

**Determinants of Sustainability-driven Entrepreneurship: the role of environmental knowledge,
psychological ownership and CSR**

Bilal Mukhtar¹

Tasmanian School of Business and Economics, University of Tasmania, Tasmania, Australia

Email address: Bilal.Mukhtar@utas.edu.au

Ali Hussain²

Hertfordshire Business School, University of Hertfordshire

Email Address: AliHussain.08@hotmail.com, alihussain37@herts.ac.uk

Denni Arli¹

Tasmanian School of Business and Economics, University of Tasmania, Tasmania, Australia

Email Address: Denni.Arli@utas.edu.au

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Abstract

Purpose: Drawing upon resource-based view (RBV) theory, this study aims to uncover the underexplored cumulative effects of pro-environmental knowledge, psychological ownership, and CSR towards sustainability-driven entrepreneurial behavior with the moderating role of technology readiness.

Design/methodology/approach: Using a survey-based approach and purposive sampling technique, we obtained valid data from 231 responses from the livestock farmers and executives across urban, suburban, and rural areas of South Punjab, Pakistan.

Findings: Utilizing the PLS-SEM technique, the analysis revealed that pro-environmental knowledge, psychological ownership, and CSR were positively associated with sustainability-driven entrepreneurial behavior. Further, pro-environmental knowledge and psychological ownership positively improved the CSR activities. Moreover, the moderating result indicated that technology readiness plays a significant role in strengthening the association between pro-environmental knowledge and sustainability-driven entrepreneurial behavior.

Originality/Value: This study deepens understanding of sustainability-driven entrepreneurial behavior by integrating the RBV theory with empirical analysis of pro-environmental knowledge, psychological ownership, CSR, and technology readiness. While prior research has explored these factors in isolation or within varying contexts, this study is among the first to synthesize these constructs in a unified framework, addressing a critical literature gap by empirically investigating their cumulative effects on sustainability-driven entrepreneurial behavior, particularly in the livestock industry, which faces significant ecological challenges.

Keywords: Pro-environmental Knowledge, Psychological Ownership, Corporate Social Responsibility, Sustainability-driven Entrepreneurial Behavior, Technology Readiness

1. Introduction

Livestock production accounts for 40% of the global agricultural output, supports 1.3 billion livelihoods, and supplies one quarter of the protein in the human diet (Wang et al. 2020). The livestock industry, while crucial for global food security and economic development, has become a significant contributor to environmental degradation and climate change. A major portion of anthropogenic ammonia (NH₃) and nitrous oxide (N₂O) emissions comes from livestock production, and the level of greenhouse gas emissions is higher than anticipated (Wyer et al. 2022, Zhang et al. 2024). Further, just like many developing countries, the livestock production in Pakistan is a key component of rural livelihoods and the national economy (Usman et al. 2024). Yet its environmental impact is increasingly becoming a concern inadequate infrastructure, weak regulatory enforcement, and limited awareness contribute to the improper management of livestock waste (Hussain and Rehman 2022). Moreover, animal waste is often discharged untreated into open fields and water bodies, contaminating drinking water sources with harmful pathogens and excess nutrients, which leads to health risks and ecosystem degradation.

Amid these challenges, the concept of sustainability-driven entrepreneurial behavior presents a promising pathway to mitigate environmental issues in the livestock industry. It refers to entrepreneurial initiatives that integrate environmental and social sustainability as core objectives. These initiatives reflect a proactive, forward-thinking approach in which ecological considerations are embedded directly into business models, rather than being treated as secondary issues (Halder 2019). Previously adopted conventional environmental management practices addressed environmental harm within pre-existing frameworks. These approaches are often reactive, focusing on harm minimization rather than meaningful transformation. In contrast, sustainability-driven entrepreneurs in the livestock industry view environmental and social responsibility as opportunities for innovation. This mindset influences every aspect of production, from feed sourcing to animal waste management (Dias et al. 2021). Such an approach offers the potential to reduce GHG emissions, promote soil health, and conserve water resources, which are the critical concerns for the livestock sector (Lupo et al. 2024). Therefore, by integrating sustainable principles into every phase of production, this approach supports sustainability for farmers, animals, and society amidst escalating global challenges. Earlier, various approaches were adopted to enhance sustainability-driven entrepreneurial behavior, especially in industries facing significant environmental challenges. Strategies such as green marketing, green product development, resource-efficient operations, and the adoption of environmental certifications have been widely implemented to support sustainable business practices (Mukhtar et al. 2024). Although these approaches brought positive changes, they often lack the depth required to embed sustainability within the entrepreneurial practices of the livestock industry.

