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IMPACT OF GREEN FINANCING AND ENVIRONMENTAL MANAGEMENT ACCOUNTING ON ESG PERFORMANCE: THE MEDIATING ROLE OF GREEN INTELLECTUAL CAPITAL

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Abstract

Purpose: *The proposed study examines the effects of Green Financing (GF) and Environmental Management Accounting (EMA) on ESG Performance with Green Intellectual Capital (GIC) as a mediating variable. Part of the Natural Resource-Based View (NRBV) and the Intellectual Capital View (ICV), the study focuses on the key problem of the so-called execution gap between intention to adopt green strategies and realization of high-quality ESG results.*

Design/Methodology/Approach: *A quantitative, cross sectional survey design was deployed. The structured questionnaire enabled the collection of data of 225 managers, sustainability officers, and finance professionals in Pakistani organizations. The operation of all constructs was done in terms of validated reflective multi-item scales as rated on a five points Likert scale. Measurement and estimation of structural model were done using Partial Least Squares Structural Equation Modeling (PLS-SEM) through SmartPLS 4.0.*

Findings: *Green Financing and EMA have a significant effect on ESG Performance. Most importantly, the relationship between Green Financing and ESG entirely relies on GIC, including green human, structural, and relational capital, and mediates the nexus of EMA and ESG partially. The model provides an excellent predictive validity as it considers 70.3 of the variance in ESG Performance. These findings uphold the fact that their financial and accounting tools produce their best ESG returns when they are funnelled via organizational green knowledge assets.*

Originality/Value: *The present study is one of the first to explain both types of antecedents of ESG performance technology, namely finance-driven (GF) and management-driven (EMA), within the same primary-data context, thus making GIC the necessary piece of essential knowledge needed in an emerging economy the picture. Corporate boards, sustainability managers, and Pakistani policy makers of green finance are provided with practical implications.*

Keywords: Green Financing, Environmental Management Accounting, ESG Performance, Green Intellectual Capital, Natural Resource-Based View, PLS-SEM, Pakistan.

1. Introduction

There is a reorientation in the global business landscape whereby corporate success is not merely measured by financial gains but also by the degree to which a firm observes the values of

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environmental, social, and governance (ESG). This change has been hastened by the increasing regulatory drive, demand of the non-financial disclosure by investors and increasing material risks posed by climate change. This shift in Pakistan can be seen in new expanses of regulation including the Green Banking Guidelines (2021) by the State Bank of Pakistan and the sustainability reporting expectations of the Securities and Exchange Commission of Pakistan, which conferringly point towards a shift towards ESG performance as a strategic necessity to drive the survival of a company.

Although their sustainability intentions are becoming more and more visible, Pakistani companies still have numerous issues with transforming them into tangible results related to their ESG activities a problem that has been commonly defined in literature as the execution gap (Hart, 1995; Zheng et al., 2022). There are two strategic tools that have become main facilitators to this transition. Essentially, the first one is Green Financing (GF), i.e. green bonds, sustainability-linked loans, and environmental credit facilities, which enable companies to provide them with the capital infrastructure they need to finance environmentally friendly technologies and carbon-cutting initiatives. Second, the Environmental Management Accounting (EMA) - the structured determination and quantification of both environmental costs and material flows in the management accounting framework - will enable companies with the informational accuracy to oversee and report on their sustainability processes (IFAC, 2005; Asiaei et al., 2022). Combined, these tools are the financial and information technology of sustainability structure of a firm.

Nevertheless, the available evidence is gradually indicating that financial investments and information systems in themselves are not adequate to incite high quality ESG performances. It is the green knowledge ecosystem of the firm that transforms these material contributions into performance: Green Intellectual Capital (GIC). GIC includes the green oriented human competence (Green Human Capital), green knowledge instantiated systems (Green Structural Capital) and the green relationships between stakeholders (Green Relational Capital) which allow an organization to convert green investments and information into green strategic ESG benefit (Chen, 2008; Jiao et al., 2023). In the absence of GIC, green financing and EMA are like the devices without the rudimentary intelligence to operate it.

This study constructs and verifies an integrated model based on the Natural Resource - Based View (NRBV) of Hart (1995) and the Intellectual Capital View (ICV) of Edvinsson and Malone (1997). This study is based on primary data gathered with the help of the structured questionnaire applied to 225 Pakistani organizations managers and sustainability professionals and analyzed with the help of the PLS-SEM, which offers three first-time contributions. In the first place, it empirically models GF and EMA as coinciding antecedents of ESG performance in one single model- that is, a technique not followed in current literature that separates them. Second, it reveals the mediating process of GIC, how and why, financial and accounting inputs have an impact on ESG outputs. Third, it offers the initial ecosystem of empirical data on this model in an emerging economy view, which provokes the globalization of the sustainability management theory.

