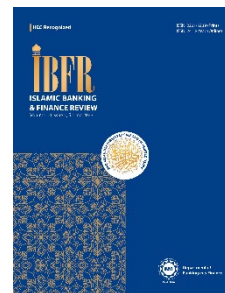
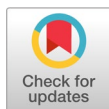


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Driving Sustainable Waste Management Through CSR, Green Accounting, and Digital Zakat: The Mediating Role of Environmental Auditing Oversight in Pakistans Commercial and Manufacturing Sector

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Abstract

This study aimed to explore how green accounting, corporate social responsibility (CSR), and digital Zakat influenced sustainable waste management practices (SWMPs) in Pakistans commercial and trading sector, with a specific focus on the mediating role of environmental auditing oversight. A quantitative research design was employed, using a structured self-administered questionnaire distributed to 478 professionals across 70 leading commercial firms in Pakistan. Structural Equation Modeling (SEM) was applied to test direct and mediated relationships within the proposed model using the PLS-SEM approach via SmartPLS 4.0. Mediation was assessed using the bootstrapping technique with 5,000 samples to generate bias-corrected confidence intervals for indirect effects. The findings revealed that all three independent variables, CSR, digital zakat, and green accounting, had significant positive effects on sustainable waste management. Environmental auditing oversight served as a critical mediating mechanism, enhancing the influence of each independent construct on SWMPs. Digital zakat demonstrated powerful direct and mediated effects, suggesting the growing relevance of Islamic social finance in corporate sustainability. CSR and green accounting showed improved outcomes when supported by robust environmental oversight structures. This study advances environmental management literature by introducing digital zakat as a novel variable and empirically establishing environmental auditing oversight as a significant mediator linking CSR, green accounting, and digital zakat to sustainable waste management practices. For practitioners, the findings advocate for embedding formal environmental governance structures within Pakistans commercial sector, enabling firms to translate ethical and financial sustainability commitments into measurable waste reduction outcomes.

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Keywords: corporate social responsibility, digital zakat, environmental auditing oversight, green accounting, sustainable waste management practices

Introduction

Pakistan's commercial sector faces a critical sustainability challenge: translating ethical commitments into concrete environmental outcomes, particularly in the domain of waste management. Faith-based financial instruments such as Zakat, when integrated with strategic governance frameworks like green accounting and corporate social responsibility (CSR), hold considerable yet underexplored potential to drive sustainable waste management practices. When anchored by formal environmental auditing oversight, these mechanisms together represent a promising but empirically understudied pathway toward sustainable development in Pakistan's trading and commercial sector (Pinto, [2023](#)). Due to the aggravation of climate scenarios and the decline in the quality of resources, the companies in the Pakistani field of commerce and trade are forced to reconsider their approach to environmental impact and waste management (Shakil et al., [2025](#)). The needs behind implementing sustainable waste management practices (SWMPs) are especially acute, with the nation producing more than 3.9 million tons of hazardous waste every year, and commercial concerns being among the leading sources of it (Osman & Elamin, [2023](#)).

Incorporating green accounting (GA) within the business reduces the cost of measuring and internalizing environmental costs. This strategic role allows commercial organizations to measure their environmental debts and correlate them to the financial performance index, which provides a data sense in the reduction of waste and resource efficiency (Pinto, [2023](#)). The fact is that the use of GA in the trade industry of Pakistan is underutilized, and even though it is well-known that its integration decreases environmental expenses and promotes an eco-efficient approach, there is still a lack of clarity about its benefits. Moreover, the same is true of corporate social responsibility (CSR), which has been transformed during the past decades to turn it into a regulatory imperative rather than a voluntary practice, with investors and other actors promoting environmental transparency and accountability (Sadallah et al., [2023](#)). CSR-associated reporting and environmental investment are now a determining factor in the orientation of waste in firms.

Comparatively, the analogous digitalization of Zakat, which initially offered only a change in the modality of donation, is also becoming a tool of financial transparency and social equity in Islamic economies. The digitalization of Zakat in Pakistan coincides with the tendency in the world to the growth of Islamic fintech and ESG finance, which are part of both environmental and social impact plans (Ali et al., [2024](#)). Digital Zakat enables companies to contribute to long-term development projects such as waste management and health and environmental rehabilitation, and at the same time fulfill their religious duties (Kismawadi & Irfan, [2025](#)). Nonetheless, the use of digital Zakat to support corporate environmental processes is a field that has received little scholarly attention, especially in developing Muslim dominant economies such as Pakistan.

The convergence of these factors resides at the locus of environmental auditing oversight (EAO), which is a mediating element that assures the verifiability and quality of environmental disclosures and sustainability assertions. The accountability structure is also enhanced at EAO since they independently verify the programs on GA, CSR, and Zakat issues and ensure that they convert into real change in the environment (Umar et al., [2023](#)). Pakistan has an unorganized environmental management system that undermines sustainability even where it is practiced well. Well-established EAO systems can also connect the strategic initiatives with performance realities, including sustainable waste management, mainly by enhancement of monitoring and compliance systems (Ali et al., [2024](#); Osman & Elamin, [2023](#)). This conceptual framework is multidimensional and requires empirical testing in the Pakistani business environment, which is also progressing to the responsible business format.

In addition, there is little empirical data in the context of the commerce and trading corporations in Pakistan, especially on how they utilize the Islamic tools, such as digital Zakat, which can be incorporated in formal mechanisms of environmental governance

The primary aim of this study is to investigate the impact of green accounting, corporate social responsibility, and digital Zakat on sustainable waste management practices, with the mediating role of environmental auditing oversight, in the context of Pakistans trading and commercial enterprises. This study seeks to empirically test the integrated model by collecting quantitative data from registered commerce-sector firms and analyzing the structural relationships among these constructs.

This study is of paramount importance to both the academic community and practitioners in the emerging Pakistan sustainability realm. The research also helps to fill the gap in the literature accumulated in recent years on environmental costings and resource tracing in emerging economies because it empirically confirms the presence of green accounting (Jan et al., [2023](#)). In regard to CSR, the study identifies the structurization and assessment of voluntary business ethics with adequate oversight that, in turn, can align the activity with the expectations of stakeholders whilst being quantifiable (Faieq & Cek, [2024](#)). Digital Zakat adds one more ethical-financial resource to the previously considered Islamic actions about everyday environmental problems, and most importantly, in the context of corporate sustainability models (Khan & Ahmad, [2025](#)). Further, the study offers fresh knowledge on the role of transparency and verification in improving the implementation of the sustainability project through the mediation of environmental auditing oversight. Notably, the concentration on the trading companies and commerce in Pakistan makes the findings applicable in the neighborhood, in which context the findings are relevant to a sector not only with significant environmental implications, but also with underdeveloped governance.

