mediates the process of improving the environmental sustainability of any organization. The policymakers can also apply the lessons that were learnt in this study to develop regulations and policies that promote the use of EMA and improve the accountability systems.

LITERATURE REVIEW

According to the NRBV (Hart, 1995)Organizational qualities become important in the management of natural resources as a competitive component of the organization. The optimal performance of the environment is based on recognizing, controlling, and the optimization of the use of environmental resources, all of which is achievable with EMA (Appannan, Mohd Said, Ong, & Senik, 2023). The results correspond to NRBV since they have established that EMA is the most powerful instrument that the EP could use as it assists a business to minimize waste, develop its resources more efficiently and sustainably (Thanh Thuy Ngoc, 2025). Thus, when EMA adoption is high (as in this case), organizations might have higher chances of gaining competitive advantages because their resource management structures are better formed and supported by stakeholders. (Zatini, Della Porta, & Za, 2025).

EMA has received so much attention as organizations aim at achieving a balance between economic and environmental objectives (Jasch, 2006). According to the theoretical frameworks like the NRBV (Hart, 1995) EMA is a powerful intra-company capability that will help firms to achieve green processes and a competitive advantage (Gunarathne & Lee, 2015). According to Burritt et al. (2023) EMA assists companies in realizing their environmental and economic output by giving pertinent information during decision-making. This is associated with the potential of obtaining cost savings, improving resource efficiency, and general sustainability (Al Doghan, Abdelwahed, Soomro, & Ali Alayis, 2022; Alessi, Battiston, Melo, & Roncoroni, 2019; Ali et al., 2023). Some researchers have presented the positive effect of EMA on the environment. Owing to the point, Chaudhry and Amir (2020) have discovered that EMA practices can result in enhanced environmental performance because the researchers have identified the possibilities of cost-reduction and enhanced resource utilization. Like Al-Mawali, Sharif, Rumman, Kerzan, and Liu (2018) have suggested, the environmental factors could be integrated into a strategic decision made using EMA in a way that would improve the environmental performance.

Responsibility plays a very important role in making organizations follow their environmental pledges. Responsibility is an important aspect if an organization intends to execute EMA. Following Rahman et al. (2024), the implementation of EMA requires further accountability

mechanisms of open reporting and accountability. These mechanisms ensure that organizations engage their responsibilities and are imbalanced to their environmental footprint, thus making EMA practices more successful (Agrawal, Wankhede, Kumar, Upadhyay, & Garza-Reyes, 2021; Bouten & Hoozée, 2013; Fuzi, Habidin, Janudin, & Ong, 2020; Jamil, Mohamed, Muhammad, & Ali, 2015). The area that requires more attention is the accountability's mediating role on the relationship of EMA and environmental performance. The accountability mechanisms, as they compel organizations to adhere to their responsibilities and commitments, could be one of the ways to enhance the effectiveness of EMA (Ferreira, Moulang, & Hendro, 2010; Imtiaz Ferdous, Adams, & Boyce, 2019; Thoradeniya et al., 2022).

EMA has direct support of transparency in that it directly provides trustworthy, verifiable, and total information on the environment internally and externally. Previous studies assert that an organization, which implements EMA practices, can deliver more credible environmental disclosures, which enhances stakeholder engagement and enables the organization to comply with environmental laws (W. Qian, Hörisch, & Schaltegger, 2018). Through the lens of NRBV, transparency made by EMA turns raw environmental information into a strategic asset that is valuable, inimitable, and rare, which helps keep the competitive advantage strong with high EP over a longer period of time(Thanh Thuy Ngoc, 2025). Even though information availability is achieved by transparency, a sense of responsibility will cause the same information to be implemented. EMA improves accountability by establishing the drivers of environmental costs, inefficiencies, and the way to maximize resources (Barani, Ahmed, Joshi, & Asiaei, 2025).

EMA is essential in facilitating accountability since it leads to a strong audit-trail of environmental data, cost analysis, and performance measurements that can support claims and establish validation of keeping the environmental promises (Rahman et al., 2024). All these dimensions together create a unified accountability system: transparency guarantees the sharing of EMA insights, responsibility guarantees their implementation, and answerability guarantees the process of continuous assessment. This paper will explore this mediating role especially in Pakistan. The hypotheses to be tested will be based on the literature review and research objectives.