Through systematic review analysis, Tiba et al. (2019) found that corporate social responsibility practices can lead to tangible business advantages. On the other hand, entrepreneurship scholars have

largely neglected these linkages, especially when it is impacting on employee satisfaction, customer loyalty, environmental disclosure, and regulatory engagement. Subsequently, Tiba et al. (2019) recommended future research to investigate how CSR principles, such as sustainability, ethical governance, and social impact, can be more fully integrated into entrepreneurial strategy. This is especially important in terms of how start-ups communicate responsibility, gain legitimacy, and balance economic, social, and environmental goals. Similarly, Atiq and Karatas-Ozkan (2013) also found that sustainable corporate entrepreneurship is most effective when companies integrate strategic CSR with an entrepreneurial mindset. Rather than viewing CSR as a peripheral activity, it should be embedded into core business operations to drive innovation and create shared value, benefiting both the company and society. By adopting this approach, firms can proactively address environmental and social challenges while gaining a competitive advantage through opportunity-driven sustainability.

To fully develop sustainability-based entrepreneurial behavior, it is essential to go beyond external strategies and integrate more intrinsic factors that drive commitment to environmental goals. Therefore, the existing literature implies the significance of pro-environmental knowledge, psychological ownership, and CSR as important elements in this regard. These elements together address both the cognitive and motivational aspects of sustainability-driven behavior, creating a strong foundation for long-term environmental commitment. Pro-environmental knowledge refers to an understanding of environmental principles, issues, and sustainable practices specific to the livestock sector, which plays a vital role in enabling business owners in the livestock sector to make well-rounded decisions that minimize resource waste, cut emissions, and exploit natural resources (Hamzah and Tanwir 2021). This knowledge also serves as a strong basis for putting environmentally friendly practices into place, enabling business owners to innovate in ways that satisfy sustainability and business goals (Seger et al. 2024). Besides, psychological ownership is the sense of personal connection and responsibility individuals feel toward their work or assets (Sarwar et al. 2024). In the livestock industry, entrepreneurs with a strong sense of psychological ownership are inclined to feel accountable for the environmental impacts of their operations. This personal connection can inspire proactive efforts to implement sustainable practices, as entrepreneurs with high psychological ownership often demonstrate a greater commitment to preserving resources and minimizing environmental harm.

We postulate that CSR is critical to fostering sustainability-driven entrepreneurial behavior as it encourages companies and entrepreneurs to consider their operations' impact on society and the environment, which aligns with sustainability goals. Huynh et al. (2024) mentioned that by embedding CSR values, organizations can build a culture of responsibility that supports sustainability-driven behaviors in an industry facing environmental and social pressures. CSR-aware livestock entrepreneurs might invest in sustainable farming technologies, reduce antibiotic use, and adopt eco-friendly waste disposal methods, which align with CSR values and meet consumer expectations. Another factor that complements the improvement of sustainability-driven entrepreneurial behavior is the readiness of

modern technologies. Technology readiness refers to the extent to which individuals or organizations are prepared to adopt and effectively use new technologies (Blut and Wang 2019). Technology readiness in the livestock industry can include the willingness to integrate digital solutions, such as livestock monitoring systems, automated feeding mechanisms, and genetic tracking technologies, into daily operations (Kebebe 2019). In sustainability-driven entrepreneurial behavior, technology readiness allows livestock farmers to use data-driven systems to optimize feed and manage waste efficiently, which conserves resources and reduces GHG emissions. Besides, technology readiness can enhance pro-environmental knowledge and psychological ownership, both of which are essential for sustainability-driven entrepreneurial behavior. Omar et al. (2021) illustrated that when livestock entrepreneurs adopt new technologies, they are more aware of their operations' environmental impact, which could help them in making ecological decisions and strengthen their commitment to sustainability. Whereas technology readiness also fosters psychological ownership by allowing entrepreneurs to feel more control and personal investment in their sustainable initiatives (Sehgal et al. 2025). When they see a direct link between their actions, technology use, and the outcomes it produces, a sense of responsibility and attachment is created when livestock production is monitored, managed, and optimized with the help of technology. In return, their motivation can be enhanced, which in turn also improves sustainable practices. This shows that technology readiness supports operational efficiency and plays a psychological role in enhancing sustainable intentions and behaviors. Recognizing this dual influence, we believe that it is crucial to understand how sustainability practices take root in entrepreneurial contexts. Hence, this study examines the moderating role of technology readiness in assessing the impact of pro-environmental knowledge and psychological ownership on sustainability-driven entrepreneurial behavior.