Literature Review

Stakeholder Theory

Stakeholder Theory, which was initially developed by Freeman (1984), holds that the fundamental goal of a firm extends and goes beyond profit maximization to the needs and interests of a vast number of stakeholders. These stakeholders consist of shareholders, employees, suppliers, customers, regulators, communities, and the natural environment, all of whom have different expectations concerning corporate behavior, especially about such issues as sustainability and ethical responsibility (Al Aina & Faisal, [2024](#)). Enterprises that fail to meet these expectations, in the current business environment, stand to lose legitimacy, trust, and goodwill in the market and with the regulatory community (Al-Taani et al., [2024](#)). Stakeholder Theory, therefore, gives another sound basis to explain why environmental accountability and ethical finance practice are becoming more required in developing economies in regions such as Pakistan, where there is a fast uprising of public awareness and legislations concerning sustainability (Sadallah et al., [2023](#)). The theory emphasizes that companies, particularly those within the business and trade industries, have

to materialize environmental policies with regard to the values and interests of various stakeholders.

When applied to green accounting, the Stakeholder Theory describes its development as one of the managerial responses to the demands of new measurements of environmental effects to be more transparent. The growing pressure on companies to internalize costs to the environment and report on the performance of environmental elements is also requiring green accounting to be an important expedient to bridge the financial and environmental performance (Kismawadi & Irfan, [2025](#)). In the Pakistani situation, stakeholders such as investors, international, and regulatory bodies are slowly pushing the need to promote accounting based on the basic environmental costs of industrial processes (Napitupulu et al., [2024](#)). Companies that do not greenify their accounting are in danger of losing these important stakeholders, and such companies might find themselves in a difficult position to enter foreign markets and attract additional funding (Walidah, [2024](#)). Thus, in Stakeholders Theory, green accounting is not only an accounting innovation but a strategic requirement that governs the relationship between the company and its stakeholders in the eco-sensitive global economy.

Equally, corporate social responsibility (CSR) complements the normative aspect of the Stakeholder Theory, which implies that companies are morally obliged to protect society and the environment, irrespective of economic gains (Umar et al., [2023](#)). CSR emerges as a process that companies use to reveal their sensitivity to the interests of the stakeholders, especially in addressing externalities like garbage and pollution (Pinto, [2023](#)). In Pakistan, where social and religious sectors strongly affect the collective perceptions of corporate ethics, CSR acts as a channel through which corporations move toward corporate ethics in accordance with the values of the stakeholders (Jan et al., [2023](#); Sadallah et al., [2023](#)). The theory highlights that the CSR projects towards sustainable waste management do not only rest on the environmental value but also enhance stakeholder trust and legitimacy (Shakil et al., [2025](#)). Stakeholder Theory, therefore, defines a holistic approach to a prospective perception of CSR as neither an optional addition nor a charity but as part of a business strategy established within a resource-rich and socially conscientious business environment.

Within this study's framework, Stakeholder Theory provides a direct theoretical rationale for the mediating role of Environmental Auditing

Oversight (EAO). Diverse stakeholder groups including regulators, investors, communities, and civil society organizations demand not only that firms adopt sustainable practices such as CSR, green accounting, and digital Zakat, but also that these practices be independently verified and credibly reported (Anser et al., [2024](#)). EAO serves precisely this function: it transforms stakeholder pressure into accountability by providing a formal verification mechanism that ensures environmental disclosures are accurate, comparable, and actionable (Khan & Shah, [2024](#)). In this sense, EAO does not merely complement CSR, green accounting, and digital Zakat; it is the structural response that Stakeholder Theory predicts organizations will develop when facing sustained, heterogeneous stakeholder demands for environmental transparency. Without such oversight, stakeholder demands risk remaining unsatisfied, regardless of the firms underlying sustainability intentions.

Green Accounting

Green accounting or environmental accounting is a new branch of accounting that incorporates environmental expenditures into standard financial analysis. It indicates the success of the organization in terms of ecological performance by converting environmental effects, waste, and resource loss into a monetary form (Hassan et al., [2025](#)). With persisting environmental regulations and the exertion of high stakes on firms to be environmentally transparent, the concept has been receiving growing interest (Yasmeen et al., [2024](#)). Green accounting particularly is indicated to be useful in industries with environmental externalities that are high that some of the trading and commercial establishments in Pakistan are more than comparable given that they pollute the urban environment, create a waste build up, and waste energy at rates that surpass expectations (Ahmad & Berghout, [2025](#)). Through the quantification of liabilities in the environment, as well as the consumption of resources, green accounting can internalize the external charges, thus enhancing strategic planning of waste management efforts (Faizi et al., [2024](#)). The following makes it all the more relevant in the context of developing nations such as Pakistan, where not only is the degradation of the environment on the rise, but where data-driven policy instruments are in grave need.

Green accounting as a theory has a strong connection with the stakeholder theory that states the answer to the question of the responsibility of an organization towards a greater number of participants, among which

environmental integrity stakeholders (Al-Daihani et al., [2025](#)). Companies that embrace green accounting indicate that they uphold integrity regarding the environment and ethical environmental performance, thus improving stakeholder trust and social license to operate (Fodol & Aslan, [2025](#)). Where the environmental regulation is substantially loose and occasionally disjointed (as it is in Pakistani circumstances), green accounting of the corporate could cover the institutional gaps by facilitating self-regulation concerning quantified environmental variables (Khalifah et al., [2024](#)). It has been proposed that organizations with systematic environmental accounting show better results with regard to waste prevention and energy savings (Rahim et al., [2024](#)). This is essential to commercial ventures that are coming under more inspection by the exporting markets and international affiliates in their environmental impact.

Moreover, green accounting plays a direct role in sustainable waste management practices (SWMPs) as it allows firms to monitor the waste streams, evaluate the usefulness of disposal processes, and determine where recycling and reuse are possible. Hoque ([2023](#)) think that by using green accounting, the country will improve waste governance by enhancing responsibilities to manage the volume, treatment, and destination of waste that is generated. In their research, where they explored environmental accounting management tools, they discovered a notable correlation where the use of green accounting corresponded to the enhancement of waste sorting, composting, and industrial recycling activities. Akhter et al. ([2025](#)) found similar results and reported that structured firm environmental accounting systems performed efficiently in segmentation and disposal of solid waste more than firms that did not use them in the commercial sector in Pakistan. This is being done in tandem with the broader sustainability agendas, such as SDG 12 (responsible consumption and production) by the United Nations, which promotes the wise management of waste as part of industrial systems.