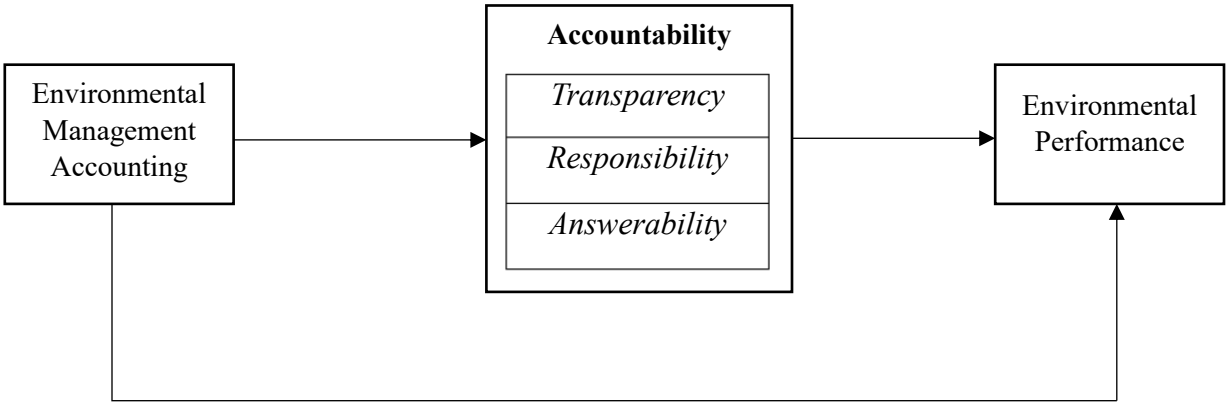
H1. EMA has a positive impact on environmental performance.

H2. Transparency significantly and positively mediates between EMA and EP.

H3. Responsibility significantly and positively mediates between EMA and EP.

H4. Answerability significantly and positively mediates between EMA and EP.

Figure 1 presents the research framework of the study.



METHODOLOGY

Sampling and Data Collection

The current research paper investigates the effects of environmental management accounting (EMA) on Environmental Performance (EP) mediated by Accountability. Primary data were collected using a survey-based design, which suits well in the research that seeks to measure organizational level perceptions in a large population of respondents. The sampling frame was a sample of 300 SMEs in Pakistan because they have higher chances of practicing environmental practices formally and thus they are relevant to the research objectives. The questionnaires were personally distributed to the managers in June 2025 through to September 2025 (590 in total).After screening for incomplete responses, 408 valid responses were retained for analysis.

The final sample size of 408 valid responses meets the statistical requirements for PLS-SEM analysis. As the instrument included 41 items, and the maximum number of items for a single construct was 10, the sample met the "10-times rule" (Hair, Risher, Sarstedt, & Ringle, 2019). Additionally, sample size recommendations for detecting medium effect sizes with adequate statistical power (Cohen, 1992) suggest that a minimum of 320 responses is sufficient. Hence, our sample of 408 ensures the robustness of the model estimation and the generalizability of the results.

Questionnaire Design and Measurements

The proposed research is to examine the impact of EMA on EP and an intervening influence of accountability on the study of SMEs in Pakistan. The study adopts quantitative methodology in order to gather primary data using questionnaires. The respondents of the research are the upper management of the SMEs in Pakistan. This group is chosen for data collection due to their consistent, in-depth knowledge and participation in the strategy formulation, and, subsequently, their knowledge and expertise in the areas of EMA and EP. The questionnaire had three major sections. During the initial phase, the purpose of the research was clarified and the respondents were promised confidentiality since their responses would not be used in any other way but in research. In the second section, our respondents were requested to give demographic information and in the third section, a 5-point Likert scale was utilized to determine the level of agreement of our respondents with the objective statements. The scales of measurement were adapted from earlier research.

In empirical investigations, measurement operationalization is required; positivism is the research philosophy, and the researcher used the new data to evaluate the preexisting theory. Additionally, Wang, Wang, and Wang (2019) provided the scale for EMA. The EMA consists of 6 questions (reliability), while the Environmental Performance Scale, adapted from (Zhu, Sarkis, & Lai, 2008) consists of 6 items (reliability). The scale to measure 'Accountability' consists of three dimensions and is adapted from the study of (Wood & Winston, 2007).

