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The Role of ESG and Digitalization Driving Sustainable Agropreneurship in Emerging Market

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ABSTRACT

This **study examines** the determinants of Firm Valuein the global agricultural sector from 2017 to 2022 across 37 countries, focusing on the impact of Digital Adoption, Board Gender Diversity (BGD), Multiple Large Shareholders (MLS), and ESG performance. The **research highlights** the growing importance of sustainable practices and effective governance in agriculture, a sector that is increasingly influenced by market dynamics and environmental challenges. The study aims to understand how these factors contribute to FV, with a particular focus on the roles of governance and sustainability in enhancing corporate performance. The **method employed** is path analysis in AMOS, which allows for a thorough examination of the relationships among these variables. The **results show** that Digital Adoption significantly enhances FV by improving operational efficiency, facilitating sustainable practices, and aligning with market trends. Board Gender Diversity contributes to better decision-making and governance, thereby positively influencing FV. In contrast, the presence of MLS negatively affects FV due to governance inefficiencies associated with concentrated ownership. Moreover, strong ESG performance is found to enhance stakeholder relationships and mitigate risks, thereby boosting FV. The study also identifies a **gap** in the literature regarding the role of digital tools such as AI and blockchain in fostering digital adoption and sustainability. The **novelty** of this study lies in its cross-country analysis and its consideration of governance structures. **The results** underscore the significance of sustainable practices and governance in enhancing FV within the agricultural sector.

1. INTRODUCTION

Over the past few years, the global business landscape has undergone a significant shift towards more sustainable and responsible corporate practices, driven by increasing stakeholder pressure for transparency, accountability, and the creation of long-term value [1]. In addressing environmental issues, promoting social justice, and institutionalizing good governance practices, Environmental, Social, and Governance (ESG) performance has emerged as one of the most influential predictors of Firm Value (FV) [2]. As agricultural firms face globalization and increasing competition, understanding how ESG performance enhances FV becomes

critical for long-term growth [3]. This study examines the relationships between DA, Board Gender Diversity (BGD), Multiple Large Shareholders (MLS), and ESG in determining FV in agricultural firms across 37 countries from 2017 to 2022.

DA, referring to the integration of digital technologies within organizations, has become a core focus in contemporary corporate strategy [4]. Scholars argue that DA serves as a dynamic capability that enhances firms' flexibility, enabling them to invest in innovation and strategic initiatives [5]. In the agricultural sector, embracing digital technologies significantly boosts operational efficiency, improves resource management, and fosters the development of sustainable practices [6]. Consequently, DA enhances FV by positioning companies to meet market demands, optimize processes, and create competitive advantages [7]. However, addressing the costs associated with digital transition and integration is crucial to avoid inefficiencies [8].

BGD plays a critical role in corporate governance [9]. It suggests that boards with diverse gender representation are more likely to consider shareholder interests, act ethically, and promote sustainable business practices [10]. Incorporating diverse viewpoints enhances a firm's ability to address complex problems and seize new opportunities, thereby increasing FV [11]. However, the effect of diversity on FV is not universal, as cultural and institutional factors influence the strength of this relationship [12]. This study examines the impact of BGD on FV in the global agricultural sector, acknowledging the sector's distinct cultural and institutional contexts, which influence gender representation on boards.

MLS is an additional dynamic in corporate governance. Unlike companies controlled by a single dominant shareholder, firms with numerous large shareholders may enhance oversight and mitigate agency problems if these shareholders act as checks on one another [13]. When firms align their sustainability initiatives with the long-term interests of all stakeholders, governance structures can promote FV [14]. However, MLS can lead to conflicts if shareholder interests diverge, reducing efficiency and hindering growth [15]. This research examines the impact of MLS on FV in global agricultural firms, which often have distinct ownership structures compared to family-owned firms or cooperatives [16].

ESG practices capture how companies integrate sustainability considerations into their strategic decision-making [17]. In agriculture, strong ESG performance not only enhances a firm's reputation but also reduces risks and attracts socially conscious investors, thereby contributing to sustainable value creation and sector continuity [18].