In spite of its advantages, the case of green accounting is widely underutilized in Pakistan, especially in the commerce and trading sector. Its implementation is restrained by various obstacles, including insufficient regulatory requirements, the low awareness of financial managers, and the lack of transparent reporting systems (Hoque et al., [2023](#)). The SECP has already undertaken initial attempts to synchronize corporate reporting and sustainability reporting; however, the enforcement is ad hoc and limited to

big manufacturing companies (Raimi & Bamiro, [2025](#)). Medium and small business organizations tend to ignore environmental accounting because it is something they are not quite sure about, not a priority, but a charitable activity or a business strategy (Rafi et al., [2025](#)). It indicates a significant point of neglect in practice and policy that this piece of work intends to fill by assessing the empirical effectiveness of green accounting in sustainable waste management and determining the mechanisms through which the approach can be moderated, including oversight by environmental auditing.

It is important to distinguish Green Accounting from Environmental Auditing Oversight (EAO), as the two constructs are related but operationally distinct. Green Accounting refers to the internal measurement, recording, and disclosure of environmental costs and liabilities within a firm's standard financial and management accounting systems; it is a proactive, firm-level practice that integrates ecological considerations into decision-making (Hoque et al., [2023](#)). Environmental Auditing Oversight, by contrast, is an external or semi-external verification and governance process that independently examines whether the environmental data and disclosures produced through green accounting (and related sustainability activities) meet established standards, regulatory requirements, and stakeholder expectations. In short, green accounting generates environmental information, while environmental auditing oversight validates and governs it.

Corporate Social Responsibility

Corporate Social Responsibility (CSR) is no longer a voluntary and charitable process; rather, it is a strategic corporate governance requirement, particularly in cases where a company has been very impactful environmentally and socially. It describes the moral duty of corporations to share the pursuit of social objectives, such as environmental conservation, minimization of wastes, and promotion of the community, without merely being within the scope of the law (Nickerson & Georgiadou, [2025](#)). In Pakistan, commercial businesses are becoming more subject to pressure to work in a manner that is compliant with the objectives of sustainability, particularly in urban regions, where having uncontrolled waste generation disrupts the setting and advances the harshest environmental emergencies (Amjad et al., [2024](#)). Such CSR initiatives as recycling campaigns, the use of biodegradable packaging, or waste analyses of the supply chain are based on the values of sustainable waste management and indicate that firms can

utilize social responsibility as a risk-and reputation-building strategy (Radwan et al., [2023](#)). The same practices have been described not merely as morally admirable but fundamental to the long-term legitimacy of operation in a resource-strained economy.

Theoretically, CSR is highly rooted in the stakeholder theory that underlines the responsibility of the firm towards a wide range of interest groups, specifically, those communities that face environmental deterioration (Napitupulu et al., [2024](#)). Developing economies such as Pakistan have dual uses of CSR; the practice fills in the normative stakeholder gap, but it also corrects institutional and regulatory failures in the environmental protection domain. CSR initiatives are frequently performed in regions where the state fails to provide such services as the collection of solid waste or environmental literacy (Yasmeen et al., [2024](#)). Fodol and Aslan ([2025](#)) agree that companies that engage in CSR and environmental sustainability have higher chances of establishing organized waste disposal policies. The included practices involve waste audits, collaboration with local waste recyclers, and internal environmental stewardship training.

Further, assimilation of CSR into the fundamental business activities has been proved to affect not only the corporate strategy but also operational procedures related to environmental performance. Within the premises of sustainable waste management, CSR helps to develop the culture of sustainability regarding waste and ecological responsibility among employees and their supply chain partners, stimulating the decrease of single-use materials, reprocessing of goods, and lean inventory (Wahab & Ali, [2025](#)). Khan ([2024](#)) indicate that a company involved in CSR activities that aim to address environmental problems demonstrates a much better performance in waste management indicators as compared to companies that do not participate in such activities. Such signs are decreasing the disposal of hazardous wastes, increasing the recycling of goods, and improving the handling processes of hazardous wastes (Memon, [2024](#)). The trading companies in Pakistan, including the import-export firms, wholesalers, and logistics companies, are also facing pressure from the local communities as well as international partners to ensure that their CSR programs include the whole life of the product and services, including the waste byproducts.

The adoption of CSR as an instrument to achieve sustainable waste

management in Pakistan has a number of institutional and practical setbacks despite its rising prominence. The issue is that many companies understand CSR as the external or secondary aspect of decision-making, which does not add value but remains a cosmetic or similar company-level intervention (Alshehadeh et al., [2024](#)). The entry of rules like the Companies Act 2017 sets in place fundamental disclosure regarding CSR, but levels of enforcement have been haphazard at best, with few environmental consequences monitored (Khan, [2022](#)). Moreover, CSR programs are rarely linked with an independent verification system or environmental audit facility and, therefore, cannot be entirely transparent and efficient. The lack of stakeholder-all-inclusive frameworks and performance-based assessment measures also undermines the long-term contribution of CSR to the management of waste (Khan, [2023](#)). There is therefore an urgent imperative to empirically explore how CSR, when adequately structured and audited, will have a central role to play in realizing sustainable management of waste among commercial and trading establishments within Pakistan.

Digital Zakat

Digital Zakat, as a technological advancement of an ancient Islamic practice of almsgiving, is an expanding aspect of Islamic social finance. From an Islamic finance perspective, Zakat represents a mandatory redistributive instrument embedded in the broader maqasid al-shariah framework, distinguishing it fundamentally from voluntary CSR-related giving; while CSR philanthropy is discretionary and strategically motivated, Zakat is a faith-mandated obligation that carries built-in accountability norms and governance expectations, making its digital operationalization particularly aligned with ESG and sustainability objectives in Islamic economies (Khan & Ahmad, [2025](#)). It has also come out to be a tool, not only satisfying religious and other obligations, but also helping achieve larger developmental and environmental goals when incorporated into strategic company dimensions.