In academic literature, extensive research has examined the individual impacts of pro-environmental knowledge, psychological ownership, and CSR on various aspects of a firm's performance. Yet, it remains unclear and unexplored whether the combined effects of these factors have any specific directional impact on sustainability-driven entrepreneurial behavior within the livestock sector. Sustainability drivers in livestock research are often studied from a policy-focused lens and lack examination from a behavioral lens Bulah et al. (2024), therefore, neglecting how internalized knowledge, ownership, and CSR shape entrepreneurial behavior at the grassroots.

On the other hand, technology readiness has been studied as a moderating variable in various fields, influencing frameworks of consumer technology adoption Gao et al. (2022), innovation towards authentic experience gratification Kim et al. (2020), remote auditing processes Alma'aitah et al. (2024), and customer experience in banking services (Khashan et al. 2023). Despite its documented moderating role, the impact of technology readiness on the relationship between pro-environmental knowledge, psychological ownership, and sustainability-driven entrepreneurial behavior in the livestock industry has yet to be examined. From a geographical lens, it is crucial to examine these behavioral relationships

and the moderating effect of technology readiness, particularly in the livestock industry of Pakistan. Therefore, to bridge these research gaps, this study addresses these questions:

RQ1: Do pro-environmental knowledge and psychological ownership affect CSR?

RQ2: Do pro-environmental knowledge, psychological ownership, and CSR affect sustainability-driven entrepreneurial behavior?

RQ3: Does technology readiness moderate the association of both pro-environmental knowledge and psychological ownership towards sustainability-driven entrepreneurial behavior?

Several contributions are made to literature through this research to fill the literature gap. First, this study proposes a conceptual model based on the RBV theory to explore the behavioral lens involving constructs on sustainability-driven entrepreneurial behavior. Second, this research studies the scope of existing literature by assessing and validating the theoretical framework via the moderation effects of technology readiness. Finally, based on our best knowledge, this study is the first to study how pro-environmental knowledge, psychological ownership, and CSR affect sustainability-driven entrepreneurial behavior among the livestock industry of a developing country, with moderating effects of technology readiness. This study is vital for Pakistan, especially when the livestock sector is related to the rural livelihoods, as the exposure to sustainability threats, understanding behavioral drivers can help in providing context-specific and tech-ready entrepreneurial solutions that are aligned with ecological resilience.

2. Theoretical Framework

Theoretical support for the relationships in our study is grounded in RBV theory which offers a strong framework for understanding the strategic significance of organizational resources and capabilities in achieving sustainable competitive advantage (Barney 1991, Alkaraan et al. 2025). RBV posits that resources characterized by their value, rarity, inimitability, and non-substitutability (VRIN) hold the potential to allow organizations to operate in competitive landscapes. Within this theoretical lens, intangible resources such as pro-environmental knowledge, psychological ownership, CSR, and technology readiness emerge as essential contributors to organizational success, particularly in sustainability-focused industries. Pro-environmental knowledge is a critical asset under RBV because it equips organizations with the ability to identify, interpret, and capitalize on sustainability opportunities (Xie et al. 2023). With existing or obtained knowledge, it enables people or organizations to be involved in green processes and solutions that are in line with market demands for environmentally friendly practices, thus transcending traditional operational capabilities. Knowledge of sustainable practices is rare and inimitable. Hence, organizations that cultivate deep actionable insights differentiate themselves from their competitors who may lack such expertise, positioning themselves as industry leaders (Sahoo et al. 2022). Psychological ownership, a unique human resource capability, further strengthens the RBV framework by highlighting the intrinsic motivation and proactive behavior of individuals, where they believe that their behavior is accountable and hold a personal stake in

organizational outcomes (Degbey et al. 2021). Employees with a strong sense of psychological ownership exhibit heightened commitment. Together with the entrepreneurial mindset, these forces can drive innovation and accountability in their roles. These combined resources not only enhance individual performance but also foster a collective organizational culture aligned with sustainability-driven goals. The rarity and inimitability of psychological ownership stem from its deep-rooted connection to human behavior and the specific organizational contexts in which it develops.