This study contributes to the literature by providing a comprehensive examination of the factors influencing FV in the global agriculture sector, emphasizing the roles of DA, BGS, MLS, and ESG performance as significant drivers of FV. It also provides deeper insights into the direct relationships between these elements and FV, thereby enhancing our understanding of governance systems and sustainability initiatives as drivers of corporate profitability, particularly in the agricultural sector [19]. This paper highlights the significance of ESG as a fundamental component of business strategy for global agrarian companies, contributing to long-term growth and value creation, particularly in addressing climate change and social issues.

The agriculture sector is a vital contributor to global productivity and sustainability. However, it requires innovation to meet the challenges of climate change, resource management, and the growing global food demand [20]. Therefore, the roles of DA, MLS, and BGD as facilitators of ESG performance are crucial, as robust ESG performance is highly likely to lead to enhanced financial value (FV). Integrated sustainability strategies enable global agricultural firms to innovate in production, resource management, and community engagement, thereby improving competitiveness and sustainability [21].

In alignment with SDGs 12 on Responsible Consumption and Production, the integration of ESG principles within the agricultural sector plays a strategic role in promoting sustainable resource use, minimizing environmental externalities, and enhancing production efficiency. Moreover, governance mechanisms such as BGD and MLS strengthen accountability and long-term orientation in decision-making, encouraging firms to adopt environmentally responsible production practices and to report transparently.

2. LITERATURE REVIEW

2.1. The Role of Digital Adoption in Business Performance

Digital adoption refers to the integration of digital technologies into business operations to improve efficiency, accelerate innovation, and improve competitiveness. In today's rapidly evolving market, companies are increasingly relying on digital tools and technologies to streamline their processes, reduce costs, and improve overall performance [22]. The adoption of digital technologies, such as Artificial Intelligence (AI),

the Internet of Things (IoT), and Big Data analytics, plays a pivotal role in transforming traditional business models into more flexible and data-driven operations [23].

Case studies in the agricultural sector have demonstrated how digital adoption has revolutionized farming practices [24]. For example, the use of IoT devices to monitor soil moisture levels, crop health, and weather patterns has allowed farmers to make informed decisions about irrigation and pest management [25]. Similarly, the implementation of AI-driven platforms for analyzing crop data has allowed farmers to optimize planting schedules, reduce waste, and maximize their harvests [26]. These advances in digital adoption illustrate how technology can transform the agricultural industry by improving performance, driving innovation, and supporting sustainability goals [27].

2.2. The Impact of ESG on FV

This section examines the relationship between ESG performance and FV [28]. Research indicates that companies with robust ESG performance tend to have stronger relationships with stakeholders, mitigate operational risks, and attract socially and environmentally conscious investors [29]. This, in turn, contributes to enhanced corporate reputation and long-term performance [30].

Prior studies have consistently documented the relationship between ESG performance and improved firm value. Firms with high ESG scores are perceived as less risky and more aligned with contemporary societal values. This alignment attracts investors who are increasingly prioritizing companies that embrace sustainable business practices [31]. Consequently, businesses that focus on ESG are better positioned to increase their financial performance and long-term value, particularly in a market where investors are more attuned to social and environmental issues [32]. Additionally, ESG initiatives can mitigate operational risks. By adopting sustainable practices and ensuring good governance, companies reduce the likelihood of ESG related issues that could impact their business operations [33]. These proactive measures help avoid potential legal, regulatory, and reputational risks, thereby contributing to overall stability and growth, which in turn further enhances FV [34].

3. RESEARCH METHOD

Using a sample of all global agriculture firms from 2017 to 2022, which is 161 companies. This research examines the key drivers of FV, DA, BGD, MLS, and ESG performance. Therefore, this study aims to explore how regional and industry heterogeneity impacts corporate sustainability, leveraging this rich dataset that captures variation in both dimensions [35]. This study is quantitative in nature and uses secondary data, which refers to data that has not been directly collected by researchers [36]. Relevant data are collected from the Refinitiv database and from the literature and journals. The analysis begins with a path analysis to determine the influence of DA, BGD, MLS and ESG performance on FV. Panel, cross-sectional, and time-series data have been used in an AMOS 22 analysis [37]. This includes outlier analysis, normality analysis, and hypothesis testing where the direct effect is assessed at a significance value of 0.05. This structure is applied to provide a deeper understanding of the relationships among variables related to corporate sustainability [28].