Common Method Bias

We cannot overlook the Common Method Bias (CMB) problem in the dataset hence we estimated Harman Single Factor, by using SPSS. Factor Analysis was conducted on all 41 items in order to derive a single major factor which accommodates most of the variance. The results indicated that the first factor is responsible for 41.35%, which is below the cut-off value of 50%. Consequently,

it has been determined that there is no chance of a substantial impact of CMB on the estimated outcomes.

Data Analysis

Data analysis is done by Smart PLS 4 and PLS_SEM (Partial Least Squares Structural Equation Modeling). PLS-SEM was chosen because it is strong enough to work with complicated models, with small samples, and it is also capable of giving detailed results of the association between latent variables. To test the reliability and validity of the constructs, convergent validity, discriminant validity, and composite reliability will be used to test the constructs through the use of Measurement Model Assessment. The Structural Model Assessment is used to test EMA, EP, and Accountability relationships. The accountability is viewed as a mediating variable and bootstrapping is assessed to measure the indirect effects.

RESULTS & DISCUSSION

The demographics of this study will be represented in table 1 as 69.36 percent of respondents are males and 30.64 percent are females. Regarding the age of the respondents, 35.53% of the respondents are in the first age group, i.e. Less than 40 years, and majority of the respondents (47.05) are in the second group of age group, i.e. 40 years-50 years. The age group of 5060 years has only 15.2 percent of the respondents. The minimum number of respondents (2.2%) is from the highest age category of "Above 60 years." 20.8% of respondents are from the experience category of "Less than 10 years." Additionally, 39.7% (the majority) of the respondents are from the second category of experience, i.e. "10–20 years," 32.8% of respondents are from the experience bracket "20–30 years," while the minimum (6.6%) have more than 30 years of experience.

Table 1: Demographics of Respondents

Respondent's Profile	Category	Frequency	Percentage
Gender	Male	283	69.36
	Female	125	30.64
Age	Less than 40 years	145	35.53
	40–50 years	192	47.05
	50–60 years	62	15.2
	Above 60 years	9	2.2
Experience	Less than 10 years	85	20.8
	10–20 years	162	39.7
	20–30 years	134	32.8
	More than 30 years	27	6.6

Measurement Model Results

Table 2 represents how each item is loaded individually and the reliability of each construct is indicated by Cronbachs alpha which proved that the value of any construct is higher than the threshold value of 0.70. Insofar as the validity can be discussed, composite reliability (CR) of each construct is also above the said level, as it is over 0.7 and under 0.95. In addition, convergent validity is evaluated using the Average Variance Extracted (AVE) and the scores suggest that the average variance extracted by each construct is more than 0.5. Thus, the results affirm the reliability and validity of all the constructs in the study. In this study, we have used the Heterotrait-Monotrait (HTMT) in checking the discriminant validity. The table 3 results indicate that the figure is below 0.85.

Table 2: Reliability and Validity

Constructs	Items	Loadings	Cronbach's alpha	CR	AVE
Environmental Management Accounting	EMA1	0.859	0.911	0.913	0.693
	EMA2	0.851			
	EMA3	0.772			
	EMA4	0.847			
	EMA5	0.869			
	EMA6	0.792			
Responsibility	RESP1	0.808	0.915	0.916	0.568
	RESP2	0.770			
	RESP3	0.753			
	RESP4	0.744			
	RESP5	0.790			
	RESP6	0.749			
	RESP7	0.710			
	RESP8	0.737			
	RESP9	0.743			
	RESP10	0.727			
Answerability	ANS1	0.795	0.905	0.907	0.540
	ANS2	0.735			
	ANS3	0.710			
	ANS4	0.686			
	ANS5	0.785			

	ANS6	0.655			
	ANS7	0.769			
	ANS8	0.745			
	ANS9	0.697			
	ANS10	0.756			
Transparency	TRP1	0.781	0.908	0.911	0.579
	TRP2	0.813			
	TRP3	0.751			
	TRP4	0.799			
	TRP5	0.818			
	TRP6	0.682			
	TRP7	0.701			
	TRP8	0.746			
	TRP9	0.742			
Environmental Performance	EP1	0.860	0.930	0.933	0.740
	EP2	0.898			
	EP3	0.880			
	EP4	0.873			
	EP5	0.808			
	EP6	0.840			

Table 3: Discriminant Validity (HTMT)

Construct	ANS	EMA	EP	RESP	TRP
ANS	-				
EMA	0.762	-			
EP	0.769	0.852	-		
RESP	0.619	0.801	0.803	-	
TRP	0.650	0.704	0.700	0.544	-