In the theoretical perspective, the Stakeholder Theory supports the incorporation of Zakat in sustainability practices of corporations by requiring a firm to meet the financial and environmental demands of people in its broader society. Islamic companies cannot focus solely on profit-making endeavors, but it is considered the stewards (khalifah) of the goodness of society; therefore, the Zakat is an instrument of redistributive justice and environmental ethics (Khan, [2024](#); Khan & Ahmad, [2025](#)).

When directed at projects aimed at reducing waste, digital Zakat meets the religious requirement of accountability and social-environmental stakeholder satisfaction driven by the same projects, including paying to participate in recycling schemes, joining community clean-up campaigns, or investing in green business ideas (Ali et al., [2024](#)). Companies that make Zakat via digital channels have an enhanced level of trust among the stakeholders, particularly when money is openly spent on visible infrastructure (Khan & Ahmad, [2025](#)). Such models exist in the limited spheres of the commercial world in Pakistan, but can be replicated and used to integrate environmental Zakat.

The use of digital Zakat in the sustainable waste management practices (SWMPs) is a promising area that is at its inception. Researchers have advocated for its organized use, in aiding the environmental sustainability initiatives under the umbrella of Maqasid al-shariah, the preservation of life, wealth, and environment (Hassan et al., [2025](#)). Companies can invest the Zakat revenues in the zero-waste awareness campaigns, set up composting networks in cities, or micro-finance the recycling enterprises run by low-income people. These projects cover poverty eradication and environmental restoration, which are two key causes of Islamic finance (Anser et al., [2024](#)). This is particularly so in the case of Pakistan, where a large proportion of the informal waste collectors and recyclers do not exist in the institutional framework. By using Zakat-based initiatives, companies will be able to eliminate social and ecological inequalities and increase their status and environmental reporting (Kismawadi & Irfan, [2025](#)). This brings Zakat straight to a belief-anchored responsibility as well as concrete, measurable environmental results.

Hypotheses Development

Green accounting has gained momentum in sustainability research because it provides firms with the possibility to measure, monitor, and disclose environmental costs associated with their operations. Green accounting in the Pakistani context is not being fully exploited, especially in the field of commerce and trade, although there is an increasing loss of environment as well as an increasing financial burden on the environment (Jan et al., [2023](#)). At the international level, it has been repeatedly demonstrated that organizations that use green accounting systems lead to high efficiency in dealing with waste and minimizing pollution (Faizi et al., [2024](#); Khan & Shah, [2024](#)). Green accounting, as one mechanism of

enhancing waste governance, is formulated through quantifying ecological costs into the financial reporting. However, empirical analysis of green accounting and the association between green accounting and the practice of sustainable waste management in the commercial enterprises of Pakistan has little evidence to support it; thus, explaining the necessity to test this relationship as a part of the current research.

H1: Green accounting has a significant effect on sustainable waste management practices in Pakistans trading and commerce sector.

Corporate Social Responsibility (CSR) has been acclaimed as an essential model regarding the management of environmental issues within the privatized sector. In Pakistan, the driving force behind CSR is more likely to be stakeholder pressure and reputational issues; however, the measures of this translation into practical results in the reduction of waste are irregular (Faieq & Cek, [2024](#)). Although most companies use CSR programs, it is not evident how effective the CSR programs are in spurring sustainable waste management practices, especially in commercial and trading firms where the CSR programs are mainly fragmented or symbolic (Al Aina & Faisal, [2024](#)). The necessity to examine the correlation between CSR and SWMPs is explained by the fact that there exist no empirical studies assessing the practical, that is, non-rhetorical, effect of CSR campaigns in the Pakistani context. The aim of the hypothesis will be to establish whether CSR is really the meta-governance in the waste industry or if it is just a branding process.

H2: Corporate social responsibility has a significant effect on sustainable waste management practices in Pakistans trading and commerce sector.

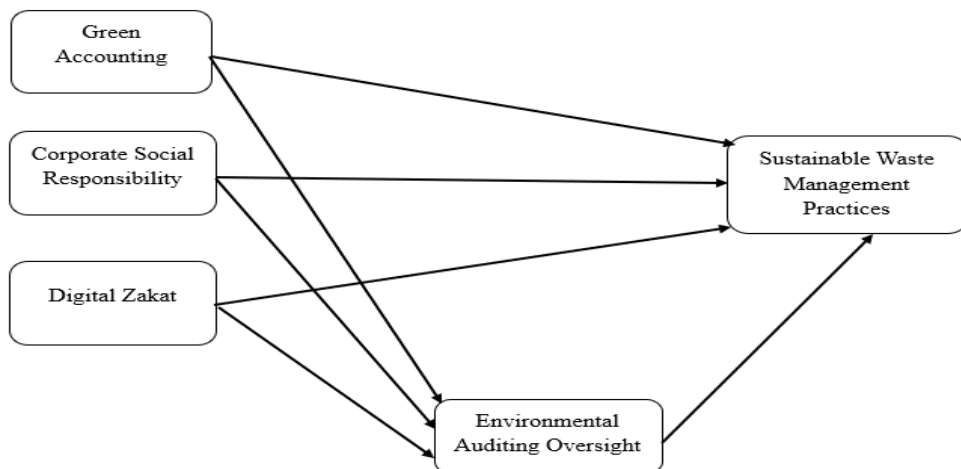
It is possible to use digital Zakat to shape the results of waste management systems at the corporate level. This is the reason why the hypothesis is needed to empirically test the answer to the question of whether digital Zakat could be a possible financial instrument of promoting sustainable waste management in the commercial sector (Fodol & Aslan, [2025](#)). Unlike CSR-related philanthropy, which is discretionary and typically firm-driven, digital Zakat is religiously mandated and externally governed, lending it a unique accountability structure that is more likely to be directed toward verifiable social and environmental outcomes rather than reputational objectives alone.

H3: Digital Zakat has a significant effect on sustainable waste management

practices in Pakistans trading and commerce sector.

Although CSR, green accounting, and Zakat are important separately, the success of their translation to actual environmental impacts will be related to the existence of oversight institutions that anchor accountability and verifiability. This is because environmental auditing oversight (EAO) contributes as a neutral player that checks the information, lessens informational imbalance, and institutionalizes sustainability reporting (Hoque, [2023](#)). In Pakistan, the absence of stringent monitoring usually sets back the execution of CSR and green programs. Empirical study proposes that EAO strengthens the effects of safeguarding strategies by setting them up with performance-based metrics (Fodol & Aslan, [2025](#)). Because the mediating impact of EAO on the relation between strategic elements (CSR, GA, Zakat) and SWMPs in Pakistan did not involve any empirical testing, it becomes important to evaluate the possibility of the auditing oversight serving as an agent of change to produce a viable waste-reduction outcome based on the strategic intentions.