3.1. Variable Definitions and Measurements

The following Table 1 presents the variables used in this study, along with their respective symbols, definitions, measurement methods, and data sources [38]. These variables encompass a range of factors crucial to understanding a firm's operations, including digital adoption and governance practices, as well as financial performance and sustainability efforts. Each variable is defined and measured in a way that aligns with the study's focus, providing clear insights into how these aspects contribute to the firm's overall strategy and success. For example, "Digital Adoption" is measured through capital expenditure on technology, while "Board Gender Diversity" is assessed by the proportion of female directors on the board [39]. Similarly, variables like "Profitability" and "Leverage" focus on financial metrics, such as return on assets and the ratio of total debt to total equity. By examining these variables, the study aims to gain a comprehensive understanding of the factors driving firm performance [40].

ESG performance as a variable offers a unique lens through which to assess the firm's commitment to sustainability [41]. By measuring a company's ESG efforts, this study investigates how responsible practices can enhance relationships with stakeholders, reduce risks, and ultimately improve the firm's market value [42]. ESG performance is quantified using a weighted scoring system derived from the Refinitiv database, providing an objective, standardized measure across firms in different regions and industries. This enables a

broader understanding of how sustainability initiatives directly impact long-term corporate success, particularly in industries such as agriculture, where environmental and social considerations are increasingly crucial.

Table 1. Variables Definitions and Measurements

Variable	Symbol	Definition	Measurements
Digital Adoption	DA	The extent to which a firm integrates digital technologies into its operations.	Total capital expenditure on technology.
Board Gender Diversity	BGD	Proportion of female directors in the company.	Measured by the proportion of female directors to the total board members.
Multiple Large Shareholders	MLS	The presence of more than one significant shareholder with substantial ownership.	Dummy variable: 1 if more than two large shareholders (>10% ownership).
Firm Value	FV	The market perception of a company's worth.	Price to book value ratio.
ESG Performance	ESG	A firm's performance in environmental, social, and governance aspects.	Refinitiv calculates the ESG score by aggregating company-specific ESG data using a weighted scoring system.
Company Age	CA	The number of years since a company was established.	IPO date.
Company Size	CS	The scale of a company's operations.	Total assets.
Profitability	PROF	A firm's ability to generate earnings relative to its revenue or assets.	Return on assets.
Leverage	LEV	The degree to which a firm uses debt to finance its assets.	Total debt to total equity.

Table 1 presents the definitions and measurements of key variables used in the study. These variables represent various aspects of a firm's operations, including its adoption of digital technologies, corporate governance practices, financial health, and sustainability efforts. The "DA" variable, for example, measures the extent to which a firm integrates digital technologies into its operations, based on capital expenditures on technology. "BGD" and "MLS" relate to corporate governance, while "FV" assesses a company's market value. The "ESG Performance" variable highlights the firm's commitment to ESG issues, using a weighted scoring system. Other variables, such as "Company Age", "Company Size", "Profitability", and "Leverage", focus on a firm's financial dimensions, providing insight into its market presence, asset base, profitability, and debt use. These variables form the foundation for analyzing a firm's overall performance and strategic decision-making [43].

3.2. Formula/Algorithm

Equation presents the research model that examines the role of DA, BGD, MLS, and ESG in determining FV.

$$FV = \beta 1.1DA + \beta 1.2BGD + \beta 1.3MLS + \beta 1.4ESG + \gamma 1.1CA + \gamma 1.2CS + \gamma 1.3PROF + \gamma 1.4LEV + \epsilon \quad (1)$$

3.3. Hypothesis

DA plays a crucial role in enhancing FV by enabling firms to invest in technological innovations, improve operational efficiency, and adopt sustainable practices. In the agricultural sector, digital adoption supports smart farming, precision agriculture, and resource optimization, which increase productivity and profitability. According to Signalling Theory, adopting digital technologies signals to investors that the firm is innovative, well-managed, and resilient. Empirical evidence supports the positive link between digital adoption and FV. DA

led to improved stock market performance and operational efficiencies. Agricultural firms using DA demonstrated better resource management and risk mitigation, thereby boosting investor confidence. Furthermore, digital adoption was found to enhance ESG and firm performance. Therefore, the following hypotheses are proposed:

- H1: DA has a Positive Effect on FV.