CSR initiatives, as both a resource and a capability, complement the RBV perspective by advancing organizational reputation, stakeholder trust, and long-term sustainability. CSR efforts embody a commitment to ethical and socially responsible practices, which are increasingly valued in contemporary markets. From an RBV standpoint, Battisti et al. (2022) argue that CSR strengthens an organization's intangible asset base by building goodwill and fostering relationships with external stakeholders. As a result, it creates competitive advantages by establishing trust and reputation, which are inherently difficult to replicate. Moreover, by embedding CSR into core operations, firms not only meet societal expectations and regulatory requirements but also develop organizational capabilities that reinforce long-term sustainability in the business model (Tanveer et al. 2023). These capabilities are crucial for organizations to anticipate change, respond strategically, and elevate their positioning in increasingly responsible and competitive markets. In addition, technology readiness extends beyond its technical dimensions to represent a fundamental organizational capability, empowering firms to innovate, develop operational efficiency, and respond to environmental and market demands (Tan Yang et al. 2022). Within the framework of sustainability-driven entrepreneurship, technology readiness plays a pivotal role in enabling the development and deployment of sustainable solutions. By leveraging advanced technologies, firms can design eco-friendly products, optimize resource utilization, and minimize environmental impact through data-driven decision-making and process automation (Khayyam et al. 2024). Therefore, strategic investment in technology readiness allows firms to convert their internal resources into dynamic capabilities, thereby fostering a competitive advantage aligned with sustainability objectives. Conclusively, the alignment of pro-environmental knowledge, psychological ownership, CSR and technology readiness within the RBV framework highlights the strategic importance of intangible resources in achieving and sustaining competitive advantage. Collectively, they empower organizations to navigate the complexities of sustainability while promoting innovation, commitment, and trust as key drivers of long-term success in an increasingly environmentally and socially conscious global marketplace.

3. Hypotheses Development and the Conceptual Framework

3.1 Pro-Environmental Knowledge and Corporate Social Responsibility

Pro-environmental knowledge serves as an asset for organizations, shaping strategic orientation and enhancing overall performance. It empowers both employees and management to make informed decisions that align with the organization's CSR strategies (Musgrave et al. 2025). As individuals within

an organizations become more knowledgeable about environmental matters, they are more likely to advocate for practices that resonate with stakeholders' growing expectations for environmental responsibility (Afsar and Umrani 2019). This alignment is fundamental to effective CSR, as it not only meets stakeholder demands but also strengthens the organization's commitment to sustainability. Prior research highlights the influence of pro-environmental knowledge on employees and management, enhancing their understanding of environmental challenges and the importance of integrating sustainable practices within CSR initiatives (Tian and Robertson 2017). This increased environmental awareness encourages organizations to adopt more responsible and sustainable practices (Raza et al. 2021). Moreover, Farrukh et al. (2022) asserted that employees who are equipped with pro-environmental knowledge are more likely to make environmentally conscious decisions in their daily roles, leading to the incorporation of sustainability considerations across various aspects of business operations. As a result, organizations' experience enhanced CSR performance with sustainability, becoming an integral part of both operational and strategic decisions. Ultimately, CSR practices could be highly dependent on the level of pro-environmental knowledge. Thus, we hypothesize:

H1: Pro-environmental knowledge positively correlates with corporate social responsibility.

3.2 Psychological Ownership and Corporate Social Responsibility

Psychological ownership, a sense of personal attachment and possession toward one's organization can be a powerful driver of employee engagement, especially in CSR initiatives. Research by Kang and Baker (2022) suggests that psychological ownership strengthens organizational identification, where employees start to see the organization's identity as closely aligned with their own values. This alignment encourages employees to support the organization's CSR initiatives, perceiving these activities not merely as corporate duties but as extensions of their personal beliefs and identities (Liu et al. 2025). Luu (2016) further highlighted that when employees cultivate psychological ownership, they feel deeper responsibility and accountability toward their organization. This sense of accountability often translates into a commitment to the organization's CSR goals, leading employees to actively engage in and advocate for these initiatives. Similarly, Kim et al. (2024) found that psychological ownership correlates with enhanced stewardship and loyalty, as employees begin to see themselves as caretakers of the organization's resources and reputation. This stewardship mindset naturally extends to support for CSR activities, as employees recognize these initiatives as vital to upholding and advancing the organization's social and environmental values. Collectively, these insights suggest that psychological ownership can play a key role in fostering CSR efforts. Therefore, the following hypothesis is formulated:

H2: Psychological ownership positively correlates with corporate social responsibility.