Figure 1
Theoretical Framework



H4: Environmental auditing oversight significantly mediates the relationship between green accounting and sustainable waste management practices.

H5: Environmental auditing oversight significantly mediates the

relationship between corporate social responsibility and sustainable waste management practices.

H6: Environmental auditing oversight significantly mediates the relationship between digital Zakat and sustainable waste management practices.

Methodology

All of variables' items were measured on a five-point Likert scale specified as 1 (strongly disagree) to 5 (Strongly agree). The instrument was well contextualized to match the Pakistani business environment and ethical facts of firms operating in the Pakistani commerce scene. To address potential common method bias, procedural remedies were applied during data collection, including the use of anonymity assurances and the separation of predictor and criterion items within the questionnaire. Post-hoc statistical checks using Harman's single-factor test confirmed that no single factor accounted for the majority of variance, suggesting that common method bias is unlikely to be a serious concern in this dataset, though this limitation is acknowledged given the reliance on a single-source, self-administered instrument.

The methodology used in this research involved judgmental sampling in order to extract industry expertise on the selected employees within various firms operating in the commercial and trading sector of Pakistan. Purposive sampling was employed in this study because the research questions require respondents with specific domain knowledge of environmental governance, sustainability accounting, and CSR implementation within Pakistan's commercial sector. The specific criteria used for firm selection were: (1) the firm operates within Pakistan's trading or commercial sector; (2) the firm has a formally documented CSR or sustainability policy; and (3) the firm employs at least one individual with designated responsibility for environmental reporting or sustainability management.

In every firm, knowledgeable respondents were primarily identified at the managerial and supervisory level: waste managers, managing directors, environmental auditors or regulators, and sustainability managers. A limited proportion of operational staff with direct environmental responsibilities were also included where no dedicated sustainability personnel were present, given that green accounting, CSR, environmental auditing, and

sustainable waste management practices cut across various organizational roles. In order to relieve the fears of violating the assumption of independent and identically distributed variables, the researchers increased the sample size to increase the generalizability and reliability of the study. Respondents of the study were adequately distributed regarding gender, age, job descriptions, and industrial domains in the sample of Pakistani commercial and trading firms. A total of 600 questionnaires were distributed across the 70 selected firms, yielding 478 valid responses (response rate = 79.7%), with each firm contributing between 4 and 12 respondents; where multiple respondents were present within a single firm, their responses were treated as independent individual-level observations consistent with the individual-unit of analysis. Among these 478 valid responses, 51.5% were male and half, 48.5% were female, which shows a close-to-equal characteristics of the genders. Regarding age, most of the participants were of the 31 to 45-year age range, 48.3% followed by the 18 to 30-year age range, 33.9% and the 46-to-60-year age range, 17.8%, demonstrating a mid-career working community. In terms of job positions, environmental auditors and regulators, 31.2% and managing directors, 30.8% were the most populous groups, followed by sustainability experts, 22.8% and waste managers, 15.3% which gave both strategic and operational perspectives. Also, the respondents cut across all six principal classes of industries, with the most significant proportion represented by textile product mills, 24.5%, apparel manufacturing, 19.9% and electronic equipment, 17.8% respectively, and the rest, including chemical manufacturing, 15.7%, beverage and tobacco, 13.6%, and leather and allied products, 8.6%.

Results

Table 1

Construct Reliability and Convergent Validity

Constructs	Factor Loadings	AVE	Rho_c
Corporate Social Responsibility		0.625	0.921
CSR1	0.765		
CSR2	0.773		
CSR3	0.748		
CSR4	0.831		
CSR5	0.736		
CSR6	0.827		

Constructs	Factor Loadings	AVE	Rho c
CSR7	0.845		
Digital Zakat		0.709	0.924
DZ1	0.902		
DZ2	0.836		
DZ3	0.839		
DZ4	0.877		
DZ5	0.748		
Environmental Auditing Oversight		0.748	0.954
EA01	0.864		
EA02	0.893		
EA03	0.885		
EA04	0.731		
EA05	0.888		
EA06	0.892		
EA07	0.888		
Green Accounting		0.666	0.922
GA1	0.770		
GA2	0.870		
GA3	0.842		
GA4	0.862		
GA5	0.855		
GA6	0.681		
Sustainable Waste Management Practices		0.644	0.942
SWMP1	0.849		
SWMP2	0.718		
SWMP3	0.880		
SWMP4	0.802		
SWMP5	0.805		
SWMP6	0.845		
SWMP7	0.607		
SWMP8	0.890		
SWMP9	0.788		

Table 1 revealed the results of the measurement model analysis and showed that there is an overwhelming indication of convergent validity and construct reliability of all latent variables involved in the analysis. The

convergent validity based on the Average Variance Extracted (AVE) measure is acceptable where all the constructs exceeded the minimum of 0.50, which was the standard suggested by Fornell and Larcker (1981). Digital Zakat (AVE = 0.709) and Environmental Auditing Oversight (AVE = 0.748) recorded the best AVE values, showing that their values lay beyond the variance of nearly 70% using the constructs under which they were the indicators. On the same note, Corporate Social Responsibility (AVE = 0.625), Green Accounting (AVE = 0.666), and Sustainable Waste Management Practices (AVE = 0.644) also met the requirement, thus confirming that the indicators were both theoretically consistent and statistically coherent. The composite reliability values also contributed to support the consistency of the internal measurement, where all the constructs were above the thumb rule of 0.70. The scores of internal consistencies between 0.921 with CSR and 0.954 with Environmental Auditing Oversight demonstrate that the level of internal consistency of all measurements has been excellently proven. These values evidenced that these constructs were measured reliably, and the items that constitute each construct were very interrelated. Factor loadings of items were also good, and this is represented by the majority of them being above the critical value of 0.70. Likewise, the loadings of items in CSR were between 0.736 and 0.845, in the case of Digital Zakat, items were between 0.748 and 0.902, and Environmental Auditing Oversight items were between 0.731 and 0.893, indicating strong item-level reliability.

