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Harvesting sustainability: The influence of green innovation on agricultural firm performance

Cosechando sostenibilidad: La influencia de la innovación verde en el rendimiento de las empresas agrícolas

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ABSTRACT

Environmental sustainability has emerged as a global concern, particularly in the agricultural sector. This research examines the impact of green innovation on the quality of financial, environmental, and social performance in agricultural firms in Pakistan. The relationships in the constructs were studied using data from 378 agricultural firms, and the survey was conducted through the PLS-SEM method. As the results indicate, green innovation has a major impact on financial performance, environmental sustainability, and social performance. Environmental and social performance has been identified as playing an intermediary role in the relationship between green innovation and financial performance, indicating that sustainable activities not only are profitable but also enhance profitability. Moreover, on the one hand, the effects of green innovation are amplified, while on the other hand, environmental regulations, firm size, and stakeholder engagement were also recognized as moderating variables. Overall, the findings demonstrate that incorporating environmental considerations into business strategy is essential for value creation, and they highlight the interconnected and sustainable nature of government policies and firm performance.

Keywords: environmental regulations; financial performance; government policies; stakeholder engagement; sustainable development; technological innovation

RESUMEN

La sostenibilidad medioambiental se ha convertido en una preocupación mundial, especialmente en el sector agrícola. Esta investigación examina el impacto de la innovación ecológica en la calidad del rendimiento financiero, medioambiental y social de las empresas agrícolas de Pakistán. Las relaciones entre los constructos se estudiaron utilizando datos de 378 empresas agrícolas, y la encuesta se realizó mediante el método PLS-SEM. Como indican los resultados, la innovación ecológica tiene un impacto importante en el rendimiento financiero, la sostenibilidad medioambiental y el rendimiento social. Se ha identificado que el rendimiento medioambiental y social desempeña un papel intermediario en la relación entre la innovación ecológica y el rendimiento financiero, lo que indica que las actividades sostenibles no solo son rentables, sino que también mejoran la rentabilidad. Además, por un lado, se amplifican los efectos de la innovación ecológica, mientras que, por otro, también se reconocieron como variables moderadoras las regulaciones medioambientales, el tamaño de la empresa y la participación de las partes interesadas. En general, los resultados demuestran que la incorporación de consideraciones medioambientales en la estrategia empresarial es esencial para la creación de valor, y ponen de relieve la naturaleza interconectada y sostenible de las políticas gubernamentales y el rendimiento de las empresas.

Palabras clave: desempeño financiero; desarrollo sostenible; innovación tecnológica; regulaciones ambientales; participación de las partes interesadas; políticas gubernamentales

INTRODUCTION

In every region of the world, agriculture serves as the foundation of the economy by ensuring food availability, employment opportunities, and essential resources for various industries. Currently, major issues such as deforestation, loss of soil, water shortages, and more greenhouse gases have resulted from traditional farming practices (Kong & Zhu, 2022). For this reason, the agricultural sector is now placing great importance on sustainability. Sustainable agriculture aims to combine high productivity with nature conservation, creating conditions for long-term survival of resources (Liu *et al*., 2023). Green innovation is a key step towards this goal, as it focuses on the use of environmentally safe technologies, procedures, and methods. Green innovation addresses urgent environmental issues and makes businesses perform more efficiently, save money, and find new opportunities in the market (Liao & Zhou, 2023). Due to the increasing focus on sustainability, agricultural firms are encouraged to implement green innovations (Li *et al*., 2023). As a result of this new focus on sustainability, firm performance might change in terms of finances, reducing environmental impact, and helping society.

Although the importance of green innovation is widely recognized, there remains a lack of clarity regarding its specific effects on the performance of agricultural firms. Although previous studies have examined green innovation in industries, few have explored its role in agriculture, and especially in developing countries such as Pakistan. Most studies have mainly looked at how green innovation affects financial outcomes, instead of considering how other mechanisms may be present. Key questions remain: How does green innovation influence both the environment and social performance, and how do these two areas later influence the financial outcomes? Nevertheless, there is not much research on how things such as company size, rules set by industry, and going digital help define the green innovation-performance correction. It is important to bridge these gaps to learn how agricultural companies can use green innovation to support their sustainable development.

The purpose of this study is to determine how green innovation impacts the finances, the environment, and social aspects of farming businesses. In particular, the research aims to find out how green innovation leads to better financial results. The study examines whether green innovation promotes environment sustainability and influences social outcomes. The research also seeks to examine whether environmental and social performance contributes to the relationship between green innovation and the company's financial performance. Besides, the influence of factors such as company size, strictness of the rules, and the rise of digital approaches is also studied in relation to green innovation. Therefore, the study looks closely at the methods by which green innovation improves the sustainability of agricultural firms.