According to Signalling Theory, improved governance and transparency result in a higher FV and will be acknowledged in the stock market, considering that BGD reflects better governance. When it comes to decision-making in agriculture, an area increasingly focused on sustainability challenges and social issues, having a diverse range of experiences, backgrounds, and perspectives on boards can help bring a more holistic and inclusive approach, especially when it comes to sustainability. Having women on the boards sends a signal to investors that the firm is committed to ensuring diversity and good governance practices, thereby increasing investor confidence and improving FV. It has been demonstrated that companies with more women on their boards have higher FVs due to more effective oversight and strategic decision-making. Gender diversity in the agricultural sector is critical to developing efficient, innovative strategies that ensure sustainable productivity. Therefore, the following hypotheses are proposed:

- H2: BGD has a Positive Impact on FV.

Stakeholder theory suggests that having MLS would improve governance and transparency within a firm, thereby increasing FV. Large shareholders have something to lose and are incentivized to monitor management so that it acts in the interests of all stakeholders. In the context of agriculture, where family or other stakeholder-group ownership structures are common across many firms, MLS can play a key role as an internal governance mechanism, alleviating the information disadvantage that management has relative to shareholders. Agency Theory also proposes that MLS can reduce potential agency problems by aligning management's interests with those of the organization as a whole. However, MLS may also give rise to conflicts of interest that lead shareholders to act in their own interests rather than for the welfare of the firm, resulting in a loss of efficiency and FV. While there is empirical evidence of the positive impacts of MLS on stronger governance and transparency, showing a positive effect on FV, their contribution to FV is context-dependent and can even be detrimental under conflicts. Therefore, the following hypotheses are proposed:

- H3: MLS has a Positive Impact on FV.

Stakeholder Theory suggests that companies that produce strong ESG practices cultivate stronger relations with investors, customers, employees, and society, ultimately strengthening their competitive position and long-term financial performance. In agriculture, where sustainability and social responsibility are increasingly becoming a big focus, practicing ESG within the global agriculture firms also allows for better environmental and sustainable farming practices that, in turn, lead to better productivity and competitiveness. According to the Legitimacy Theory, strong ESG disclosures are expected to legitimize firms in social perceptions, leading to less operational risk and higher investor trust, thus increasing FV. Individual research has established a positive relationship between ESG performance and FV, particularly when appropriate ownership structures encourage ESG transparency. In agriculture, strong ESG performance can help firms build trust with the public and investors, especially regarding sustainability and social innovation. Therefore, the following hypotheses are proposed:

- H4: ESG Performance has a Positive Impact on FV.

4. RESULT AND DISCUSSION

4.1. Descriptive Statistics

The table below presents the descriptive statistics of the variables used in this study. The table includes the number of observations (N), minimum and maximum values, mean, and standard deviation for each variable, providing an overview of the data distribution and central tendency. This helps in understanding the general characteristics and variability of the data before further analysis. These descriptive statistics offer valuable insights into the range and concentration of values across variables, enabling identification of potential

outliers or inconsistencies. By examining the data distribution, we can better interpret the underlying patterns and trends that will inform subsequent analyses.

Additionally, this step serves as a crucial foundation for assessing the assumptions of normality and the suitability of the data for advanced statistical testing.

Table 2. The Descriptive Statistics of Variables

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Digital Adoption	966	1.00	15.90	8.5516	3.24689
Board Gender Diversity	966	2.94	99.55	49.2958	26.37127
Multiple Shareholders	966	0.00	1.00	0.6541	0.47591
ESG Performance	966	0.93	90.44	50.4165	18.65609
Firm Value	966	0.13	19.46	1.5849	1.84845
Company Age	966	15.51	25.44	22.4724	1.35064
Profitability	966	0.00	0.67	0.0648	0.05989
Leverage	966	0.00	7.20	0.6940	0.68216
Company Size	966	1.00	74.00	35.5252	22.36307
Valid N (listwise)	966	-	-	-	-