Results of the Structural Model

The analysis of the structural model suggests that answerability is a key determinant of enhancing environmental performance ($\beta = 0.227$, $p = 0.003$), and it may be observed that accountability machinery strengthens the sustainable activities in organizations. On the same note,

answerability, transparency, and responsibility are positively related with environmental management accounting with 0.695, 0.643 and 0.733 respectively which are statistically significant. The findings affirm that EMA is a major factor that causes the formation of accountability organizational mechanisms, transparency, and ethical accountability among others, and consequently contributes to the enhancement of the environmental performance. The direct impact of EMA on the environmental performance, which is positive and significant (0.277, p =0.003) proves that EMA is an important tool of strategy in its role in enabling performance in sustainability. Those companies that integrate EMA in the decision making process are better placed to align the operational strategies with the environment objective, therefore, improving efficiency and long term ecological worth. Besides, the results also indicate the positive influence of responsibility (β =0.323, p = 0.000) and transparency (β = 0.179, p = 0.012) on the environmental performance, that is, ethical organizations with an open communication system have a higher chance of achieving the sustainability targets.

Table 4: Standardized Estimates of Direct Effects

Path	β (Path Coefficient)	Standard deviation (STDEV)	t-value	p-values	Significance
Answerability -> Environmental Performance	0.227	0.076	3.007	0.003	***
Environmental Management Accounting -> Answerability	0.699	0.051	13.702	0.000	***
Environmental Management Accounting -> Environmental Performance	0.277	0.094	2.960	0.003	***
Environmental Management Accounting -> Responsibility	0.733	0.041	17.829	0.000	***
Environmental Management Accounting -> Transparency	0.643	0.052	12.379	0.000	***
Responsibility -> Environmental Performance	0.323	0.087	3.722	0.000	***
Transparency -> Environmental Performance	0.179	0.070	2.521	0.012	***
Environmental Management Accounting -> Answerability -> Environmental Performance	0.159	0.056	2.849	0.004	***
Environmental Management Accounting -> Transparency -> Environmental Performance	0.114	0.047	2.421	0.016	***
Environmental Management Accounting -> Responsibility -> Environmental Performance	0.236	0.066	3.570	0.000	***

Mediation analysis was also used to support these findings. Answerability mediator regarding the impact of EMA on the environmental performance (β = 0.159, p = 0.004) and this also implies the fact that organizations tend to get better sustainability outcomes when EMA is

connected to increased accountability. Similarly, the effects of transparency (in the EMA relationship) and (environmental performance) are mediated by transparency (β = 0.114, p = 0.016), and (= 0.236, p = 0.000) which immigrates the significance of ethical openness and responsibility in enhancing the effect of EMA. This mediation confirms that the impact of EMA on sustainability is not just direct, but it is also enhanced by the availability of organizational accountability, transparency, and responsibility.