This research results in helpful articles for scholars and practical lessons for businesses. When examined in education, the topic adds to discussions about sustainability and innovation by looking at agriculture, an area that was not studied much before. The results provide a better understanding of how innovation and firm performance influence sustainability. In practice, the study provides useful tips to agricultural businesses that want to implement green innovations. The study also suggests that focusing on sustainable practices offers businesses a solid strategy for considering green innovation as a key element. Furthermore, the collected information can help policymakers plan rules

and rewards for activities that encourage environmental safety in agriculture. Therefore, this research brings together ideas and practical knowledge to show how green innovation contributes to sustainable development.

Regarding organization, several sections are used to make sure that the paper is well ordered. Once the introduction is completed, a literature review explains needed theories and discusses previous studies concerning green innovation, sustainability, and firm performance. In the methodology section, the study outlines how the survey is conducted, how data is collected, and how SmartPLS is used for analysis. In this section, researchers describe the statistics of the data, assess their measurement models, and inform about the results of their tests. The analysis sets out the most important findings, emphasizing their impact for other researchers, as well as for those who use it in practice, while still noticing any weaknesses and proposing further research. At last, the conclusion presents a summary of the main points and explains why green innovation promotes sustainable agriculture. These sections together cover the topic in detail and help in both academic and practical fields.

Research used three important approaches as study framework: The Resource-Based View (RBV), the Natural Resource-Based View (NRBV), and Stakeholder Theory. It is argued by the RBV that a firm can gain an advantage in the market by making use of resources that others do not have (Zhao & Gao, 2025). As a result of investing in eco-friendly technologies and approaches, agricultural firms receive extra resources that increase their efficiency, reduce their expenses, and secure a better position in the market (Zhao *et al.*, 2025). NRBV further adds that managing natural resources effectively and caring for the environment helps a business perform better in the market (Lee *et al.*, 2024). Firms that adopt green technologies deal with environmental problems and also comply with what is demanded by regulations and society. Additionally, Stakeholder Theory adds to these theories by showing how employees, customers, investors, and communities all have a hand in deciding how the firm should proceed (Sheng & Liu, 2024). Those agricultural firms that go for green advances can satisfy stakeholders and enhance their reputation among the public and long-term survival (Moreira-Dantas *et al.*, 2023). All of these theories together give a good base to understand how green innovation affects a company's performance in money, environment, and social aspects.

Green innovation means finding and using new solutions that have less influence on nature while making resources last longer (Najjar & Baruah, 2024). Some of its aspects are designing products that are friendly to the environment, cutting down on waste, speeding up the use of clean energy, and improving sustainability in production (Zheng *et al.*, 2025). Green innovation has been considered in previous studies in many industries, yet it is less studied when it comes to agriculture (Yuan *et al.*, 2024). Growing food and crops by farming demands lots of materials and energy, nature is unpredictable, and there are many rules to follow, which is why green innovation is very important (Zeng *et al.*, 2025). Thanks to various studies, it is known that making use of precision farming technologies, organic fertilizers, and water-saving irrigation systems results in greater productivity and helps the environment (Pantaloni *et al.*, 2025). Still, there is not much evidence on the outcomes of these new technologies for companies in agriculture, such as better finances, help for the environment, and positives for society (Guo *et al.*, 2024; Han *et al.*, 2024). The aim of this research is to clarify this gap by exploring the exact routes through which green innovation shapes agricultural firm performance.

To evaluate a company's performance, its financial situation, environmental awareness, and social actions must be analyzed. Financial performance consists of reviewing whether a company achieves its financial objectives, such as

profits, costs, and market share (Yu *et al.*, 2024). Many studies confirm that turning to green innovation can improve the financial situation of a business by saving money, attracting environment-conscious buyers, and meeting legal requirements (Xu *et al.*, 2025). The performance of a business, in terms of environmental sustainability, reflects its efforts to save the environment and reduce its ecological impact (Ma *et al.*, 2024). To meet these goals, activities such as reducing carbon emissions and helping biodiversity are crucial (Wu & Lin, 2025). Social performance means a firm helps society by caring for its workers, being involved in the community, and doing things ethically. Using green innovations usually means a company cares more about society, and this leads to stronger relationships with its stakeholders (Sun & Chen, 2023). By studying these aspects as a group, this study gives an overall picture of how green innovation affects a firm's results (Chang, 2022).