Table 2 presents descriptive statistics for various variables across a sample of 966 firms. DA has a mean value of 8.5516 with a standard deviation of 3.24689, ranging from 1.00 to 15.90. BGD reports a mean of 49.2958 and a standard deviation of 26.37127, with values ranging between 2.94 and 99.55, indicating substantial variability across firms. MLS shows a mean of 0.6541 with a standard deviation of 0.47591, within a range of 0.00 to 1.00. ESG Performance records an average value of 50.4165 and a standard deviation of 18.65609, ranging from 0.93 to 90.44, while FV has a mean of 1.5849 with a standard deviation of 1.84845, and values between 0.13 and 19.46. Control variables indicate that CA has a mean of 22.4724 (SD = 1.35064), Profitability (Prof) averages 0.0648 (SD = 0.05989), Leverage (Lev) has a mean of 0.6940 (SD = 0.68216), and CS records a mean of 35.5252 with a standard deviation of 22.36307, as detailed in the table [44].

4.2. Verificative Analysis

The impact of DA, BGD, MLS, and ESG on FV was tested using path analysis in AMOS 22. A multivariate normality check with an outlier test using Mahalanobis distance was conducted. The max Mahalanobis distance was 169.87, greater than the critical chi-square value ($X^2 = 16.92$ for degrees of freedom = 9), indicating the presence of outlier cases, which can affect the normality assumption, as shown in table 3.

Table 3. Outlier Detection Through Mahalanobis Distance

Observation number	Mahalanobis d-squared	p1	p2
480	169.874	0.000	0.000
825	110.202	0.000	0.000
868	100.098	0.000	0.000
73	97.574	0.000	0.000
709	97.439	0.000	0.000
550	97.096	0.000	0.000
391	96.899	0.000	0.000
232	96.492	0.000	0.000
852	75.306	0.000	0.000
534	65.724	0.000	0.000
375	49.579	0.000	0.000
321	44.656	0.000	0.000
617	39.462	0.000	0.000
335	36.964	0.000	0.000
8	34.941	0.000	0.000
666	32.560	0.000	0.000

Observation number	Mahalanobis d-squared	p1	p2
639	31.141	0.000	0.000
875	28.882	0.001	0.000

Table 3 presents the results of outlier detection using Mahalanobis distance. A Mahalanobis distance greater than a certain threshold indicates potential outliers. As indicated by the p-values, all observations have significant values, confirming that they are outliers based on the distance calculations [45].

4.3. Multivariate Normality Test

One of the key requirements for using the maximum likelihood estimation method in path coefficient analysis is that the data must follow a multivariate normal distribution. Therefore, it is essential to analyze the data distribution to verify whether this normality assumption is met. In this study, the normality test was conducted multivariately, and the results of the normality assessment are presented in Table 4.

Table 4. Initial Model Multivariate Normality Test Results

Variable	min	max	skew	c.r.	kurtosis	c.r.
DA	1.00	15.901	-0.423	-5.337	-0.183	-1.156
BGD	2.941	99.550	0.203	2.557	-1.157	-7.297
MLS	0.000	1.000	-0.648	-8.170	-1.580	-9.963
ESG	0.933	90.438	-0.341	-4.295	-0.660	-4.161
FV	0.126	19.458	5.985	75.462	51.064	321.946
CA	1.000	74.000	0.546	6.883	-1.177	-7.424
CS	15.507	25.442	-0.628	-7.923	1.321	8.326
PROF	0.001	0.666	3.079	38.823	17.945	113.141
LEV	0.001	7.203	2.888	36.413	15.898	100.236
Multivariate	102.140	140.000	-	-	-	-

As shown in Table 4, after the removal, the critical ratio (c.r) dropped to 3.805, which is below the threshold of 5.00, confirming that the data is now multivariate normal and suitable for further analysis [46]. This approach follows established practices in the literature, as extreme outliers can distort model parameters and affect the robustness of results [47].

The initial test from Table 4 showed a critical ratio (c.r) of 112.1, indicating that the data did not follow a multivariate normal distribution, as a critical ratio above 5.00 suggests non-normality [48].