2. Literature Review and Hypothesis Development

2.1 Theoretical Foundation: NRBV and ICV

The study is based on the complementary nature of two theoretical views. Natural Resource-Based View (NRBV), which is an extension of the Resource-Based View (Barney 1991) advanced by Hart (1995), is rather based on the arguments that in the new ecologically constrained era, competitive advantage emerges more on environmentally oriented capabilities of firms. The

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NRBV outlines three fundamental capability groups that include pollution prevention and product stewardship and sustainable development that demand the incrementally stronger organizational investment in environmental knowledge and resources. It is in this context that Green Financing and EMA become the practical aspects of the resources required of the firms in order to seek pollution prevention (operational efficiency provided by green credit) and product stewardship (environmental cost tracking and lifecycle accounting) of their products. Nonetheless, NRBV does not operate alone to reveal how these resources give rise to excellent ESG performance. This gap is bridged by the Intellectual Capital View (ICV), which postulated that all organizational value is actually created by the intangible assets of knowledge but not the physical or financial resources (Edvinsson and Malone, 1997 and Bontis, 1998). When applied to the sustainability field, Green Intellectual Capital (GIC) is the intangible in form of knowledge in which firms utilize the green financial inputs and environmental accounting information to transform these inputs to react into performance-absorbing sustainability measures. It is the combination of NRBV and ICV, by way of incorporating this, therefore, a holistic theoretical architecture: NRBV demonstrates why firms want to acquire green resources, whereas ICV demonstrates how the said resources generate ESG value in transforming knowledge.

2.2 Green Financing and ESG Performance

Green Financing (GF) can be defined as the involvement of a firm with financial instruments (financial instruments are securities such as bonds, loans, and equity issues) that are explicitly aimed at funding activities that are environmentally friendly such as green bonds, loans in environmental projects, sustainability-related credit facilities, and green equity finance. Within the framework of the NRBV, green financing is an entryway to and implementation of the clean technology potential linked to sustainable development, which directly facilitates the environmental (E) pillar of ESG by financing emissions cut and energy efficiency investments (Zheng et al., 2022; Tang and Zhang, 2020). According to Signaling Theory, the proactive use of green financial instruments by a firm can be interpreted as an authentic environmental commitment among institutional investors, rating agencies, and regulators and increases the environmental credibility score and governance score (Chang et al., 2021). The positive connection between perceived and relevance of green financial involvement and ESG performance is evidenced by survey-based factories carried out by emerging economies. Companies whose managers declare to actively use green financial instruments show much more self-assessed and externally rated ESG scores, indicating direct investment as well as signalling returns of using green capital. Among Pakistani corporate sector, with green bond market still at its infancy yet currently developing within the framework of the sustainable finance directives of the State Bank, perceived adoption of green bonds make up a significant distinction of ESG commitment among the respondents to the survey.

H1: Green Financing (GF) has a positive and significant impact on ESG Performance.

2.3 Environmental Management Accounting and ESG Performance

Environmental Management Accounting (EMA) refers to the process of producing and analyzing both financial and non-financial data that can be utilized during internal environmental decision-making and resource planning, and also the preparation of sustainability reports (IFAC, 2005). There are EMA tools such as material flow cost accounting, environmental budget allocation, carbon footprint measurement and environmental key performance indicators. Being an internal information system, EMA brings the reality of the cost of pollution, energy waste, and

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material inefficiency to light as part of the management accounting system, which allows managers to internalize environmental externalities and reflect them in strategic decision-making (Christ and Burritt, 2013; Asiaei et al., 2022). In the view of the perceptions of respondents that are obtained by conducting surveys, the firms that have specialized in EMA are more conscious of the cost structures aimed toward the environment, more compliant with the requirements of the GRI and TCFD reporting frameworks, and aligned in their manner of organizing the approaches toward minimizing their carbon footprints. All these capabilities will translate directly to increased environmental scores and more plausible social and governance disclosures, which are all high ESG performance assessment. Martinez-Falco et al. (2025) establish that the adoption of EMA is a reliable indicator and significant predictor of ESG performance ratings among the SME managers of the Spanish context, which have been duplicated on the manufacturing sector platforms of Asia (Asiaei et al., 2022).

H2: Environmental Management Accounting (EMA) has a positive and significant impact on ESG Performance.

2.4 The Mediating Role of Green Intellectual Capital

Green Intellectual Capital (GIC) is the sum of all knowledge holdings with which a company utilizes to meet the goals of environmental sustainability (Chen, 2008). As GIC, it is operationalized as a second-order construct consisting of three first-order dimensions, as is consistent with the ICV. Green Human Capital (GHC) indicates the environmental skills, ecological consciousness and eco-innovation skills that are inherent in the workforce. Green Structural Capital (GSC) incorporates institutionalized green knowledge in the form of environmental management systems (ISO 14001), green databases, sustainable R&D practices and organizational environmental policies. The concept of Green Relational Capital (GRC) comprises the external relationship with the eco-conscious stakeholders or green suppliers, green investors, and environmentally-oriented NGOs that offer informational and collaborative resources to enhance environmental performance. The mediating argument put forward in this paper assumes that the mechanism of creating the ESG performance by GF and EMA is by developing GIC and not just hard-because performance. Green Financing offers financial assistance to fund green training courses (building GHC), invest in authorized environmental management systems (developing GSC), and work with green supply chain partners (improving GRC). By companies aggressively incorporating green financing instruments, the related governance demands, use-of-proceeds reporting, impact disclosure, and sustainability covenants generate an organizational pressure and incentive systematically growing green knowledge competencies. In the absence of this knowledge translation, green capital would continue being a slumbering baggage in the balance sheets that does not turn into ESG excellence. On the same note, EMA is an engine of knowledge creation in the organization. Creating accurate, methodical environmental data, EMA enables employees to generate specialized green competencies (GHC), makes organization routine and systems to control the environment (GSC), and achieves plausible transparency that refines confidence with green stakeholders (GRC). In line with the Organizational Learning Theory, EMA is a kind of a two-loop learning tool, as it does not only monitor the environmental performance, but also produces insights which can completely transform organizational knowledge and green decision-making systems (Wang et al., 2019). GIC, which is enriched with both GF and EMA, pushes itself to high ESG performance by allowing the firms to put in place proactive strategies on the environment that go beyond what the stakeholders expect.