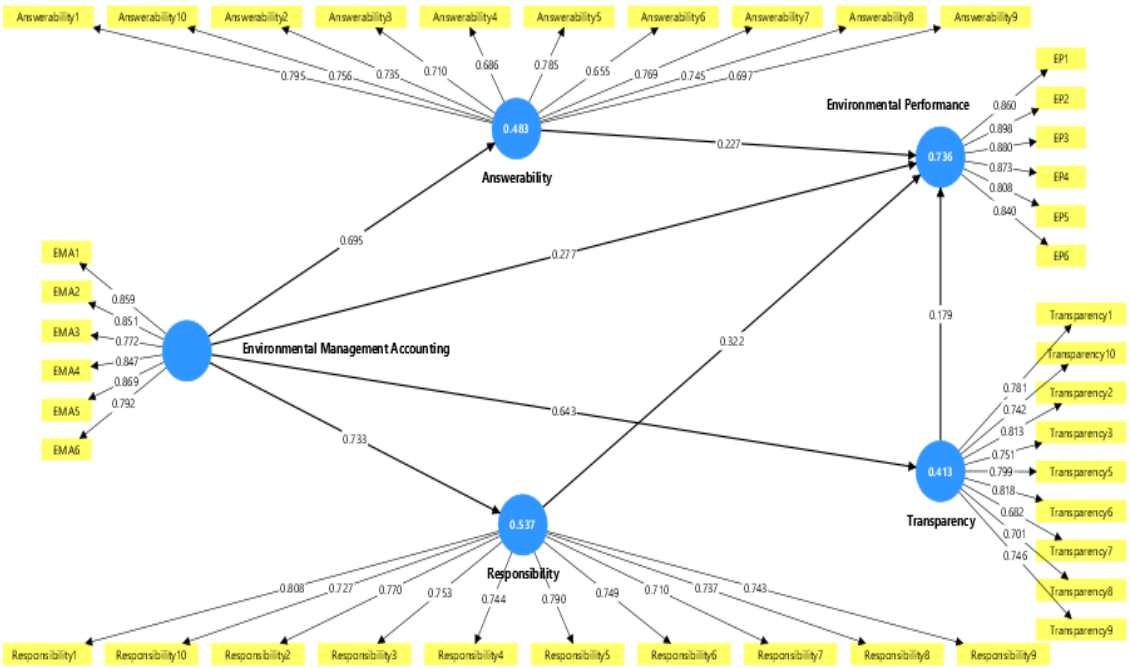


Table 5 shows the model fit on the whole. The SRMR was 0.067 that is below the mark of 0.08, meaning that the model fits well (Sarstedt et al., 2022). The value of dULS (3.879) and dG (1.944) are not very high which can indicate that there is no serious model misspecification. The goodness of the model is also shown by the value of the Chi-square (889.996), although the Chi-square is a good tendency statistic of sample size. The NFI value was 0.734, which is not as high as 0.9 recommended, and thus the model does not have a perfect fit, but it can be accepted in the exploratory research setting (Hair et al., 2019). All these indicators imply that the model fit is not ideal but within an acceptable range to explain and offer a good foundation on which to test hypotheses.**Table 5: Model fit**

	Saturated model	**Estimated model**
SRMR	0.060	0.067
d_ULS	3.144	3.879
d_G	1.917	1.944
Chi-square	888.383	889.996
NFI	0.734	0.734

The present study has contributed to the literature on sustainability since it is empirical in essence and it explores the impact of EMA on EP where accountability aspects (answerability, responsibility and transparency) mediate the interactions. these findings are very similar to the stakeholder theory and the accountability theory, which holds that organizations ought to perform better in terms of sustainability in instances where they have employed accountability processes and met the needs of the stakeholders (Bovens, 2007; Freeman & Reed, 1983). The findings showed that EP is directly and significantly influenced by EMA (0.277 = 0.003). This conclusion supports the previous research that environmental accounting practices can improve resource efficiency and sustainability performance through aligning business operations with environmental goals (Gerged, Zahoor, & Cowton, 2024; Y. Qian et al., 2021). This confirms the assumption that EMA is an important force behind the enhancement of environmental performance.

Moreover, the results found the positive, significant impact of EMA on answerability (0.699, p = 0.000), transparency (0.643, p = 0.000), and responsibility (0.733, p = 0.000). This indicates that the direct positive impact of EMA on the environmental performance is not only evident, but it also impacts the design of the answerability that is very important in the inculcation of the principles of sustainability in the business operation. It reinforces previous findings on EMA by reinforcing the ethical governance framework and builds the trust that has been attained among the stakeholders (Burritt & Schaltegger, 2010; Latan, Jabbour, de Sousa Jabbour, Wamba, & Shahbaz, 2018). All of these components were found to significantly enhance EP, including answerability (p = 0.003, β = 0.227), responsibility (p = 0.000, β = 0.323), and transparency (p = 0.012, β = 0.179). This shows that the individuals who embrace the concept of accountability, responsibility, and transparency are in a good position to achieve the goals of sustainability. The study results are similar to the previous research studies that have highlighted the importance of accountability mechanisms in defining sustainable organizational performance (Michelon, Pilonato, & Ricceri, 2015; Perego & Kolk, 2012). The mediation analysis also increased these observations The mediation variables with significant impact on EMA and EP include answerability (β = 0.159, p= 0.004), responsibility (β = 0.236,p = 0.000), and transparency (β = 0.114, p= 0.016). These outcomes guarantee that when EMA is integrated with high degree of accountability, it can be more effective in helping achieve environmental outcomes. This is founded on accountability theory according to which ethical responsibility and open communication would improve the validity and functionality of sustainability projects (Gray, 1996).