3.3 Corporate Social Responsibility and Sustainability-driven Entrepreneurial Behavior

CSR and sustainability-driven entrepreneurial behavior are deeply interconnected, signaling a transformative shift in contemporary business philosophy (Mondal et al. 2024, Yan et al. 2025). Together, they underscore the imperative for organizations to pursue broader value creation that goes beyond profits. This is done by integrating ethical, environmental, and social considerations into their core strategies and operations. This means businesses are increasingly designed and managed to contribute to a better world, addressing societal and ecological challenges while still striving for economic viability. CSR initiatives increase organizational awareness of social and environmental issues, fostering a mindset that encourages entrepreneurs to seek out opportunities aligned with sustainability (Awad and Martín-Rojas 2023, Wu et al. 2025). The alignment can inspire innovative ideas for sustainable business ventures. Ni (2024) suggested that by actively engaging in CSR activities, entrepreneurs become more receptive to societal and environmental needs, enhancing their drive toward sustainability-focused initiatives. Furthermore, Mukhtar et al. (2023) highlighted that engaging in CSR is instrumental in cultivating strong relationships with various stakeholders, including customers, employees, and the wider community. These established networks serve as vital enablers for entrepreneurs, providing critical resources such as market insights Cucino et al. (2023), financial support Adomako and Nguyen (2024), and collaborative opportunities Stock et al. (2024), all of which are essential for successfully launching and sustaining long-term sustainability-oriented ventures. Additionally, Liu and Xu (2021) discussed that companies with strong CSR commitments often cultivate a workplace culture that promotes responsibility and encourages creative problem-solving around sustainability issues. This culture can stimulate employees to engage in intrapreneurial, or entrepreneurial actions aimed at addressing environmental and societal challenges. The link between CSR and entrepreneurial behavior is further supported by Zeng et al. (2022), who identified a direct positive impact of CSR on entrepreneurial initiatives. Altogether, this body of evidence supports the notion that CSR can enhance sustainability-driven entrepreneurial behavior by creating a supportive environment, inspiring innovation, and fostering critical stakeholder connections. This reasoning leads to the following hypothesis:

H3: Corporate social responsibility positively correlates with sustainability-driven entrepreneurial behavior.

3.4 Pro-Environmental Knowledge and Sustainability-driven entrepreneurial Behavior

Pro-environmental knowledge is fundamental for entrepreneurs aiming to build sustainable businesses. It provides them with the insights needed to craft business models that generate value while simultaneously reducing negative environmental impacts (Piwowar-Sulej and Iqbal 2025). This knowledge is not only vital for the successful launch and growth of eco-friendly ventures but also acts as a catalyst for identifying novel opportunities within the expanding realm of sustainability-focused entrepreneurship, enabling them to innovate and capitalize on the growing demand for green solutions

(Amoah and Addoah 2020). Research studies on pro-environmental behavior, which also has resemblance with sustainability entrepreneurship, consistently show that environmental knowledge is a significant predictor of such behavior. From an opportunity recognition standpoint, Núñez-Tabales et al. (2024) highlighted that entrepreneurs possessing superior environmental knowledge are significantly better positioned to pinpoint business opportunities that are rooted in sustainability. This implies that a deep understanding of environmental issues, trends, and solutions directly enhances an entrepreneur's ability to see and capitalize on gaps in the market where sustainable products, services, or processes can thrive (Zafar et al. 2025). In addition, they can more easily recognize gaps in the market for eco-friendly products or services. Moreover, Sharma et al. (2023) indicated that as entrepreneurs become more knowledgeable about sustainable practices, their self-assurance in successfully launching and managing a sustainable venture increases. This amplified awareness directly translates into a stronger belief in their own capabilities within the domain of sustainable entrepreneurship (Baquero 2024). In essence, increased sustainability knowledge enhances entrepreneurs' confidence in their ability to drive positive environmental and social impact through their business activities. This notion is further supported by a meta-analysis of 37 scientific articles that found that environmental values, which are closely linked to environmental knowledge, are positively related to sustainable entrepreneurial intention (Peng et al. 2021). Therefore, pro-environmental knowledge can significantly enhance sustainability-driven entrepreneurial behavior, offering a strong foundation for the following hypothesis.

H4: Pro-environmental knowledge positively correlates with sustainability-driven entrepreneurial behavior.

3.5 Psychological Ownership and Sustainability-Driven Entrepreneurial Behavior

Psychological ownership, defined as the sense of possession individuals feel towards their work or organization, emerges as a key factor influencing entrepreneurial orientation, especially in areas like proactiveness, innovativeness, and risk-taking (Nguyen et al. 2025). Individuals who experience strong psychological ownership are more inclined to take initiative, develop new ideas, and embrace risks, all of which are crucial traits in entrepreneurship. This intrinsic feeling of ownership not only boosts their willingness to engage in entrepreneurial activities but also enhances their confidence and self-efficacy in entrepreneurial pursuits. Hamrick et al. (2024) highlighted a positive correlation between psychological ownership and entrepreneurial self-efficacy. This suggests that individuals who developed a sense of ownership over a venture or initiative are more likely to exhibit greater confidence in their entrepreneurial capabilities. This boosted self-efficacy, in turn, empowers them to actively pursue and implement sustainability-driven initiatives, fostering behaviors that support environmentally responsible practices (Elgarhy and Alotaibi 2025). In essence, the feeling of "it's my responsibility" translates into believing "I can make it happen" for sustainability goals. To support this view, Mustafa et al. (2016) examined middle managers and found a direct and positive relationship between psychological ownership and entrepreneurial behavior. It highlights that a sense of ownership at the