Table 2

Correlation

	1	2	3	4
1. Corporate Social Responsibility	-			
2. Digital Zakat	0.78	-		
3. Environmental Auditing Oversight	0.50	0.71	-	
4. Green Accounting	0.61	0.60	0.51	-
5. Sustainable Waste Management Practices	0.50	0.73	0.88	0.50

Table 2 shows the Pearson correlation coefficients between the five primary constructs of the research, namely Corporate Social Responsibility (CSR), Digital Zakat, Environmental Auditing Oversight (EAO), Green Accounting (GA), and Sustainable Waste Management Practices (SWMPs). Each correlation ran positive and proved statistically important, resulting in

the constructs being theoretically interrelated with the other constructs in the sustainability context. It is to be noted that Environmental Auditing Oversight and Sustainable Waste Management Practices showed the strongest relationships ($r = 0.88$), which indicated a very strong as well as direct relationship. This meant that the greater the environmental auditing oversights, the greater the chances of strong application of the management of sustainability of waste materials by businesses in the corporate sphere. Digital Zakat and SWMPs ($r = 0.73$) also had a robust correlation, indicating the increased importance of Islamic social finance in helping environmental outcomes. Moreover, Digital Zakat has also had good associations with CSR ($r = 0.78$) and EAO ($r = 0.71$), which further points to the fact that the firms that participated in digital Zakat disbursement were more likely to have higher social responsibility and monitoring practices. In the meantime, the Green Accounting exhibited moderate positive correlations with CSR ($r = 0.61$), Digital Zakat ($r = 0.60$), and SWMPs ($r = 0.50$), which indicates the complementary nature of Green Accounting in sustainable reporting and operational enhancement of the environment.

Table 3*Fornell-Larcker Criterion*

	1	2	3	4	5
1. Corporate Social Responsibility	0.790				
2. Digital Zakat	0.784	0.842			
3. Environmental Auditing Oversight	0.498	0.707	0.865		
4. Green Accounting	0.611	0.599	0.508	0.816	
5. Sustainable Waste Management Practices	0.501	0.728	0.878	0.502	0.803

The findings of the Fornell-Larcker Criterion listed in Table 3 were applied to evaluate discriminant validity among the latent constructs. Fornell and Larcker (1981) state that the evidence supporting a discriminant validity is revealed through the square root of the Average Variance Extracted of each construct (the diagonal values in the model should be larger than their correlations with other constructs (off-diagonal). The diagonal values (0.790, 0.842, 0.865, 0.816, and 0.803) were the square roots of the AVE of each construct, Corporate Social Responsibility, Digital Zakat, Environmental Auditing Oversight, Green Accounting, and Sustainable Waste Management Practices, respectively. These values were larger than the off-diagonal correlations with other constructs in all cases,

which fulfilled the criterion of discriminant validity. As an example, the square root of AVE in the case of Digital Zakat (0.842) was higher than its correlation with CSR (0.784), Environmental Auditing Oversight (0.707), Green Accounting (0.599), and SWMPs (0.728). On the same note, the AVE square root of Environmental Auditing Oversight (0.865) was larger than the correlations with Digital Zakat (0.707), CSR (0.498), Green Accounting (0.508), and SWMPs (0.878), indicating that following strong relationships, the construct emerged as fundamentally different.

Table 4

Mediation Analysis:

	Coefficient	SD	<i>t</i>	<i>p</i>
Corporate Social Responsibility -> Environmental Auditing Oversight -> Sustainable Waste Management Practices	0.15	0.05	2.95	0.003
Digital Zakat -> Environmental Auditing Oversight -> Sustainable Waste Management Practices	0.54	0.04	13.08	0.000
Green Accounting -> Environmental Auditing Oversight -> Sustainable Waste Management Practices	0.13	0.03	4.11	0.000

Paths of mediation showed statistically significant values in their *t*-statistic (all $t > 1.96$), and the *p*-value was less than 0.05, indicating that a significant mediating effect existed. The partial mediation role played by CSR on SWMPs through the Environmental Auditing Oversight amounted to a coefficient of 0.151, with a *t*-value of 2.954 and *p*-value of 0.003, which showed a significant partial mediation. This implied that as much as CSR had an impact on SWMPs, the impact had been enhanced by environmental auditing structures to conduct oversight and mentor sustainability activities. On the same note, the mediation effect of green accounting was found to be 0.128, the *t*-value was 4.108, and the *p*-value was $p < 0.001$, indicating that green accounting practices were now quite effective in driving waste management results when they went through procedural controls. Significantly, the high mediation effect was recorded by the Digital Zakat to SWMPs using the Environmental Auditing Oversight path, which recorded a value of 0.545 with a large *t*-value of 13.076 and a *p*-value of $p < 0.001$. This referred to an intense mediation, which means that the Zakat-driven sustainability initiative (and particularly the one incorporated into formal processes of auditing) produced a significant effect on waste

governance.

Table 5

Path Coefficient

	Coefficient	<i>p</i>
Corporate Social Responsibility -> Environmental Auditing Oversight	0.211	0.003
Corporate Social Responsibility -> Sustainable Waste Management Practices	0.638	0.022
Digital Zakat -> Environmental Auditing Oversight	0.765	0.000
Digital Zakat -> Sustainable Waste Management Practices	0.276	0.000
Environmental Auditing Oversight -> Sustainable Waste Management Practices	0.712	0.000
Green Accounting -> Environmental Auditing Oversight	0.179	0.000
Green Accounting -> Sustainable Waste Management Practices	0.456	0.000

The structural model analysis, shown in Table 5, revealed the direct impacts of the Corporate Social Responsibility (CSR), Digital Zakat, Green Accounting, and Environmental Auditing Oversight (EAO) on the Sustainable Waste Management Practices (SWMPs) along with the paths toward the mediator. The relationships between the constructs in the model were confirmed because all of the paths were significant (*p*-value less than 0.05). The journey between CSR and EAO displayed a slightly positive and significant coefficient of 0.211 ($p = 0.003$), which led to the conclusion that socially responsible businesses were more inclined to institutionalize the mechanisms of environmental auditing. What is more, the direct impact of CSR on SWMPs also emerged ($b = 0.638$, $p = 0.022$), demonstrating that corporate social initiatives had an independent effect in the adoption of waste reduction and sustainability practices. These findings confirmed the two-pronged effect of CSR as both a direct and an indirect determinant of the environmental outcome. In Digital Zakat, the structural impact on Environmental Auditing Oversight was the biggest, with the path coefficient of 0.765 ($p = 0.000$), which means that the businesses with digital Zakat practices were strongly oriented to instill formal auditing and compliance structures. In addition to that, Digital Zakat also influenced SWMPs (positively and directly, 0.276, $p = 0.000$), which supported the idea of an independent role of Digital Zakat in promoting environmental performance, presumably with ethical and socially-focused investment in waste projects. The impact of Environmental Auditing Oversight on SWMPs was the

strongest (0.712; $p = 0.000$), which highlights the indispensability of control measures in propelling favorable waste management results. This result also confirmed the findings of the mediation indicated above. Moreover, finally, the direct relationships to EAO (0.179, $p = 0.000$) and SWMPs (0.456, $p = 0.000$) were also massive in Green Accounting. These findings highlighted how considering the effects of the environment in financial practices not only increased the efficiency of the organizations audit but also directly increased the organizational behavior regarding waste management.