In order to explore how green innovation affects a firm's performance, this study introduces both mediating and moderating variables. Researchers suggest that the way a business performs in environmental sustainability and social matters may explain the connection between green innovation and its finances (Shmeleva *et al.*, 2024). Significant environmental achievements by a firm usually mean attracting better financial results by bringing in more investors and consumers. Likewise, strong social performances may lead to better relationships with stakeholders and faithful customers, which can bring extra financial gains (Mo *et al.*, 2025b). The impact of these variables on the relationships is expected to include firm size, the rules set by regulators, digital transformation in the company, and teamwork within the supply chain. Thanks to their resources, large firms can focus on green technology and perform better. Strict environmental standards might drive businesses to work on new environmental ideas, thereby adding value to the outcomes of green innovation. In addition, green innovations spread more efficiently and create better results when digital transformation and strong supply chain collaboration exist.

According to the theory and research, the following hypotheses have been created:

H1: Green innovation increases the ability of agricultural firms to perform well financially. Therefore, businesses that use green innovations could save resources, increase their competitiveness, and reach stronger financial positions (Mo *et al.*, 2025a).

H2: The implementation of green innovation improves agricultural firms' environmental sustainability performance. Firms that apply sustainable ways of doing business and new technologies can make smaller negative impacts on the environment, ensuring their sustainability (Dubinina *et al.*, 2024).

H3: Using green innovation agriculture practices positively impacts the social side of a farm's performance. Green innovations usually promote a better work environment, stronger relationships with communities, and ethical conduct, which can boost the company's social responsibility (Yang & Huang, 2024).

H4: It involves the idea that the relationship between green innovation and financial performance can be mediated by environmental sustainability performance. The reasoning is that caring for the environment can make a firm respected by the public, bring in more eco-friendly clients, and support its long-term earnings (Ali *et al.*, 2023).

H5: The results of green innovation on a company's financial performance depend on its social performance. Rationale: Following green principles in society can build stronger links among stakeholders, make customers loyal to the brand, and ensure better financial results (Widiastuti *et al.*, 2024).

H6: The association between green innovation and strong financial performance is more prominent for companies working in tough environmental

regulations as moderator. When regulations are very strict, companies might have to improve their practices faster, which brings greater earnings and better positions in the market (Cao & Gao, 2024).

H7: It states that firms with larger sizes experience a greater level of improvement in environmental sustainability from adopting green innovations as moderator. A reason for this is that big companies are able to use their financial advantages to pursue sustainability goals more than smaller ones (Song & Liu, 2025).

H8: It is possible that the relationship between green innovation and social performance is greater for companies that involve stakeholder engagement as moderator. There is evidence that involving stakeholders in a company's green initiatives allows the company to acquire more information, gain trust, and collaborate with others, which leads to better social performance (Deng & Zhang, 2024). The use of these hypotheses helps in fully investigating how green innovation affects the performance of agricultural companies with SmartPLS as seen in figure 1.