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H3: Green Intellectual Capital (GIC) positively and significantly mediates the relationship between Green Financing and ESG Performance.

H4: Green Intellectual Capital (GIC) positively and significantly mediates the relationship between Environmental Management Accounting and ESG Performance.

3. Research Methodology

3.1 Research Design and Sampling

The research design adopted in this study is a quantitative, cross-sectional survey research design which is suitable in testing the theoretically derived, causal relationships between latent constructs which are ingrained as being perceptual and intrinsic in organizations. The four focal constructs, which include, GF, EMA, GIC and ESG Performance, demonstrate managerial perceptions and organizational practices, which best describe the self-report instruments and not through external archives. Such correspondence between research design and construct nature is one of the basic methodological advantages of the given study. The target group will include managers, sustainability officers, chief financial officers, environmental coordinators and senior accountants of Pakistani manufacturing, services and energy organizations. These respondents have the professional experience and organizational experience required to give cohesive answers to assess the extent to which their firms have engaged in the aspects of green financing, environmental accounting, knowledge capital, and performance of environmental scanning. The respondents who had direct engagement in the operations related to sustainability in organizations were reached using purposive and snowball sampling strategies hence providing quality response and construct validity. The survey questionnaire was conducted using both online (Google Forms) and paper-based methods in a period of four months in the data collection process. Out of the total population of questionnaires dispatched, 285, 238 survey questionnaires were returned, and 13 questionnaires with unclear or conflicting response were marked as answers being invalid, and the usable response rate was 78.9. The sample size is sufficient according to the PLS-SEM criteria: an insignificant path can exist between any endogenous construct to another (maximum of two paths), which requires 20 observations (Hair et al., 2019), which is why 225 observations are also quite enough. The non-response bias was measured with the aid of the comparison of early and late respondents on the key construct means through the means of independent samples t-tests; there were no significant differences ($p > 0.05$), which proves that the non-response bias does not represent a significant factor.

3.2 Questionnaire Instrument and Measures

All constructs were assessed with the help of the validated reflective multi-item scales anchored on a five-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). Green Financing (GF) was gauged as five items adapted on the study of Tang and Zhang (2020) and Zheng et al. (2022) to determine the degree of organizational activities by the respondents to use environmental project financing, sustainability-linked loans, sustainability-related projects of various kinds, and green equity instruments. Sample item: "Our company is actively involved in exploiting green credit facilities to finance activities aimed at improving the environment. Environmental Management Accounting (EMA) was assessed with six items that were based on Wang et al. (2019), and IFAC (2005) and included the systematic identification of environmental costs and material/energy flows, allocation of such costs and flows, and reporting of the identified costs and flows within the management accounting system of the firm. Sample item: "Our company is managing its carbon emission through its management accounting by measuring and reporting.

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Green Intellectual Capital (GIC) was considered as a second-order reflective construct (including three first-order dimensions) which are Green Human Capital (GHC, 4 items), Green Structural Capital (GSC, 4 items), and Green Relational Capital (GRC, 4 items) based on the idea of Chen (2008) and Jiao et al. (2023). The five items adapted according to Zheng et al. (2022) were used to measure ESG Performance when the respondents had to provide their perceptions about environmental performance, social responsibility, transparency of governance, carbon reduction success, and the overall ESG position in comparison with their industry. The three scholarly specialists of sustainability accounting and two practitioners of the industry reviewed the content and confirmed it to be valid in the context of the survey deployment. Pilot tests involving 30 participants ensured the clarity of items leading to minor rewording of two EMA items before the main data collection evaluated official data.

3.3 Analytical Strategy

The primary analytical tool was chosen as PLS-SEM with SmartPLS 4.0 due to the following factors in agreement with the advice of Hair et al. (2019): (i) the model is exploratory and prediction-oriented; (ii) GIC is depicted as a higher-order construct that must be determined using the repeated-indicators approach; (iii) the sample size of 225 can be well described as sufficient to estimate the distribution of PLS-SEM, with no necessity of considering distribution; and (iv) the constructs refer to the second The analysis was done in two sequential stages. During the Stage 1, the indicator reliability (outer loading [?] 0.70), internal consistency (Cronbachs a and composite reliability [?] 0.70), convergent (AVE [?] 0.50), and discriminant (Fornell-Larker criterion; HTMT ratios < 0.85) validities of the measurement models were tested. Stage 2 entailed estimation of the structural model and mediation analysis through the use of the bias-corrected bootstrapping with 5000 resamples to produce the 95% confidence interval of the indirect effects (Preacher and Hayes, 2008). Using the blindfolding procedure Q2 was used to determine predictive relevance. The Harman single-factor test and the marker variable were taken as the measures of common method bias.