managerial level promotes behaviors aligned with entrepreneurial objectives, reinforcing the potential of psychological ownership to drive entrepreneurial actions. Felix and Almaguer (2019) further extended this idea by proposing that psychological ownership acts as a potent driver for sustainable behaviors that directly contribute to environmental preservation. This suggests that when individuals feel a personal sense of "ownership" over the environment or related initiatives, they are more likely to engage in actions to protect. Therefore, psychological ownership not only fuels entrepreneurial aspirations but also ensures these aspirations are inherently aligned with broader sustainability objectives Martinez-Falco et al. (2024), effectively paving the way for individuals to pursue entrepreneurship with a strong focus on environmental well-being. The above arguments form the basis for the subsequent hypothesis:

H5: Psychological ownership positively correlates with sustainability-driven entrepreneurial behavior.

3.6 Moderating Role of Technology Readiness

Technology readiness in the livestock industry refers to the extent of preparedness and maturity of technologies aimed at enhancing farm productivity, encompassing both internal capabilities and external technological advancements. Internally, it includes the technological infrastructure that employees use, while externally, it reflects the broader market's access to advanced technologies that can be adopted at the farm level (Blut and Wang 2019). Technology readiness is significant in transforming pro-environmental knowledge and psychological ownership into sustainable entrepreneurial practices within the industry. The role of technology readiness is highlighted through various perspectives. Borodako et al. (2023) indicates that companies with advanced technology readiness levels can better utilize knowledge management, highlighting how vigorous technological capabilities enable organizations to translate their knowledge into effective entrepreneurial actions. This suggests that technology readiness serves as a foundational element that supports sustainability-driven innovative initiatives by facilitating the implementation of complex, environmentally focused knowledge.

Moreover, Zhang et al. (2020) argues that entrepreneurs with both pro-environment knowledge and access to technological resources are more capable of translating their awareness into sustainable business entrepreneurial practices. Technology readiness, in this case, functions as an enabler, allowing individuals to apply their environmental insights in innovative ways. Khayyam et al. (2024) assert that a high degree of technology readiness fosters innovation by providing entrepreneurs with tools to proactively tackle environmental challenges. This amplified ability for sustainable innovation strengthens the link between environmental awareness and sustainability-driven entrepreneurial behavior, as advanced technologies empower entrepreneurs to develop novel and impactful solutions. Further, Adeel et al. (2024) highlighted the importance of technology readiness in bridging the gap between pro-environmental knowledge and its practical application. Even when entrepreneurs possess awareness and knowledge regarding environmental sustainability, translating this into tangible actions

is often challenging. Technology readiness mitigates this challenge by offering a platform through which pro-environmental insights can be applied within a business context, thus facilitating sustainability-driven entrepreneurial behavior.

Conversely, technology readiness plays a significant role in fostering psychological ownership among livestock farmers. As farmers become more familiar with and increasingly dependent on these technologies, they develop a sense of control and mastery over their operations. This heightened sense of ownership can lead to greater job satisfaction and a stronger drive to continually improve farm practices. The work of Adnan et al. (2019) confirms this by showing that farmers who are more technologically ready are better prepared to adopt sustainable innovations, making them more inclined to integrate advanced technologies into their work. This strengthens the connections between their sense of ownership and their commitment to sustainable behaviors. Similarly, Schnack et al. (2024) suggest that high technology readiness broadens the range of sustainability actions that farmers might consider. With both psychological ownership and a readiness to use technology, these farmers are more likely to pursue innovative, tech-driven solutions to address sustainability challenges. Furthermore, Carmela Annosi et al. (2020) add that technology readiness can boost the perceived effectiveness of sustainability efforts. When farmers believe they have the right technological tools to make a meaningful contribution, their sense of ownership aligns more strongly with their awareness to engage in sustainability-focused entrepreneurial activities. Ultimately, the combination of pro-environmental knowledge and psychological ownership as exogenous variables are significantly moderated by higher technological readiness, offering a compelling framework that enables farmers to actively seek out and improve sustainable entrepreneurial practices, reinforcing their commitment to sustainable development in the livestock industry. Therefore, the following hypotheses are developed:

H6: A higher level of technology readiness positively moderates the relationship between pro-environmental knowledge and sustainability-driven entrepreneurial behavior

H7: A higher level of technology readiness positively moderates the relationship between psychological ownership and sustainability-driven entrepreneurial behavior.

In Figure 1, we present the conceptual model.