Figure 2

Hypotheses Testing

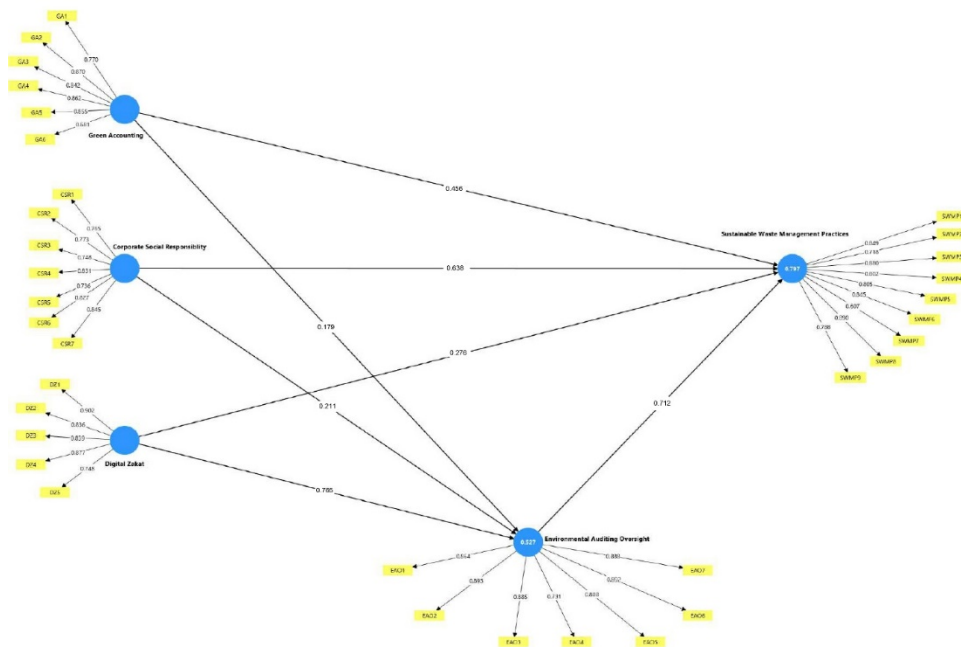


Table 6

HTMT

Constructs	HTMT
Digital Zakat <-> Corporate Social Responsibility	0.885
Environmental Auditing Oversight <-> Corporate Social Responsibility	0.538
Environmental Auditing Oversight <-> Digital Zakat	0.697
Green Accounting <-> Corporate Social Responsibility	0.642
Green Accounting <-> Digital Zakat	0.628
Green Accounting <-> Environmental Auditing Oversight	0.543

Constructs	HTMT
Sustainable Waste Management Practices <-> Corporate Social Responsibility	0.544
Sustainable Waste Management Practices <-> Digital Zakat	0.740
Sustainable Waste Management Practices <-> Environmental Auditing Oversight	0.627
Sustainable Waste Management Practices <-> Green Accounting	0.531

Discriminant validity was assessed using the HTMT criterion, where values below 0.85 indicate strict validity and values below 0.90 are considered acceptable. The majority of construct pairs demonstrate adequate discriminant validity, as their HTMT values fall well below the recommended thresholds. However, the relationship between Digital Zakat and Corporate Social Responsibility (0.885) approaches the upper acceptable limit, suggesting conceptual proximity.

Table 7

Coefficient of Determination

Endogenous Construct	R^2	Adjusted R^2	t	p
Environmental Auditing Oversight	0.527	0.524	22.58	0.000
Sustainable Waste Management Practices	0.797	0.795	54.19	0.000

The structural model assessment demonstrates substantial explanatory power and strong statistical robustness. The coefficient of determination (R^2) indicates that the model explains 52.7% of the variance in Environmental Auditing Oversight and 79.7% of the variance in Sustainable Waste Management Practices, suggesting moderate to substantial predictive accuracy. The adjusted R^2 values (0.524 and 0.795, respectively) are nearly identical to the original R^2 values, confirming model stability and minimal inflation due to sample size.

Discussion

The results of the study demonstrated that Corporate Social Responsibility (CSR) exerted a dual effect on both direct and indirect influence of sustainable waste management practices through Environmental Auditing Oversight (EAO). Companies that incorporated the principles of CSR into their culture, that is, environmental stewardship, stakeholder engagement activities, and ethical operations, had higher chances of institutionalizing auditing mechanisms that would monitor environmental conformance. This

agrees with the works of earlier scholars like Faieq and Cek (2024) and Sadallah et al. (2023), who had stressed that CSR-driven firms, in many instances, incorporate governance structures, which they use to strengthen their environmental responsibility. The findings showed that CSR not only promoted environmental responsibility culture but also established the operational channels, including auditing supervision, to transform the policy to performance, in improving the sustainable performance of waste management.

The study also validated that Digital Zakat came across as a potent ethical-financial tool, which contributed significantly to the results of environmental auditing and waste management. Companies that participated in digital Zakat platforms have shown a greater chance of incorporating formal monitoring frameworks, which implies moving to strategic Zakat governance with a focus on sustainability. The evidence is confirmed by Al-Taani et al. (2024) and Hassan et al. (2025), who refer to the fact that digital Zakat can be aligned with Islamic ESG principles and used to benefit more environmental and social causes. The notably strong mediation coefficient of Digital Zakat (0.545) compared to CSR (0.151) and Green Accounting (0.128) may be explained by the distinctive governance structure of digital Zakat: because Zakat funds are religiously mandated and publicly traceable through digital platforms, firms are compelled to institute formal auditing mechanisms to demonstrate Shariah compliance and accountability, which in turn drives more rigorous and verifiable waste management outcomes. This finding suggests that faith-based financial obligations, when digitized and made traceable, may exert stronger institutional pressures for environmental governance than voluntary CSR commitments or internal accounting reforms alone. Diverting the money collected on the basis of Zakat to measurable and accountable projects, the firms have not only fulfilled the religious requirements but also enhanced their influence on the environment, which is less explored in the Pakistani scenario.