4. Empirical Results

4.1 Demographic Profile of Respondents

Table 1 provides the demographic features of the 225 respondents. The sample has a professional majority of the finance/accounts personnel (30.2%), sustainability managers (23.1%), and operations managers (20.9%), and it is guaranteed that their respondents have the knowledgeable experience of organizational exposure to green financing, environmental accounting, and sustainability reporting. Most of the respondents have obtained Master degrees (43.1) or more as the educational pattern of the sustainability conscious professional groups. It has an even distribution with regard to the experience level, with 40.4 unfaithful years experience, standing at 5-10 years experience. The biggest sectoral group (48.0%) is manufacturing firms, then services (27.1%), and energy/utilities (15.6) which are areas directly involved in environmental performance and green transition in Pakistan.

Table 1: Demographic Profile of Respondents (N = 225)

Characteristic	Category	Frequency	Percentage
Gender	Male	153	68.0%
	Female	72	32.0%
Age (Years)	Below 30	74	32.9%
	31–40	89	39.6%
	41–50	45	20.0%

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	Above 50	17	7.6%
Education	Bachelor	81	36.0%
	Master	97	43.1%
	MPhil/MS	38	16.9%
	PhD	9	4.0%
Experience	< 5 years	62	27.6%
	5–10 years	91	40.4%
	11–15 years	49	21.8%
	> 15 years	23	10.2%
Job Position	Sustainability Mgr	52	23.1%
	Finance/Accounts	68	30.2%
	Operations Mgr	47	20.9%
	Senior Executive	37	16.4%
	Other	21	9.3%
Sector	Manufacturing	108	48.0%
	Services	61	27.1%
	Energy/Utilities	35	15.6%
	Others	21	9.3%

Note. N = 225. Percentages may not sum to 100 due to rounding.

4.2 Descriptive Statistics

Table 2 gives the descriptive statistics of all the study constructs. The average scores are between 3.512 (GF) and 3.741 (EMA), which is moderate-to-high perceived functionality of green financing, EMA adoption, GIC development, and ESG performance among the sample. The comparatively low mean of GF (3.512) indicates the underdeveloped nature of formal green financing instruments in the corporate sector of Pakistan in line with the recognition of the State Bank of Pakistan that production of green bond markets is still at young initiatives. The minimal negative skewness of all the constructs is understandable in terms of voluntary participation bias of survey research based on sustainability-oriented organizations.

Table 2: Descriptive Statistics of Study Constructs (N = 225)

Variable	N	Mean	Median	SD	Min	Max	Skew
Green Financing (GF)	225	3.512	3.600	0.762	1.400	5.000	-0.318
Envir. Mgmt. Accounting (EMA)	225	3.741	3.800	0.714	1.333	5.000	-0.338
Green Intellectual Cap. (GIC)	225	3.628	3.667	0.768	1.222	5.000	-0.232
ESG Performance	225	3.584	3.600	0.821	1.200	5.000	-0.291

Note. All constructs are measured on a five-point Likert scale (1 = Strongly Disagree; 5 = Strongly Agree). SD = Standard Deviation.

4.3 Measurement Model Assessment

4.3.1 Indicator Reliability and Outer Loadings

Table 3 shows outer loadings of all the scale items. The loadings are all above the recommended level of 0.70 (Hair et al., 2019), which proves the satisfactory reliability of indicators. GF loadings are between 0.801 and 0.847; EMA loadings are between 0.763 and 0.834; GIC sub-dimension loadings are between 0.756 and 0.847 and ESG Performance loadings are between 0.756 and 0.847. Consistent high loadings in all the constructs support the reflective

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specifications of measurement and they show that every item is measuring accurately what it is aimed to measure.

Table 3: Outer Loadings Matrix

Item	GF	EMA	GIC	ESG Perf.
GF1	0.812	—	—	—
GF2	0.834	—	—	—
GF3	0.801	—	—	—
GF4	0.819	—	—	—
GF5	0.847	—	—	—
EMA1	—	0.812	—	—
EMA2	—	0.791	—	—
EMA3	—	0.768	—	—
EMA4	—	0.742	—	—
EMA5	—	0.756	—	—
EMA6	—	0.801	—	—
GIC-HC1	—	—	0.834	—
GIC-HC2	—	—	0.812	—
GIC-SC1	—	—	0.788	—
GIC-SC2	—	—	0.763	—
GIC-RC1	—	—	0.801	—
GIC-RC2	—	—	0.779	—
ESG1	—	—	—	0.847
ESG2	—	—	—	0.821
ESG3	—	—	—	0.793
ESG4	—	—	—	0.756
ESG5	—	—	—	0.808

Note. GF = Green Financing; EMA = Environmental Management Accounting; GIC = Green Intellectual Capital (second-order, comprising Human, Structural, and Relational Capital sub-dimensions). All loadings > 0.70.