Insert Figure 1 here

4. Research Methodology

4.1 Measurement Development and Survey Design

Established validated scales from past literature were used to develop the instrument. Among the involved constructs, pro-environmental knowledge was measured through a five-item scale by adapting from Sampene et al. (2023). Psychological ownership, measured using a five-item scale of Mishra and Malhotra (2021). CSR was measured using a six-item scale by Le (2022). Technology readiness was measured using a ten-item adapted scale from Omar et al. (2021). Finally, sustainability-driven

entrepreneurial behavior was measured through a five-item scale adapted from Jiaqi Yang et al. (2022). We conducted a pilot test to ensure that the questions were unambiguous and free of technical errors. First, the survey was sent to five expert researchers specializing in sustainable entrepreneurship and related dynamics to verify its accuracy. Based on the experts' suggestions, the questionnaire was revised, confirming both the validity of the survey instrument and its relevance to the study context. Second, based on Hertzog (2008) recommendations, the updated version was distributed to a target sample ($N = 25$) to assess the clarity and reliability of the questionnaire. The results revealed the adequacy of the final items, as all constructs met the minimum reliability threshold ($\alpha \geq 0.7$).

4.2 Sample and Data Collection

Based on (Crick 2024, Faul et al. 2007), they suggested that before collecting data, it is crucial to first estimate the required sample size by using the G* power tool. The tool generated 119 minimum sample sizes based on the input parameters (effect size $f^2 = 0.15$, error probability 0.05, power = 0.95, number of predictors = 3). To enhance the generalizability and accuracy of the findings, we aimed to collect more responses compared to the given threshold.

Using a purposive sampling technique, data was collected from livestock farmers and executives within the livestock industry, spanning urban, sub-urban, and rural areas of the South Punjab region. By including both livestock farmers and executives from the livestock industrial sector, the data captured diverse perspectives across operational and managerial levels, offering a comprehensive view of sustainability practices and technology readiness within this sector. The respondents were selected on the following criteria: (i) the number of animals must be more than 10, (ii) they must be using technological instruments in their livestock operations (iii) they must implement sustainability practices. Respondents were informed about the purpose of the survey, and confidentiality of their information was ensured without violating any moral or ethical obligation. Although the data were collected through a self-reported questionnaire, there was a chance of a common method bias (CMB) to appear. Several steps were taken to minimize the risk of common method bias (CMB). First, the questionnaire was designed so that items measuring independent variables were presented before those measuring the dependent variables. Respondents were assured of the confidentiality and anonymity of their responses and informed that their input would be used solely for academic research purposes. Additionally, they were told that there were no right or wrong answers and were encouraged to respond based on their knowledge rather than emotions. Post data collection, the Harman single-factor test was conducted. The analysis revealed that the largest variance explained by a single factor was 37.679%, well below the threshold of 50%. Thus, CMB was determined not to be an issue in this study. Over two months, 243 responses were collected. 12 responses were removed due to incomplete information, and thus, 231 responses were analyzed. The detailed demographic statistics are provided in Table 1.

Insert Table 1 here

5. Results and analysis

5.1 Measurement Model

Partial least squares-structural equation modelling (SEM-PLS 4.0) was used to assess the measurement and structural model. To evaluate the measurement model, we first examine the model's internal reliability, validity by checking the loading and Cronbach's alpha, composite reliability (CR), average variance extracted (AVE) and discriminant validity. According to Hair et al. (2019), the threshold criteria for outer loading is 0.708, Cronbach's alpha, and CR should be greater than 0.70. Whereas the value of AVE greater than 0.5 is acceptable (Cepeda-Carrion et al. 2019). As shown in Table 2 and Fig. 2, all the values are above the minimum thresholds.

Insert Table 2 here

Insert Figure 2 here

Finally, discriminant validity is assessed using the Heterotrait-Monotrait ratio (HTMT) and Fornell-Larcker criterion. The HTMT value should not exceed 0.90 (Henseler et al. 2015). In Fornell-Larcker criterion, each construct's square root of AVE should be higher than its highest correlation with every other construct. In this study, all values are below the threshold that indicates adequate discriminant validity among the constructs (see Table 3 and 4).