Also, as demonstrated, Green Accounting was discovered to have a direct and mediated impact on sustainable waste management activities, which affirms its strategic importance in governing the environment. Companies that managed to quantify ecological costs and integrate environmental data into financial planning had a higher likelihood of employing minimizing strategies of waste production and of placing such

strategies under formal control. The latter can be associated with discoveries made by Kismawadi and Irfan (2025) and Memon (2024), who found green accounting as one of the key drivers of sustainable decision-making in developing economies. Moreover, this mediated effect of the EAO also showed that the effectiveness of the green accounting practices was enhanced when implemented in governance systems accompanied by issues of transparency and regulatory compliance. On the whole, the results placed Environmental Auditing Oversight as the key linking agent that had incremental performance effects on CSR, digital Zakat, and green accounting on sustainable waste management.

Practical Implications

This study has two or more actionable areas that practitioners can use to operate in Pakistan in the commercial and trading sectors. It is therefore the most appropriate action that organizations should take, and it is possible to do that by integrating environmental auditing supervision mechanisms, which have a greater involvement in the result of sustainable waste management based on CSR, digital Zakat, or green accounting. The managers will be urged to integrate CSR components into any monitoring systems that may have been formalized so that environmental responsibilities can be included in the operations. Also, companies could use the digital Zakat platforms as a strategic opportunity to contribute towards eco-centric opportunities like the waste infrastructure and environmental rehabilitation, besides the religious commitment. An institutionalized practice of the application of green accounting in financial reporting systems must be implemented to allow precise environmental costs and use of resources, so that decisions can be made based on these data to reduce the wastages. These insights together would indicate that there can be significant environmental impacts when ethical, financial, and oversight schemes are adjusted in the business environment.

Theoretical Implications

Theoretically, this paper adds value to the existing discourse by testing the theoretical moderated model that links the composite of CSR, green accounting, and digital Zakat to sustainable waste management through environmental auditing supervision. The results build on stakeholder theory and institutional theory to show that external control systems, i.e., auditing oversight, Act as a vital medium through which ethical and financial

programs are factualized into long-term results. Moreover, the research, on the one hand, contributes to the existing body of knowledge on sustainability, presenting digital Zakat as a recent Islamic social finance factor, and broadening the theoretical framework of religious-economic tools in environmental governance. The fact that mediation effects play a significant role as well proves the point that organizational sustainability is not all about the intention per se (e.g., CSR or the accounting practices); moreover, it is all about the products of organizational processes that warrant working compliance, transparency, and continuity. These lessons present the future academicians to look into the hybrid mechanism that will combine ethical, religious, and institutional mechanisms to effect sustainability transitions of emerging economies.

Future Directions and Limitations

This study presented strong empirical granularities of the mediator role of environmental auditing oversight in linking CSR, green accounting, digital Zakat, and sustainable waste management practices. However, there exist several limitations that need to be addressed. To start with, the research considered only the trading and commercial firms in Pakistan and therefore does not apply to other sectors or even regions. Furthermore, in spite of the fact that the results strengthened direct and mediated relations, the model failed to consider the presence of possible moderator variables - e.g., organizational size, regulatory pressure, or environmental awareness that can be used to determine the strength or direction of relationships. Despite these procedural and statistical precautions, the reliance on a single-source, self-administered questionnaire remains a significant limitation, as common method bias cannot be entirely eliminated through post-hoc statistical tests alone. Furthermore, the cross-sectional design precludes causal inference; the relationships reported here are associative, and readers should exercise caution in interpreting path coefficients as evidence of directional causality. The self-reported nature of all constructs means that social desirability and response bias may have inflated certain relationships, particularly those involving CSR and Digital Zakat, where respondents may perceive socially favorable answers. Future research should consider longitudinal designs or the collection of data from multiple, independent sources (e.g., combining manager self-reports with firm-level archival data on environmental performance) to further mitigate this concern.

While this study makes a significant empirical contribution, several

avenues for future research emerge from its findings and limitations. First, future studies should employ qualitative or mixed-methods designs to explore how digital Zakat platforms are specifically designed, governed, and directed toward environmental projects within Pakistan and other Islamic economies an area that remains almost entirely unexplored in the empirical literature. Specific research questions might include: "What governance structures do Islamic fintech platforms use to ensure that digital Zakat disbursements contribute to sustainable environmental outcomes?" and "How do corporate managers perceive the legitimacy and effectiveness of digital Zakat as an environmental financing tool?" Second, longitudinal research designs would allow scholars to examine whether and how environmental auditing oversight strengthens over time as firms deepen their CSR and green accounting practices—addressing the directionality assumptions inherent in cross-sectional SEM.

Conclusion

The purpose of the study was to determine the effect of green accounting, corporate social responsibility (CSR), and digital Zakat on sustainable waste management practices (SWMPs) in the Pakistani commercial and trade segment, where environmental auditing oversight serves as a mediating factor. The results were conclusive that CSR activities and green accounting practices have had a good impact on sustainable waste planning in this industry, which depends more on environmental responsibilities. CSR was implemented via institutional reports on ethical activities and social responsibility, whereas green accounting permitted organizations to absorb the environmental expenses, and it facilitated the decision-making concerned with waste. We should note that digital Zakat has become a unique Islamic financial instrument that is directly involved in helping SWMPs in terms of contributing, as well as an instrument that promotes the formalization of environmental governance with the assistance of audit control. The control of environmental auditing was the focal point of raising the influence of all three predictors since it institutionalized monitoring, compliance, and control functions. On the whole, the research was able to find out that in the commercial environment of Pakistan, the result of sustainability is much better when ethical, financial, and religious accountability is strategically blended and supported through internal governance mechanisms.

Author Contributions

Asfa Anwar: sole Author

Conflict of Interest

The authors of the manuscript have no financial or non-financial conflict of interest in the subject matter or materials discussed in this manuscript.

Data Availability Statement

Data supporting the findings of this study will be made available by the corresponding author upon request.

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The authors did not use any type of generative artificial intelligence software for this research.

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