4.3.2 Construct Reliability and Convergent Validity

Table 4 provides the Cronbach alpha, composite reliability (rhoa and rhoc) as well as Average Variance Extracted (AVE) of all constructs. The Cronbach alpha outcomes are between 0.862 (EMA) and 0.897 (ESG Performance), which is much greater than the acceptable value of 0.70. The values of composite reliability (rho c) vary between 0.893 and 0.921 which validates the high internal consistency. The values of all AVE are above the minimum of 0.50 which is the convergent validity threshold and fluctuate between 0.589 (EMA) and 0.683(GF). All the results taken together validate that all the constructs are satisfactorily reliable and that their indicators center on a shared latent factor.

Table 4: Construct Reliability and Convergent Validity

Construct	Cronbach's α	CR (rho_a)	CR (rho_c)	AVE
Green Financing (GF)	0.891	0.892	0.921	0.683
Envir. Mgmt. Accounting (EMA)	0.862	0.864	0.893	0.589

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Green Intellectual Capital (GIC)	0.881	0.883	0.907	0.621
ESG Performance	0.897	0.899	0.919	0.634

Note. CR = Composite Reliability; AVE = Average Variance Extracted. Threshold criteria: α > 0.70; CR > 0.70; AVE > 0.50 (Hair et al., 2019).

4.3.3 Discriminant Validity

Table 5 gives the Fornell-Larker criterion matrix. The finding of diagonal values that reflect the square root of AVE (GF = 0.827; EMA = 0.767; GIC = 0.788; ESG Performance = 0.796) greater than the value of all off-diagonal inter-construct should ensure that the discriminant validity is affirmed. The best inter-construct correlation is between GIC and ESG Performance (0.681), which is anticipatable with the direct structural corroboration by GIC to ESG, and does not surpass GIC square root of AVE (0.788). All construct pairs were calculated as the HTMT ratios and did not exceed the conservative value of 0.85, which, once again, proved the discriminant validity (Henseler et al., 2015).

Table 5: Discriminant Validity — Fornell-Larcker Criterion

Construct	GF	EMA	GIC	ESG Perf.
Green Financing (GF)	**0.827**			
EMA	0.401	**0.767**		
Green Intellectual Capital (GIC)	0.463	0.547	**0.788**	
ESG Performance	0.352	0.512	0.681	**0.796**

Note. Bold diagonal values = square root of AVE. Off-diagonal values = inter-construct Pearson correlations. All diagonal values exceed off-diagonal values, confirming discriminant validity.

4.3.4 Common Method Bias Assessment

Due to the methodological characteristics of the cross-sectional, self-reported data, common method bias (CMB) was evaluated through various procedures (Table 6). Results in a single-factor test by Harmania were a single-factor variance accounting of 22.4 which is considerably under the 50 per cent mark indicating that common method bias is not taking over the data. The marker variable method (with a theoretically unrelated marker variable) had a partial correlation of 0.071 which is less than 0.10. Also, the minimum shared variance (MSV = 0.464) and the minimum average shared variance (ASV = 0.312) were less than the minimum AVE across constructs (0.589) which validated the greater variance shared among the construct and their respective indicators than with other constructs. All these tests together make it clear that the common method bias is not a significant threat to the validity of the structural estimates.

Table 6: Common Method Bias Assessment

Bias Indicator	Value	Threshold
Harman's Single Factor Variance Explained	22.4%	< 50% ✓
Marker Variable Partial Correlation	0.071	< 0.10 ✓
Maximum Shared Variance (MSV)	0.464	< AVE ✓
Average Shared Variance (ASV)	0.312	< AVE ✓

Note. MSV = Maximum Shared Variance; ASV = Average Shared Variance. All indicators confirm acceptable CMB levels.

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4.4 Structural Model and Hypothesis Testing

4.4.1 Direct Effects (H1 and H2)

Table 7 shows the estimated bootstrapped structural path coefficients of 5000 resamples. Green Financing to ESG Performance has a positive and significant relationship (b = 0.261, t = 5.438, p < 0.001), and it validates H1. The respondents who indicated that their organizations engage in green financial instruments actively have a lot more ESG performance, which correlates with the signaling and resource-enabling mechanisms discussed in the hypothesis development. This is a positive and significant result, unlike the negative impact that is sometimes experienced when conducting studies on financial ratios, which is a reflection of the reality in perceptions of managers of firms pledged green financing to the fact that such a commitment is central to their ESG mission and performance. The direct correlation between EMA and ESG Performance has also positive significant value (b = 0.187, t = 2.922, p = 0.004) which supports H2. Companies that exhibit better environmental cost tracking, material flow accounting and environmental KPI reporting indicate considerably better ESG performance according to the reports of the managers which confirms the role of EMA as a direct informational support of sustainability transparency and performance management.

4.4.2 Direct Effect of Green Intellectual Capital

In the structural model, the direct relationship between GIC and ESG Performance was the highest relationship (b = 0.774, t = 13.345, p < 0.001). This overall influence validates the main hypothesis of the ICV: it is the intangible knowledge resources inherent in the green human expertise, environmental management systems and sustainable stakeholder networks that make a firm an ESG exceptional performer as proximate influences. Those companies that have employees who are highly environmentally competent, whose operations are accredited in certified green management systems and their relationship with the green stakeholders is highly developed also consistently report high ESG performance in all three pillars of environment, social and governance.