CONCLUSION

This research examined how EMA can be used to attain improved EP and how dimensions of accountability can mediate this effect. The findings agreed with the argument that EMA can be significant in achieving sustainability directly and indirectly with the help of answerability, responsibility, and transparency. The results show that the effectiveness of EMA is enhanced by the presence of the inferential mechanisms, in relation to the ethical expectation, the receptive communication, and the responsiveness to the expectation of the stakeholders. So EMA is not a technical instrument of environmental reporting: it is a strategy agency creating a sense of responsibility and organizational credibility. The findings justify the consideration of integrating EMA and accountability practices to achieve long-term sustainability objectives.

The paper also contributes to a theory of stakeholder and accountability theory because it presents the use of accountability mechanisms in making EMA a sustainable entity in an empirical

manner. The study shows that despite the fact that the past research was mostly focused on the direct impact of EMA on performance, the paper illustrates the mediating role of the dimensions of accountability, thereby increasing the theoretical understanding of how sustainability may become a constituent of organizational governance regimes. Besides, the results contribute to the limited body of empirical studies in the developing world, especially in Pakistan, where the institutions are weak, hence accountability practice is even more vital to the sustainability performance.

On the managerial component, this study demonstrates that the integration of EMA is not sufficient to ensure sustainability. In order to maximize the benefits of EMA, organizations ought to improve the same accountability, disclosure, and responsibility. The managers should consider the development of frameworks that support transparency and moral responsibility because they increase the impact of EMA on environmental performance. To policymakers, the results indicate that there should be regulation frameworks that promote the adoption of EMA in addition to accountability systems in order to have an inclusive and effective sustainability practice within the manufacturing industry.

Despite being a useful study, there are limitations to it. First, the data were cross-sectional, and thus they could not be able to capture long-term changes in the relationships between EMA, accountability, and EP. Future studies can use longitudinal designs to address the dynamic nature of accountability in the sustainability outcomes. Second, the research was limited to manufacturing organizations in Pakistan, which limits its generalizability. Future research ought to examine other industries and international settings in order to confirm the results. Third, although the focus of this research was on accountability mechanisms, other organizational variables like leadership style, green innovation, or institutional pressures might also moderate or mediate the relationship between the EMA and EP. Future studies may elaborate on the framework by including such contextual variables so as to give a more in-depth picture of sustainability practices.

REFERENCES

Abbas, M. W., & Ul Hassan, M. (2017). Moderating impact of environmental turbulence on business innovation and business performance. *Pakistan Journal of Commerce and Social Sciences (PJCSS), 11*(2), 576-596.

Adomako, S., Ning, E., & Adu-Ameyaw, E. (2021). Proactive environmental strategy and firm performance at the bottom of the pyramid. *Business Strategy and the Environment, 30*(1), 422-431.

Agrawal, R., Wankhede, V. A., Kumar, A., Upadhyay, A., & Garza-Reyes, J. A. (2021). Nexus of circular economy and sustainable business performance in the era of digitalization. *International journal of productivity and performance management, 71*(3), 748-774. doi:10.1108/ijppm-12-2020-0676

Ahmad, S. (2018). Can ethical leadership inhibit workplace bullying across East and West: Exploring cross-cultural interactional justice as a mediating mechanism. *European Management Journal, 36*(2), 223-234. doi:10.1016/j.emj.2018.01.003

Ahmed, W., Ahmed, W., & Najmi, A. (2018). Developing and analyzing framework for understanding the effects of GSCM on green and economic performance: Perspective of a

developing country. *Management of Environmental Quality, 29*(4), 740-758. doi:10.1108/Meq-11-2017-0140

Al-Mawali, H., Sharif, A., Rumman, G. A., Kerzan, F., & Liu, G. (2018). Environmental strategy, environmental management accounting and organizational performance: evidence from the United Arab Emirates market. *Journal of Environmental Accounting and Management, 6*(2), 109-118.

Al Doghan, M. A., Abdelwahed, N. A. A., Soomro, B. A., & Ali Alayis, M. M. H. (2022). Organizational environmental culture, environmental sustainability and performance: the mediating role of green HRM and green innovation. *Sustainability, 14*(12), 7510.

Alam, S., Rehman, S., & Butt, M. S. (2011). Trade liberalization, environmental degradation and sustainable development in Pakistan. *European Journal of Social Sciences, 19*(1), 84-96.

Alessi, L., Battiston, S., Melo, A. S., & Roncoroni, A. (2019). The EU Sustainability Taxonomy: a financial impact assessment. *European Commission, available at: https://ec. europa. eu/jrc/en/publication/eusustainability-taxonomy-financial-impact-assessment*.