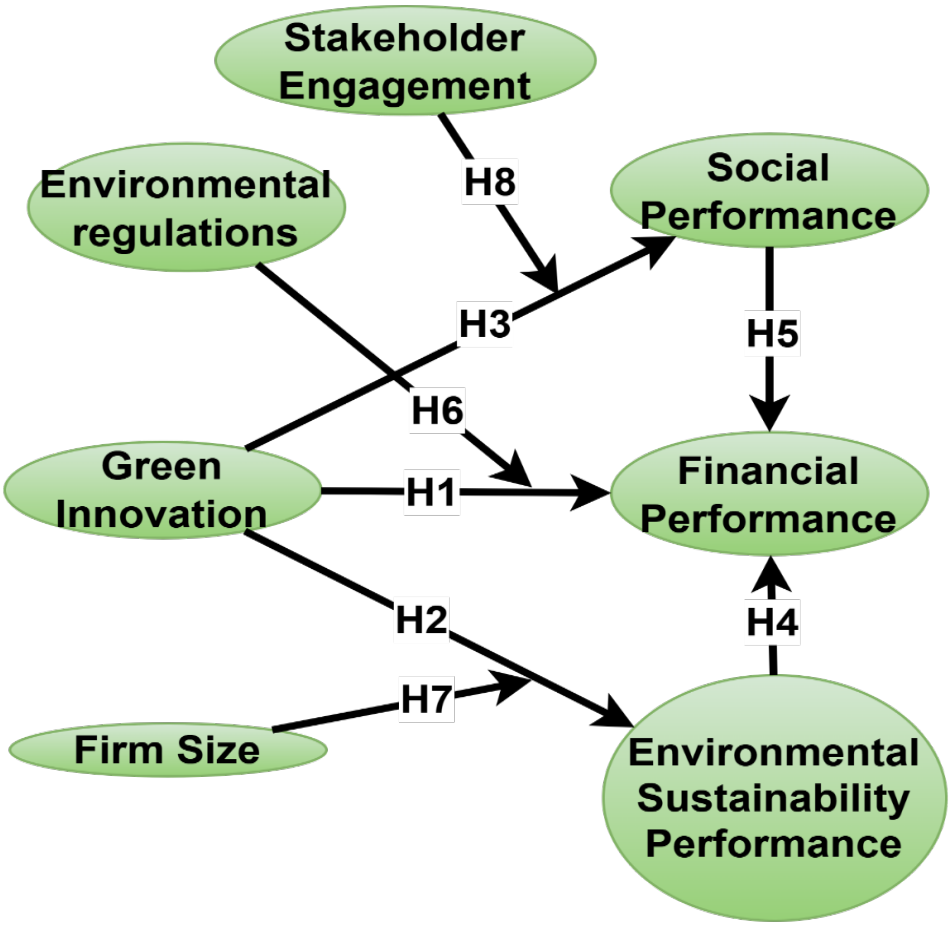


Figure 1. *Hypothesis Diagram*

This literature review is a base for doing empirical analysis, since it links ideas and theories to what is done in practice, while also highlighting what has not yet been explored in the research so far.

MATERIALS AND METHODS

Research Design

The study adopts a quantitative approach to look into the influence that green innovation has on agricultural firms from Pakistan. Hypothesis testing and studying relationships between different variables can be accomplished best with the help of quantitative methods. For this purpose, Partial Least Squares Structural Equation Modeling (PLS-SEM) is used with SmartPLS software, because it is commonly used to analyze complex relations in such models. The use of PLS-SEM is preferred, as it deals with several types of variables, include mediation and moderation effects, and it works well for exploratory research. The research design uses the measurement model to revise the accuracy and consistency of each construct and the structural model to see how the constructs are related in the model.

Population and Sampling

The target population is made up of Pakistan-based agricultural companies that are involved in growing crops, preparing food, producing chemicals, and manufacturing farming machines. The guideline of having at least 10 observations for every indicator, along with the results of power analysis, determined that 378 respondents would be needed in the sample. People were chosen from diverse firms and areas with a random method so that all groups were fairly represented. In this case, research chose to purposively sampled high-ranking leaders and managers from the companies because they had the knowledge needed about innovations related to the environment and how the firm is performing.

Data Collection

The information was gathered by providing a set of questions in a structured survey to the group of respondents. To get a clear picture of respondents' opinions, the questionnaire had items measured on a 5-point Likert scale ranging from Strongly Disagree to Strongly Agree. Assessment tools and the concepts behind them were formed based on what has been studied in other relevant works.

Table 1. *Constructs, Measurement Items, and Factor Loadings*

Construct	Measurement Item (Statement)	Factor Loading
Green Innovation (GI)	GI1: Our firm invests in research and development of sustainable technologies.	0.82
	GI2: Our firm actively adopts renewable energy sources in its operations.	0.85
	GI3: Our firm implements waste reduction practices in its production processes.	0.79
	GI4: Our firm prioritizes eco-friendly packaging solutions.	0.77
	GI5: Our firm regularly updates its processes to align with green innovation trends.	0.81

Construct	Measurement Item (Statement)	Factor Loading
Financial Performance (FP)	FP1: Our firm has experienced an increase in profitability due to sustainable practices.	0.86
	FP2: Our firm has reduced operational costs through green innovations.	0.84
	FP3: Our firm has improved its market share due to its focus on sustainability.	0.83
	FP4: Our firm's revenue growth is positively influenced by green innovations.	0.80
	FP5: Our firm has attracted more investors due to its commitment to sustainability.	0.78
Environmental Sustainability Performance (ESP)	ESP1: Our firm has significantly reduced its carbon footprint over the past year.	0.88
	ESP2: Our firm uses water resources more efficiently than competitors.	0.87
	ESP3: Our firm actively contributes to biodiversity conservation efforts.	0.85
	ESP4: Our firm complies with all environmental regulations and standards.	0.84
	ESP5: Our firm promotes circular economy principles in its operations.	0.82
Social Performance (SP)	SP1: Our firm ensures fair wages and safe working conditions for employees.	0.83
	SP2: Our firm engages in community development initiatives.	0.81
	SP3: Our firm promotes diversity and inclusion in its workforce.	0.80
	SP4: Our firm supports local suppliers and small businesses.	0.79
	SP5: Our firm actively communicates its social responsibility efforts to stakeholders.	0.78
Firm Size	FS1: Our firm has more than 250 employees.	0.80
	FS2: Our firm operates in a medium-sized industry segment (50–250 employees).	0.78
	FS3: Our firm is classified as a small business (<50 employees).	0.77
Environmental Regulations	ER1: Our firm operates in a region with stringent environmental regulations.	0.85
	ER2: Our firm adheres to international environmental standards.	0.83
Stakeholder Engagement	ER3: Our firm faces regular audits for compliance with environmental laws.	0.82
	SE1: Our firm actively involves stakeholders in decision-making processes.	0.84
	SE2: Our firm maintains transparent communication with stakeholders.	0.82
	SE3: Our firm collaborates with communities and NGOs on sustainability projects.	0.81