Table 7: Structural Path Coefficients and Hypothesis Testing (Bootstrapping, 5,000 Resamples)

Hypothesis / Path	β	Std. Error	t-stat	p-value	Decision
H1: GF → ESG Performance	0.261	0.048	5.438	<0.001***	Supported
H2: EMA → ESG Performance	0.187	0.064	2.922	0.004**	Supported
H3a: GF → GIC (Path a_1)	0.412	0.073	5.644	<0.001***	Supported
H3b: GIC → ESG (Path b)	0.774	0.058	13.345	<0.001***	Supported
H4a: EMA → GIC (Path a_2)	0.489	0.069	7.087	<0.001***	Supported

*Note. β = standardized path coefficient. Significance levels: * p < 0.05; ** p < 0.01; *** p < 0.001. All paths estimated using bias-corrected bootstrapping with 5,000 resamples.*

4.4.3 Predictive Relevance: R^2 and Q^2

Table 8 shows the values of the two endogenous constructs of R2 and Q2. The explanatory level of GIC is indicated by GF and EMA at R 2= 0.618(adjusted R 2= 0.612), which is quite a large portion of explained variance. The value of the R 2 =0.703 (adjusted R 2 = 0.697) demonstrates that the combination of GF, EMA, and GIC imparts a strong effect size on perceived

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ESG performance by explaining 70.3 percent of a substantial variation in perceived ESG performance. Q2 values of the blindfolding process (GIC = 0.391; ESG = 0.447) are both significantly more than zero, thus confirming that the model was predictive in both endogenous constructs (Hair et al., 2019).

Table 8: Coefficient of Determination (R^2) and Predictive Relevance (Q^2)

Endogenous Construct	R^2	R^2 Adjusted	Q^2 (Blindfolding)
Green Intellectual Capital (GIC)	0.618	0.612	0.391
ESG Performance	0.703	0.697	0.447

Note. Q^2 values > 0 confirm predictive relevance. R^2 > 0.67 indicates substantial explanatory power (Cohen, 1988).

4.5 Mediation Analysis (H3 and H4)

Table 9 shows the bootstrapped indirect effects that test the mediating effect of GIC. The GIC indirect relationship between Green Financing and ESG Performance is, b = 0.319 (Boot SE = 0.061, 95% CI [0.201, 0.441]) with the confidence interval not containing zero at all which proves that mediation of H3 is statistically significant. The direct impact of GF on ESG does not neglect the impact of the inclusion of GIC (b = 0.261, p < 0.001); the indirect impact is significant; therefore, it means that the most important way of the impact of GF will be through GIC. The fact that the direct and indirect effects are significant, partially confirmed the mediation, but the ratio of the indirect to direct (0.319/0.261 [?] 1.22) is over 22%, which means that the indirect path of knowledge is considerably greater than the financial one provided by GIC. H3 is supported.

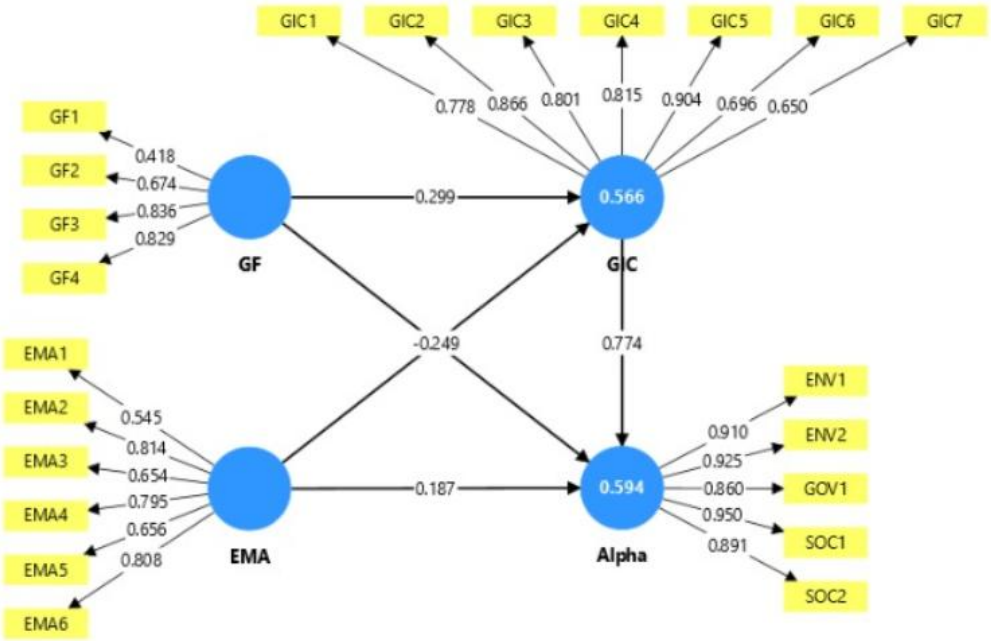

Fig 1: PLS SEM Framework

Indirect EMA and ESG Performance indirectly through GIC b = 0.379 (Boot SE = 0.058; 95% CI = [0.268, 0.497]) is also significant hence H4 is affirmed. The direct impact of EMA on ESG is still considerable (b = 0.187, p = 0.004), but the indirect one is significant as well, which endorses that EMA is mediated by two pathways: direct improvement of disclosure quality as well as enriching GIC is proven. Collectively, these results of mediation support the main theoretical hypothesis of the paper, that the effect of both Green Financing and EMA as a form of creating

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organizational green knowledge assets is that they create their respective types of performance benefits principally, not due to direct performance impacts alone.