Table 5. Final Model Multivariate Normality Test Results

Variable	Min	Max	Skew	c.r.	Kurtosis	c.r.
DA	1.000	23.912	-1.338	-17.441	-0.157	-1.026
BGD	0.000	55.556	0.662	8.631	-0.273	-1.778
MLS	0.000	1.000	1.644	21.421	0.702	4.573
ESG	6.221	90.621	-0.485	-6.324	-0.229	-1.492
FV	0.142	10.277	1.335	17.404	1.856	12.095
CA	1.000	117.000	0.775	10.097	0.095	0.618
CS	18.904	26.008	0.312	4.065	0.236	1.537
LEV	0.000	271.647	1.282	16.704	1.962	12.784
PROF	-7.770	26.070	1.007	13.127	1.602	10.440
Multivariate	-	-	3.023	-	-	3.429

Table 5 to meet the assumption of multivariate normality, which is crucial for accurate statistical analysis and valid results. Specifically, 52 of the largest outliers were removed to ensure that extreme values did not disproportionately influence the analysis.

4.4. Path Coefficient Estimation Results (Structural Model)

Following the data testing, the structural model results will be presented to examine the effects of DA, BGD, and MLS, ESG performance and its impact on FV. Based on data analysis using AMOS 22, the path

coefficients for each independent variable on FV were calculated, as detailed in Table 6.

On the other hand, the path between PROF → FV showed no significant effect, as evidenced by its negative coefficient of -0.030 and the p-value of 0.313. This suggests that Profitability (PROF) may not directly influence FV. Additionally, the variable LEV → FV exhibited a negative coefficient of -0.228, with a CR value of -7.095, indicating that higher leverage could be detrimental to the firm's value. These findings are consistent with existing literature, which suggests that excessive financial leverage may lead to increased financial risk and negatively impact firm performance [49].

Table 6. Verification Results of the Influence Between Variables

Path	Coefficient*	CR	p-value	R Square
DA → FV	0.164	4.371	0.000	0,427
BGD → FV	0.141	5.028	0.000	-
MLS → FV	-0.093	-3.138	0.002	-
ESG → FV	0.230	6.151	0.003	-
CA → FV	0.096	3.026	0.002	-
CS → FV	0.624	16.890	0.000	-
PROF → FV	-0.030	-1.010	0.313	-
LEV → FV	-0.228	-7.095	0.000	-

Table 6 presents the results of the verification analysis for the influence between various variables. It shows the path coefficients, critical ratios (CR), p-values, and R-square values for each path. Among the significant variables, CS → FV (coefficient = 0.624) and ESG → FV (coefficient = 0.230) exhibit strong positive influences, with high CR values (16.890 and 6.151, respectively). In contrast, PROF → FV displays a non-significant relationship, as indicated by a p-value of 0.313. The R-square values are provided where applicable, showing the explanatory power of the respective models. This table serves as a summary of the direct influences of various factors on the dependent variable FV.

4.5. Hypothesis Testing

Hypothesis testing will be conducted to examine whether DA, BGD, MLS, and ESG influence FV. Figure 1 provides a summary of the findings regarding the direct effects of DA, BGD, MLS and ESG on FV.

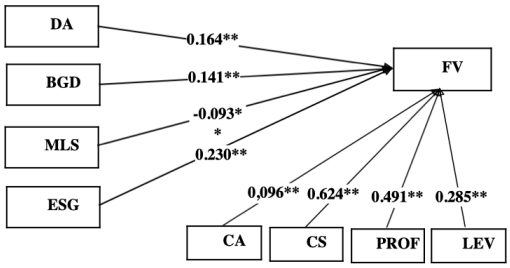

Figure 1. Path diagram of the direct influence hypotheses on Stock Valuation

Figure 1 presents the CR for individual variables affecting FV in global agriculture firms: DA (CR 4.371, p=0.000) and BGD (CR 5.028, p=0.000) positively impact FV, while MLS (CR -3.138, p=0.002) negatively affects FV. ESG (CR 6.151, p=0.003) also boosts FV. Additionally, CA (CR 3.026, p=0.002) and CS (CR 16.890, p=0.000) increase FV, while PROF (CR -1.010, p=0.313) shows no significant effect, and LEV (CR -7.095, p=0.000) decreases FV.