Ali, K., Kausar, N., & Amir, M. (2023). Impact of pollution prevention strategies on environment sustainability: role of environmental management accounting and environmental proactivity. *Environ Sci Pollut Res Int, 30*(38), 88891-88904. doi:10.1007/s11356-023-28724-1

Amir, M., & Chaudhry, N. I. (2019). Linking Environmental Strategy to Firm Performance: A Sequential Mediation Model via Environmental Management Accounting and Top Management Commitment. *Pakistan Journal of Commerce and Social Sciences, 13*(4), 849-867.

Amir, M., Rehman, S. A., & Khan, M. I. (2020). Mediating role of environmental management accounting and control system between top management commitment and environmental performance: A legitimacy theory. *Journal of Management and Research, 7*(1), 132-160.

Appannan, J. S., Mohd Said, R., Ong, T. S., & Senik, R. (2023). Promoting sustainable development through strategies, environmental management accounting and environmental performance. *Business Strategy and the Environment, 32*(4), 1914-1930.

Awan, U., Kraslawski, A., & Huiskonen, J. (2017). Understanding the Relationship between Stakeholder Pressure and Sustainability Performance in Manufacturing Firms in Pakistan. *27th International Conference on Flexible Automation and Intelligent Manufacturing, Faim2017, 11*, 768-777. doi:10.1016/j.promfg.2017.07.178

Azzahra, F., Ihdina, I., Muda, I., & Kesuma, S. A. (2023). The correlation of environmental management system and financial performance: a systematic literature review. *Brazilian Journal of Development, 9*(12), 31886-31894.

Barani, O., Ahmed, A. D., Joshi, M., & Asiaei, K. (2025). How environmental management accounting drives performance: a meta-analysis considering national EMA maturity. *Journal of Accounting Literature, 47*(5), 416-443.

Bouten, L., & Hoozée, S. (2013). On the interplay between environmental reporting and management accounting change. *Management Accounting Research, 24*(4), 333-348. doi:10.1016/j.mar.2013.06.005

Bovens, M. (2007). Analysing and assessing accountability: A conceptual framework 1. *European law journal, 13*(4), 447-468.

Bresciani, S., Rehman, S. U., Giovando, G., & Alam, G. M. (2023). The role of environmental management accounting and environmental knowledge management practices influence on environmental performance: mediated-moderated model. *Journal of Knowledge Management, 27*(4), 896-918.

Burritt, R. L., & Schaltegger, S. (2010). Sustainability accounting and reporting: fad or trend? *Accounting, Auditing & Accountability Journal, 23*(7), 829-846.

Burritt, R. L., Schaltegger, S., & Christ, K. L. (2023). Environmental management accounting–developments over the last 20 years from a framework perspective. *Australian Accounting Review, 33*(4), 336-351.

Chaudhry, N. I., & Amir, M. (2020). From institutional pressure to the sustainable development of firm: Role of environmental management accounting implementation and environmental proactivity. *Business Strategy and the Environment, 29*(8), 3542-3554. doi:10.1002/bse.2595

Cohen, J. (1992). Statistical power analysis. *Current directions in psychological science, 1*(3), 98-101.

Ferreira, A., Moulang, C., & Hendro, B. (2010). Environmental management accounting and innovation: an exploratory analysis. *Accounting Auditing & Accountability Journal, 23*(7), 920-948. doi:10.1108/09513571011080180

Freeman, R. E., & Reed, D. L. (1983). Stockholders and stakeholders: A new perspective on corporate governance. *California management review, 25*(3), 88-106.

Fuzi, N. M., Habidin, N. F., Janudin, S. E., & Ong, S. Y. Y. (2020). Environmental management accounting practices, management system, and performance SEM approach. *International Journal of Quality & Reliability Management, 37*(9-10), 1165-1182. doi:10.1108/Ijqrm-12-2018-0325

Gerged, A. M., Zahoor, N., & Cowton, C. J. (2024). Understanding the relationship between environmental management accounting and firm performance: The role of environmental innovation and stakeholder integration–Evidence from a developing country. *Management Accounting Research, 62*, 100865.

Gray, S. F. (1996). Modeling the conditional distribution of interest rates as a regime-switching process. *Journal of financial economics, 42*(1), 27-62.

Gunarathne, N., & Lee, K.-H. (2015). Environmental Management Accounting (EMA) for environmental management and organizational change: An eco-control approach. *Journal of Accounting & Organizational Change, 11*(3), 362-383.