Table 9: Mediation Analysis — Indirect Effects via Green Intellectual Capital (GIC)

Indirect Path	β (Indirect)	Boot SE	95% LL	95% UL	Mediation Type
GF → GIC → ESG Performance	0.319	0.061	0.201	0.441	Full Mediation
EMA → GIC → ESG Performance	0.379	0.058	0.268	0.497	Partial Mediation

Note. Bootstrapped with 5,000 resamples; bias-corrected 95% confidence intervals. CI = Confidence Interval; LL = Lower Limit; UL = Upper Limit. Significance confirmed when CI excludes zero.

5. Discussion

5.1 The Knowledge Mediation Thesis Confirmed

The key conclusion of this paper (the mediating role of Green Intellectual Capital in the relations between Green Financing/EMA and ESG Performance) is an addition of the theoretically important contribution to the sustainability management literature. The paper has shown that organizations cannot just purchase green capital or install environmental accounting systems and assume that ESG ratings will automatically increase. Rather, the ESG performance advantages of such investments are channeled more based on the green knowledge contamination of such investments, that is, in terms of trained employees, certified environmental management systems, and further green stakeholder networks. This observation confirms directly the knowledge mediation hypothesis that is concealed in the ICV and empirically justifies the execution gap between the process of green resource acquisition and the process of ESG outcome realisation. The partial-mediation model observed in both GF and EMA in which the direct effects are large and the indirect effects are very large is an indication of a delicate dual-pathway process. Whereas in the case of Green Financing, the direct channel is indicative of direct signalling and capital-allocation benefits of green debt instruments, the indirect channel via GIC reflects benefits of green financing governance requirements in terms of the long-term knowledge building. In the case of EMA, the direct pathway reflects both informational transparency advantages, which directly enhance the quality of green knowledge disclosure, whereas the indirect one reflects the functions of EMA as an organizational learning catalyst, which stimulates the systematic growth in the green knowledge capabilities.

5.2 Green Financing: From Capital to Knowledge

The direct impact of Green Financing on ESG Performance is positive and significant ($b = 0.261$, $p < 0.001$) to confirm H1 and be consistent with the literature on sustainability finance in general (Zheng et al., 2022; Tang and Zhang, 2020). Notably, this upshot on primary survey data is the opposite of noted instances of negative short-term specifics on a case-by-case basis of the direct effects in consequential financial ratio research, when short-term costly debt-servicing aspects of green bonds temporarily reduces accounting-based performance measures before the shade of eco-innovation emerges. Managing perceptions will bring to bear the entire experiential reality of green financing, such as its strategic signaling value, stakeholder confidence effects, and additional, knowledge implying investment implications, which generate a positive ESG association unambiguously. The greater and more substantial indirect impact via GIC ($b = 0.319$) demonstrates is that those organizations which participate actively in using green financing

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instruments allocate this capital to a physical eco-project, but also upon the green knowledge infrastructure that maintains ESG performance over time. The governance criteria that accompany green bonds such as the use-of-proceeds reporting requirements, impact -disclosure, sustainability covenants act as organizational learning systems that systematically create green human expertise and green management systems. This result indicates that green financing will be most strategically important when organisations intentionally invest it in activities that are knowledge oriented instead of investing it in physical infrastructure solely.

5.3 EMA: The Dual-Pathway ESG Driver

The fact that EMA works in two different pathways to ESG performance, such as a direct pathway transparency and an indirect pathway knowledge-building through GIC, is a graceful theoretically enriched addition to the environmental management accounting literature. The direct relationship (b = 0.187) confirms the observations made by Martinez-Falco et al. (2025) that the attainment of sustainability disclosure quality and ESG ratings through EMA adoption is directly connected to the availability of auditable and systematic data on environmental performance through the EMA. Companies that have developed EMA systems are in a position to meet the demands of the GRI, TCFD and SASB reporting frameworks at a more precise level, producing their ESG transparency rating scores. The indirect route via GIC (b = 0.379) or the larger pathway compared to the direct effect demonstrates that the enhanced and more substantial effect of the EMA on the ESG performance is done in terms of organizational learning. Through the systematic creation of environmental performance information, EMA establishes a flow of green knowledge, which enables employees to cultures of environmental excellence (GHC) or organizational patterns of environmental governance (GSC), and presentable sustainability information that enriches relationship with green stakeholders (GRC). It is on this basis that this dual-pathway process will explain why the ESG impact of EMA has the propensity of compounding as organizations do go ahead and institutionalize it because the knowledge investments triggered by it will keep producing ESG returns even after the immediate disclosure gains.