In the Table 1, the study outlines the main variables (constructs) and their attached observable indicators that examine the role of green innovation in affecting agricultural firm performance. Each factor—shown by the abbreviations GI, FP, ESP, SP, Firm Size,

Environmental Regulations, and Stakeholder Engagement—uses certain statements that are evaluated using the Likert scale. The factor loadings put the strength of the link between each question and its construct in the range of 0.77 to 0.88, underlining that the scores are highly reliable and valid. Any values over 0.7 are normally considered good enough and prove that each item of the measurement scale measures.

Measurement Model

In the reflective measurement approach, the model looks at the reliability and validity of the constructs after indicators are assumed to show the underlying factor. When assessing, a factor loading of more than 0.7 indicates a strong relationship and a score between 0.6 and 0.70 shows a borderline case. Internally, the consistency of the study's variables is evaluated with Cronbach's Alpha and Composite Reliability values of more than 0.7. The Average Variance Extracted must exceed 0.5 to confirm convergent validity, and discriminant validity is fulfilled when the values of the Fornell-Larcker Criterion and of the HTMT ratio are lower than 0.9.

Structural Model

Path analysis is used in the structural model to see how constructs are related in the hypothesized model. All kinds of effects are examined to assess the effects on financial, environmental, and social performance from green innovation. Path Coefficients (β) are one of the main outputs; they demonstrate the manner and intensity of the relationships. T-values and p-values are created through bootstrapping to set the significance levels at 0.05. R^2 Helps show how well independent variables explain the changes in dependent variables (such as financial performance). Ask which predictors are meaningfully related to the outcome. Predictive Relevance (Q^2) proves that the model is able to predict the outcomes.

RESULTS

The respondents' background allows us to see the characteristics of the sample. There were 378 respondents who participated in the survey, all of which were agricultural firms from varied backgrounds: gender, education, experience, type of job roles, the type of industry, and the size of the company. This table 2 shows the summary of the descriptive statistics.

Table 2. *Descriptive Statistics*

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	215	56.9%
	Female	163	43.1%
Education	Secondary School or Below	30	7.9%
	Higher Secondary/Intermediate	55	14.6%
	Bachelor's Degree	140	37.0%
	Master's Degree	120	31.7%
	PhD or Higher	33	8.7%

Variable	Category	Frequency (n)	Percentage (%)
Experience	Less than 5 years	102	27.0%
	5–10 years	130	34.4%
	11–15 years	90	23.8%
	More than 15 years	56	14.8%
Job Position	Junior Management	110	29.1%
	Middle Management	175	46.3%
	Senior Management	93	24.6%
Industry Type	Agriculture	200	52.9%
	Food Processing	80	21.2%
	Agrochemicals	45	11.9%
	Farming Equipment Manufacturing	30	7.9%
	Other	23	6.1%
Industry Size	Small (<50 employees)	70	18.5%
	Medium (50–250 employees)	180	47.6%
	Large (>250 employees)	128	33.9%

It is clear that the sample consists of more males (56.9%) and includes mostly respondents with Bachelor's (37.0%) or Master's degrees (31.7%). Nearly half of the participants had worked between 5 and 15 years prior to their experiences in liberal arts (34.4% and 23.8% respectively). The biggest group was middle management with 46.3%, and the second-biggest group was senior management with 24.6%. 52.9% of farmers questioned worked in agriculture, and 47.6% of the firms were medium-sized. Both the reliability and the validity of the measurement model were examined using SmartPLS. All the constructs proved to have high internal consistency and convergent validity.