Gunarathne, N., Lee, K.-H., & Hitigala Kaluarachchilage, P. K. (2023). Tackling the integration challenge between environmental strategy and environmental management accounting. *Accounting, Auditing & Accountability Journal, 36*(1), 63-95.

Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European business review, 31*(1), 2-24.

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of management review, 20*(4), 986-1014.

Imtiaz Ferdous, M., Adams, C. A., & Boyce, G. (2019). Institutional drivers of environmental management accounting adoption in public sector water organisations. *Accounting, Auditing & Accountability Journal, 32*(4), 984-1012.

Jamil, C. Z. M., Mohamed, R., Muhammad, F., & Ali, A. (2015). Environmental management accounting practices in small medium manufacturing firms. *Contemporary Issues in Management and Social Science Research, 172*, 619-626. doi:10.1016/j.sbspro.2015.01.411

Jasch, C. (2006). Environmental management accounting (EMA) as the next step in the evolution of management accounting. In (Vol. 14, pp. 1190-1193): Elsevier.

Latan, H., Jabbour, C. J. C., de Sousa Jabbour, A. B. L., Wamba, S. F., & Shahbaz, M. (2018). Effects of environmental strategy, environmental uncertainty and top management's commitment on corporate environmental performance: The role of environmental management accounting. *Journal of cleaner production, 180*, 297-306.

Michelon, G., Pilonato, S., & Ricceri, F. (2015). CSR reporting practices and the quality of disclosure: An empirical analysis. *Critical perspectives on accounting, 33*, 59-78.

Perego, P., & Kolk, A. (2012). Multinationals' accountability on sustainability: The evolution of third-party assurance of sustainability reports. *Journal of business ethics, 110*(2), 173-190.

Qian, W., Hörisch, J., & Schaltegger, S. (2018). Environmental management accounting and its effects on carbon management and disclosure quality. *Journal of cleaner production, 174*, 1608-1619.

Qian, Y., Xiao, L., Wang, Q., Head, J. W., Yang, R., Kang, Y., . . . Wang, G. (2021). China's Chang'e-5 landing site: Geology, stratigraphy, and provenance of materials. *Earth and Planetary Science Letters, 561*, 116855.

Rahman, M. M., Saha, S., & Hoque, M. (2024). Unveiling the link between environmental management accounting, energy efficiency, and accountability in state-owned enterprises: An integrated analysis using PLS-SEM and fsQCA. *Environmental challenges, 14*, 100832.

Sarstedt, M., Hair, J. F., Pick, M., Liengaard, B. D., Radomir, L., & Ringle, C. M. (2022). Progress in partial least squares structural equation modeling use in marketing research in the last decade. *Psychology & Marketing, 39*(5), 1035-1064.

Schaltegger, S., & Burritt, R. L. (2010). Sustainability accounting for companies: Catchphrase or decision support for business leaders? *Journal of World Business, 45*(4), 375-384. doi:10.1016/j.jwb.2009.08.002

Thanh Thuy Ngoc, T. (2025). Unlocking environmental management accounting and environmental performance: a mediated moderation model through green technology innovation and environmental strategy. *Meditari Accountancy Research, 33*(2), 733-758.

Thoradeniya, P., Lee, J., Tan, R., & Ferreira, A. (2022). From intention to action on sustainability reporting: The role of individual, organisational and institutional factors during war and post-war periods. *British Accounting Review, 54*(1), 101021. doi:ARTN 101021

10.1016/j.bar.2021.101021

Wang, S., Wang, H., & Wang, J. (2019). Exploring the effects of institutional pressures on the implementation of environmental management accounting: Do top management support and perceived benefit work? *Business Strategy and the Environment, 28*(1), 233-243.

Wood, J. A., & Winston, B. E. (2007). Development of three scales to measure leader accountability. *Leadership & Organization Development Journal, 28*(2), 167-185.

Zatini, G., Della Porta, A., & Za, S. (2025). Deciphering Barriers and Strategies in Environmental Management Accounting (EMA) Adoption: A Comprehensive Two-Decade Analysis. *Corporate Social Responsibility and Environmental Management, 32*(3), 3355-3370.

Zhu, Q., Sarkis, J., & Lai, K.-h. (2008). Confirmation of a measurement model for green supply chain management practices implementation. *International journal of production economics, 111*(2), 261-273.