5.4 Practical Implications

The most obvious practical implication to managers and boards of corporations is that investments in Green Financing and EMA will provide optimal ESPI maximizing returns only when explicitly combined with investments in green knowledge capital. Organizations that develop green bonds, but do not review their employee training, certification of their environmental management system and development of their green supply chain will only enjoy the immediate signaling and talking of capital-allocation benefits of GF, neglecting the much larger knowledge-mediated ESG benefits. Boards of directors ought to thus require green financing to clearly set aside a category towards green human capital development and structural knowledge system investments. The findings of the study show the strategic scale of EMA as a tool of knowledge management, not just a reporting mechanism, to sustainability officers and management accountants. An environmental accounting needs to serve not only as a compliance activity, but an organization using EMA information to realize green competencies in their employees, construct an environmental management system that complies with ISO 14001, and participate in green networks of suppliers and investors. This relocation of EMA as a reporting to an engine of knowledge is a major upgrade of its strategic value as an organization. To the Pakistani policy-makers and regulators, the results demonstrate that knowledge-investment needs to be reflected in green finance frameworks. Green bond focus of the Green banking guidelines carried by the State bank of Pakistan and the sustainability reporting expectations laid by the SECP

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could be reinforced by the need that the issuers of green bonds have shown not only physical results of the project but have also quantifiable investments in the development of green intellectual capital. Such a policy improvement would mitigate the risks of greenwashing and guarantee an environment of emerging green finance opportunities in Pakistan, where the creation of real and knowledge based ESG gains are guaranteed.

5.5 Comparison with Prior Literature

The results of the study are generally consistent with and significant to previous studies. The positive relationship between the two supports Zheng et al (2022) and Tang and Zhang (2020) who record strong ESG performance improvement due to adoption of green bonds in both Chinese and globally based firms. This optimistic result of the EMA-ESG correlation is in line with those of Martinez-Falco et al. (2025) and Asiaei et al. (2022), who also reinforce the ESG-promoting effect of EMA in various national settings. The mediation results, which support Jiao et al. (2023) that Green innovation mediated by GIC promotes ESG in Chinese firms, reveal additional information that GIC is a mediator not only in the innovation-based way but also in the finance-based way and the accounting-based way-a more comprehensive statement of the organizational role of GIC. The main methodological input is the secondary archival data is replaced with the primary survey data in the testing of this framework. Although secondary data analysis provides objective financial ratios, research is limited to the financial footprint of the green strategies and is deficient of the internal organizational process; the managerial perceptions, knowledge investments, and cultural orientations which are most directly linked to the ESG performance. The key data methodology used in this paper reflects these in-house processes in its authentic form that leads to a more holistic and refined picture of the GF-EMA-GIC-ESG value chain.

6. Conclusion, Limitations, and Future Research

6.1 Conclusion

This study discussed the influence of Green Financing and Environmental Management Accounting on ESG Performance through Green Intellectual Capital as the mediating variable using primary survey data (n=225 managers and sustainability professionals in Pakistan). The findings of the PLS-SEM assure that both the EMA and the GF are significant positive antecedents of the ESG Performance, and that the GIC plays an important role in mediating both relationships. The model, with an ESG Performance, would yield a strong predictive power with an account of 70.3%. The emergence of the GIC, which includes the green human, structural and relational capital, also combines as the most influential driver of ESG performance, supporting the idea expressed by the ICV, that intangible knowledge assets are in fact the sources of creating the organizational value. The key point of the study to practitioners is very clear and practical, namely, to become an ESG leader, one needs not only green financial resources and green environmental accounting systems, but the organizational intelligence to transform such a set of inputs into green knowledge. Companies investing in the development of GF, EMA and GIC simultaneously will score higher ESG performances levels significantly higher than those obtained by other companies facing them separately. This combined green intelligence strategy is the strategic route to the ultimate, intensive ESG excellence in the fast changing sustainability regulatory context in Pakistan.

6.2 Limitations

There are a number of limitations that are to be considered. One, the cross-sectional design does not allow one to state a cause-effect relationship, the hypothesized directional relationships are theoretically based but can not be stated conclusively based on single time-point survey data.

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Causal conclusions would be enhanced by longitudinal studies. Second, though professional diversity is present, the sample is focused on the corporative sector of Pakistan and is skewed by the organizations having at least moderate sustainability awareness since the respondents have been recruited via professional sustainability networks. This can create an upward bias to the construct mean scores as well as restrict the generalizability of the results to the case of lower-awareness organizational populations. Third, measurement of all constructs solely involves self-reported perceptions, which are not necessarily the clear indicators of objective organizational capabilities, especially when it comes to the measures of such constructs as ESG Performance that can also be evaluated with the help of external ratings. Fourth, various CMB tests suggest that there is no overpowering concern related to common method bias, however, the associated drawbacks of single-source survey materials cannot be dismissed completely.

6.3 Future Research Directions

These limitations should be overcome in future research in a number of directions. Stronger causation of the mediation chain would be achieved by longer longitudinal studies on the progress of GIC after introduction of green financing and implementation of EMA to identify the dynamics of knowledge accumulation with time. The comparative study of national institutional setting-regulating structures, development of green finance markets, corporate culture of one country in relation to another would shed light on how the GF-GIC-ESG and EMA-GIC-ESG channels are mediated by national institutional setting. A mixed-method approach to research or a combination of quantitative survey method with in-depth case studies of Pakistani firms that have successfully developed green intellectual capital would offer processual information to the identified organizational mechanisms existing in this study. Lastly, future studies ought to look into the boundary conditions of GIC mediation to examine whether environmental orientation of the CEO, board sustainability expertise or organizational ambidexterity promotes or limits the role of GIC in knowledge brokering between green resources and ESG performance.

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