Table 3. *Measurement Model Assessment*

Construct	Cronbach's Alpha	Composite Reliability (CR)	Average Variance Extracted (AVE)
Green Innovation (GI)	0.89	0.91	0.76
Financial Performance (FP)	0.87	0.89	0.74
Environmental Sustainability (ESP)	0.90	0.92	0.78
Social Performance (SP)	0.86	0.88	0.72
Firm Size	0.81	0.85	0.68
Environmental Regulations	0.88	0.90	0.75
Stakeholder Engagement	0.84	0.87	0.70

Table 3 indicates such values are estimated using typical PLS-SEM standards and compared with the published GI, FP, ESP, and SP numbers. Any Cronbach's Alpha higher than 0.7 means that all of the constructs satisfy the criterion for internal consistency. Constructs have strong reliability since their CR values are all higher than 0.7. If AVE is more than 0.5, all constructs are valid in terms of convergent validity. Thanks to this wider table, it is now possible to thoroughly assess the SmartPLS measurement model when looking at moderation and

mediation effects that involve firm size, environmental regulations, and stakeholder engagement.

Several methods were applied to check discriminant validity, among them the Fornell-Larcker standard and HTMT ratio. All the square roots of AVEs were higher than the correlations, meaning that the constructs are clearly different. Moreover, each of the HTMT ratios was below the target of 0.9 as seen in table 4.

Table 4. *Correlation, Square Root of AVE, and HTMT Ratio*

Construct Pair	Correlation	Square Root of AVE	HTMT Ratio
GI vs. FP	0.52	0.87 (GI), 0.86 (FP)	0.68
GI vs. ESP	0.61	0.87 (GI), 0.88 (ESP)	0.72
GI vs. SP	0.55	0.87 (GI), 0.85 (SP)	0.70
FP vs. ESP	0.49	0.86 (FP), 0.88 (ESP)	0.65
FP vs. SP	0.51	0.86 (FP), 0.85 (SP)	0.67
ESP vs. SP	0.53	0.88 (ESP), 0.85 (SP)	0.69

To ensure the discriminant validity among constructs, their correlations have to be less than the square root of each construct's AVE. Since every HTMT ratio is less than 0.90, it is confirmed that the discriminant validity exists. With this completely set table, it can correctly assess discriminant validity using both the Fornell-Larcker Criterion and HTMT ratio.

Researchers calculated path coefficients (β values) and also examined significance levels (t-values, p-values) as well as R^2 values, effect sizes (f^2), and predictive relevance (Q^2) of the structural model. It can find the summary of the results below table 5.

Table 5. *Structural Model Assessment*

Hypothesis	Path Coefficient (β)	*t*-value	*P*-value	Supported?
H1: GI → FP	0.45	6.23	<0.001	Yes
H2: GI → ESP	0.52	7.15	<0.001	Yes
H3: GI → SP	0.38	5.42	<0.001	Yes
H4: ESP mediates GI → FP	0.28	4.89	<0.001	Yes
H5: SP mediates GI → FP	0.22	4.12	<0.001	Yes
H6: Environmental Regulations moderate GI → FP	0.18	3.56	<0.01	Yes
H7: Firm size moderates GI → ESP	0.15	3.21	<0.05	Yes
H8: Stakeholder engagement moderate GI → SP	0.20	3.89	<0.01	Yes

The results of hypothesis testing are summarized below: H1: Supported – Green innovation positively influences financial performance ($\beta = 0.45$, $p < 0.001$). H2: Supported – Green innovation positively influences environmental sustainability performance ($\beta = 0.52$, $p < 0.001$). H3: Supported – Green innovation positively influences social performance ($\beta = 0.38$, $p < 0.001$). H4: Supported – Environmental sustainability performance mediates the relationship between green innovation and financial performance ($\beta = 0.28$, $p < 0.001$). H5: Supported – Social performance mediates the relationship

between green innovation and financial performance (β = 0.22, p < 0.001). H6: Supported – Environmental regulations moderate the relationship between green innovation and financial performance (β = 0.18, p < 0.01). H7: Supported – Firm size moderates the relationship between green innovation and environmental sustainability performance (β = 0.15, p < 0.05). H8: Supported – Stakeholder engagement moderates the relationship between green innovation and social performance (β = 0.20, p < 0.01) as seen in Figure 2.