DA plays a vital role in FV, particularly in industries like agriculture, where the integration of digital technologies such as AI, IoT, and data analytics can significantly improve operational efficiency. By leveraging these tools, agricultural firms can optimize resource utilization, monitor crop health, and predict market demands more accurately, ultimately increasing competitiveness. According to the Technology-Organization-Environment (TOE) framework, embracing digital technologies signals a company's readiness to innovate, which in turn boosts stakeholder confidence and supports sustainable growth. Studies have consistently shown

a positive relationship between DA and company performance, demonstrating that firms adopting digital solutions can achieve better decision-making, reduce operational costs, and enhance supply chain transparency. This adoption also supports sustainability efforts, such as precision farming, which reduces environmental footprints while creating long-term value. However, it is important for firms to ensure that they adopt the right technologies tailored to their specific needs to avoid inefficiencies and resource wastage [50].

5. MANAGERIAL IMPLICATIONS

This study presents several important insights for managers, especially in the agricultural sector, on how to leverage DA, BGD, MLS, and strong ESG performance to improve FV.

5.1. Digital Adoption

Managers should prioritize the integration of digital technologies, such as AI, IoT, and Big Data analytics, to streamline operations, enhance productivity, and reduce environmental impact. Digital adoption is essential not only for improving operational efficiency but also for fostering innovation and creating sustainable practices. It is crucial for managers to tailor digital strategies to their specific business needs to avoid inefficiencies and maximize resource utilization.

5.2. Board Gender Diversity

Companies with gender-diverse boards are better equipped to make more inclusive decisions and respond to complex market challenges. Managers should strive to promote gender diversity at the board level, as it has been shown to enhance governance practices, improve strategic decision-making, and boost FV. The inclusion of women on boards can signal a commitment to sustainability and ethical business practices, which are highly valued by investors.

5.3. Multiple Large Shareholders

The study indicates that MLS may negatively impact FV due to governance conflicts. Therefore, managers should carefully manage shareholder relationships to ensure alignment of interests. Regular communication and the establishment of clear governance structures can help mitigate the risks associated with MLS, particularly by fostering greater collaboration and transparency between shareholders.

5.4. ESG Performance

Strong ESG practices are positively correlated with FV. Managers should focus on strengthening ESG strategies to not only improve relationships with stakeholders but also to reduce operational risks and attract socially-conscious investors. In industries like agriculture, where sustainability is becoming increasingly important, demonstrating robust ESG performance can lead to competitive advantages, improved market reputation, and enhanced financial performance.

6. CONCLUSION

Innovation is pivotal in driving both productivity and sustainability in the agricultural sector, playing a significant role in advancing SDGs 12 (Responsible Consumption and Production). This study underscores the importance of DA, BGD, MLS, and ESG performance as key determinants of FV.

However, this study is not without limitations. It primarily focuses on traditional aspects of DA, BGD, MLS, and ESG performance, leaving out several other critical factors, such as government policies, market volatility, and regional variations that could also influence firm performance and sustainability efforts. Additionally, the study's exclusion of digital entrepreneurship limits the understanding of the evolving role of digital technologies in advancing SDG 12. Given the rapid evolution of digital tools and their increasing role in agricultural innovation, further research in this area is necessary to explore their full potential.

Future research should focus on harnessing advanced digital tools like big data, AI, and innovations in digital entrepreneurship to optimize resource allocation, reduce waste, and enhance sustainability within the agricultural value network, thereby directly contributing to SDG 12. Additionally, exploring ESG practices across diverse regions and understanding their impact on firm performance can provide valuable insights into global agricultural practices. This will help create a clearer picture of how the agricultural sector can lead in

responsible consumption and production, driving sustainable change across the industry. Further, investigating the integration of emerging technologies such as blockchain and machine learning could offer innovative solutions for improving traceability and transparency in sustainable agricultural supply chains.

7. DECLARATIONS

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7.2. Author Contributions

Conceptualization: AA; Methodology: CS; Software: IA; Validation: DR and AA; Formal Analysis: CS and IA; Investigation: DS; Resources: AA and EK; Data Curation: CS; Writing Original Draft Preparation: IA and DR; Writing Review and Editing: AA and CS; Visualization: IA and EK; All authors, AA, CS, IA, DR and EK, have read and agreed to the published version of the manuscript.

7.3. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

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7.5. Declaration of Conflicting Interest

The authors declare that they have no conflicts of interest, known competing financial interests, or personal relationships that could have influenced the work reported in this paper.

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