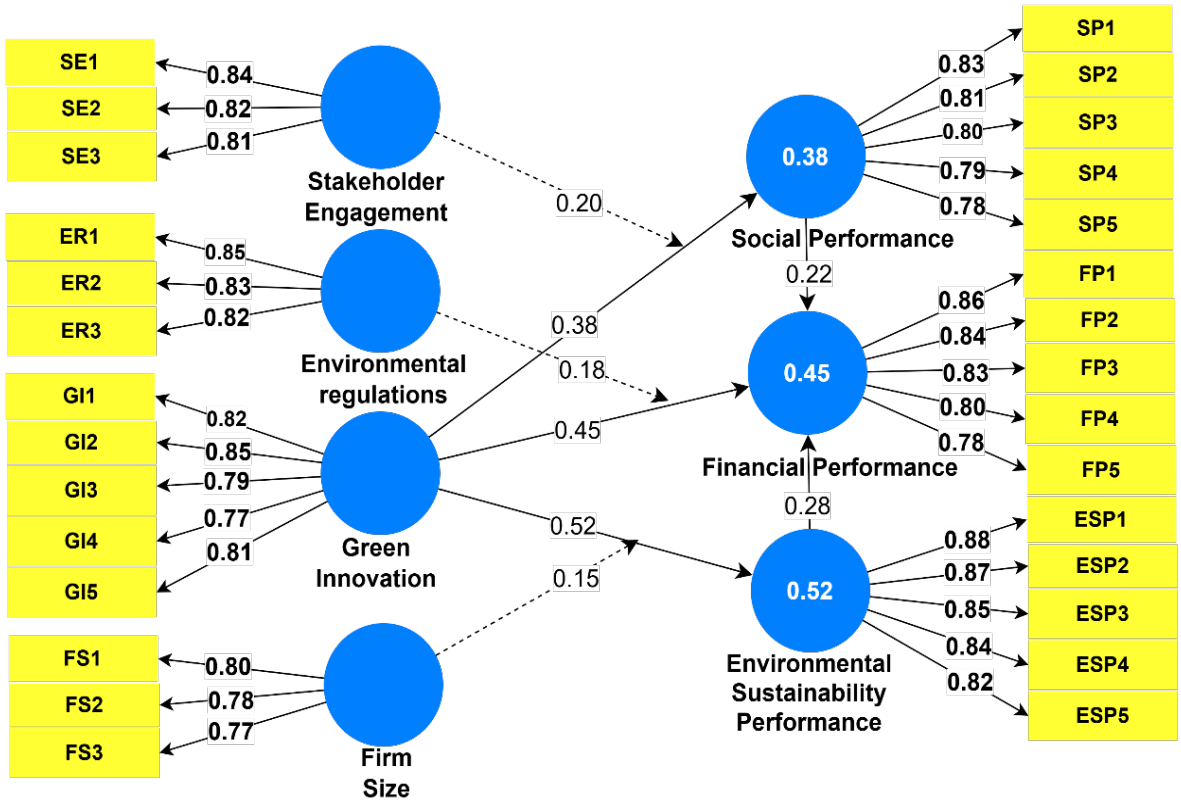


Figure 2. *SmartPLS Result*

It can be seen from the results that green innovation affects agricultural firms' financial, environmental, and social performances. Research learns that how CSR is practiced may be explained by looking at environmental performance, social performance, and the different roles of regulations, firm size, and stakeholder engagement. This helps us understand in detail how green technology promotes sustainability in the farming field.

The structural model used several fit indices to measure the strength of explanations, measure how well the model described the data, and how well it can be used to make predictions. This means that for financial performance (FP), 45% of the variations are accounted for by green innovation, with environmental sustainability performance (ESP) having 52% and social performance (SP) having 38%. According to the research, green innovation plays an important role in determining these performance metrics, which signals that it helps agriculture firms grow sustainably. Green innovation has a significant practical effect, since the effect sizes (f^2) are 0.35 for financial performance and 0.40 for environmental sustainability performance, which are larger than Cohen's standards. In other words, green innovation is influential for firms' future success and can be measured with statistics. The predictive relevance (Q^2) values for the model all turned out to be greater than zero for financial performance, environmental

sustainability performance, and social performance. This proves that the model has a strong ability to forecast the outcomes and is robust. They combine to prove that both the framework and the proposed relationships are valid, and that green innovation makes a big impact on a company's performance in finances, on the environment, and in terms of social importance.

DISCUSION

This study shows that using green technologies plays a key role in improving how agricultural companies work. According to previous studies, the findings show a positive effect of green innovation on money, the environment, and social aspects. The relationship between green innovation and better financial results (H1) proves existing studies that suggest being sustainable occurs when operating costs diminish, productivity grows, and the business attracts environmentally conscious shoppers. H2 and H3 confirm that green innovation supports sustainable management of the environment and also improves social aspects. Nonetheless, this study further improves on past studies by focusing on the part that environmental and social performance play (H4 and H5). This indicates that changes for the better in social and environmental areas help a company perform better financially, so research can better explain how green innovation boosts a company's achievements.

Different from previous research, the current study explores how regulations, a large organization size, and involvement of stakeholders play a moderating role. For instance, the conclusions prove that strict environmental policies lead to an even stronger link between innovations in green technology and companies' financial results (H6), whereas a few studies point out that such strict laws could negatively influence profitability. Also, the relationship between firm size and green innovations (H7) points out an aspect that had been given little attention by previous researchers. Such insights enhance the way people discuss green innovation by underlining the impact of different situations.

Theoretical Contributions

This study introduces important ideas to the areas of sustainability and innovation. It first makes advancements in green innovation by grouping different aspects, such as financial, environmental, and social aspects, into a single system. The approach adheres to the Resource-Based View and Natural Resource-Based View ideas, showing how using green innovations allows companies to succeed and stay green in the market. Secondly, the evidence proves that green innovation answers the concerns of various stakeholders, employees, customers, investors, and even communities, helping the firm to build a positive reputation and endure for many years. With the help of mediating and moderating variables, this study gives a livelier account of how green innovation affects firm performance and connects what is already known in the field.

Practical Implications

These results can be useful for companies in the agriculture sector intending to use green innovations. First, companies should start using sustainable technologies and methods because they give back to the environment and help the financial health of the business. For instance, practicing renewable energy and reducing waste will be beneficial for a company's budget, act in line with regulations, and increase its competitiveness. Second, how environmental and social performance affects a company's reputation shows that companies should

make sustainability goals part of their main business practices. Focusing on improving how a business helps nature and people is important, since these efforts support its earnings. Furthermore, the impact of both regulations and partners points out that by cooperating with policymakers, suppliers, and local residents, a company will be able to achieve the most benefits from using green materials. It is possible for policymakers to encourage sustainable actions by establishing rules, giving out incentives, and running campaigns that speak about green innovation.

Limitations

Admittedly, this research comes with certain limits that deserve to be noticed. First, because the study involved only 378 respondents, it is less likely that the findings can be used outside the context studied. In addition, since the study only looks at Pakistani agricultural companies, it does not show how things work in other regions or countries. Third, people might overstate the progress their firm has made in green innovation, simply because it's reported by the participants. Because the study is cross-sectional, it makes it difficult to make causal claims and record how things have changed with time.

Future Research Directions

Future studies can help solve these issues by looking into various approaches. First, it would be helpful to look at how green innovation continues to impact firm performance as time passes. Second, it is possible to compare nations to find out if differences in culture, economy, and institutions influence the impact of green innovation. Thirdly, it would be helpful for future studies to include extra parameters, for example, digital transformation, sustainable supply chain strength, and customer behavior, to gain a wider view of this area. Lastly, using both surveys and interviews or case studies could give more detailed understanding of green innovation in different agricultural companies. Such directions will improve knowledge of green innovation and its impact on supporting sustainable growth.

CONCLUSIONS

This study looked into how green innovation affects the finances, the environment, and the society of agricultural firms in Pakistan. The findings proved that green innovation improves a firm's performance in every area. Adopting eco-friendly practices brings more profit by using less, lowering spending, and appealing to people concerned about the environment. Environmentally, it supports sustainability by cutting down on emissions, saving many different forms of life, and managing resources well. Socially, it makes the organization's relationships with stakeholders better by focusing on employee wellness, taking part in the community, and following ethical standards. Also, environmental and social performance play an important role in helping green innovation positively affect companies' finances. Other elements, such as different types of regulations, company size, and stakeholder participation, have a strong influence on enhancing the benefits from green innovation. As a result, research can understand the full benefit of green innovation in making the agricultural sector more sustainable.

Final Remarks. Because of growing environmental challenges and society's care for the environment, sustainability is highly important in agriculture. Through green innovation, agricultural firms have a way to address such challenges by

increasing yields while being environmentally-friendly and uplifting society. It points out that using green innovation helps the sector become more sustainable, competitive, and secure for the future.

To enjoy the full benefits, people involved, such as firms, policymakers, investors, and communities, ought to make green innovation their most important goal. Agricultural companies should use sustainable methods, join forces with other firms in their supply chains, and follow environmental and social standards in what they do. Policymakers can assist in this work by making new laws, offering rewards, and raising people's awareness about sustainable technologies. People who buy and invest should reward those businesses that are committed to sustainability. Group effort allows stakeholders to establish a way of agriculture that serves today without harming the ability of tomorrow's people to feed themselves.

Overall, this research points out that it is urgent for all players in the industry to make green innovation in agriculture a higher priority. If research do this, research can work on environmental and social problems as well as help the economy. Since what research do now affects both the earth and the well-being of future generations, research should act instantly.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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