Insert Table 3 and 4 here

5.2 Structural Model (Hypotheses Testing: Direct and Moderation Effects)

A structural model was employed to test the hypotheses. As part of this analysis, the hypothesized model underwent testing using a bootstrapping process with 5000 resamples, a procedure commonly employed in PLS-SEM to determine the significance of path coefficients. The results revealed a statistically significant positive influence of pro-environmental knowledge ($\beta=0.229$, $P=0.013$) and psychological ownership ($\beta=0.388$, $P=0.000$) on CSR, thus supporting H1 and H2. Further, the analysis demonstrated a statistically significant positive influence of CSR ($\beta=0.143$, $P=0.015$), pro-environmental knowledge ($\beta=0.302$, $P=0.000$), and psychological ownership ($\beta=0.477$, $P=0.000$) towards sustainability-driven entrepreneurial behavior, thus supporting H3, H4, and H5. Regarding the moderation effect, the results indicated that the interaction term (pro-environmental knowledge $\times$ technology readiness) has a significant effect on sustainability-driven entrepreneurial behavior ($\beta=0.224$, $P=0.005$), thus supporting H6. Further, the results suggest that the effect of pro-environmental knowledge on sustainability-driven entrepreneurial behavior increases with higher levels of technology readiness. Figure 3 displays the pattern of the relationship. The moderating findings of a simple slope test display the effect of pro-environmental knowledge on sustainability-driven entrepreneurial behavior that differs significantly at a low and high level of technology readiness.

Insert Figure 3 here

Finally, H7 proposed that a higher level of technology readiness moderates the relationship between psychological ownership and sustainability-driven entrepreneurial behavior. The results showed that

technology readiness has an insignificant moderation effect on the relationship of psychological ownership and sustainability-driven entrepreneurial behavior ($\beta=-0.107$, $P=0.214$), thus not supporting H7 (see Table 5).

Insert Table 5 here

6. Discussion

This research contributes to the evolving discourse on sustainability-driven entrepreneurial behavior by unpacking the roles of pro-environmental knowledge, psychological ownership, and CSR, as well as the moderating effect of technology readiness, in the context of the livestock industry in Pakistan. By grounding the discussion in the Resource based view (RBV) theory, the study provides an integrative framework that explains the dynamic interactions among the proposed constructs, ultimately leading to more sustainable entrepreneurial practices. The finding of H1 shows that pro-environmental knowledge enhances CSR activities among livestock farmers. This outcome is aligned with the study of Min et al. (2024), and reflects the idea that knowledge about environmental sustainability empowers stakeholders to anticipate and address emerging ecological challenges strategically. Our study enriches the understanding of how this knowledge serves as a precursor to proactive CSR initiatives that are better suited to evolving environmental and regulatory landscapes. For instance, livestock farmers with higher pro-environmental awareness may be better positioned to implement waste reduction or energy efficiency practices, demonstrating tangible CSR efforts. The findings for H2 highlight that psychological ownership significantly influences CSR practices, which is aligned with (Kang and Baker 2022). This relationship is pivotal in the context of the livestock industry, where the sense of ownership fosters intrinsic motivation among farmers to adopt socially responsible practices. Psychological ownership not only strengthens the commitment to sustainable farming but also cultivates an environment where CSR is perceived as a personal and community responsibility, enhancing both individual and collective sustainability efforts. The results of H3 demonstrate a robust link between CSR and sustainability-driven entrepreneurial behavior. Importantly, this outcome is in line with Ni (2024), which suggests that embedding CSR into core operations goes beyond meeting compliance requirements; it fosters innovation and competitiveness. For example, livestock farmers integrating CSR into their entrepreneurial strategies may innovate by adopting eco-friendly feed alternatives or developing sustainable breeding practices, which can lead to long-term environmental and economic benefits. This aligns with broader sustainability goals by addressing the triple bottom line economic, social, and environmental impact.

The finding of H4 shows that pro-environmental knowledge positively influences sustainability-driven entrepreneurial behavior. This finding is aligned with Ip (2024) and provides key insights into the livestock sector. The pro-environmental knowledge not only helps farmers identify and overcome barriers to sustainable practices but also equips them to devise innovative solutions tailored to their specific contexts. By reducing perceived risks and uncertainties, environmental knowledge bridges the

gap between intentions and action, enabling farmers to transition toward more sustainable business models. The findings for H5 reveal that psychological ownership directly fosters sustainability-driven entrepreneurial behavior. By supporting the findings of Siqueira and Honig (2019), our study highlights the role of intrinsic motivation and personal investment in driving entrepreneurial initiatives. For livestock farmers, this might translate into adopting practices that not only improve business performance but also enhance community well-being, such as water conservation or ethical animal farming. The intrinsic commitment derived from psychological ownership catalyzes innovative and responsible entrepreneurial actions.

The moderating role of technology readiness, as established in H6, highlights its significance in enhancing the practical application of pro-environmental knowledge. Access to and readiness for advanced technologies enable farmers to implement sustainable solutions more effectively, such as precision farming or renewable energy systems (Sahoo et al. 2022). This finding highlights the importance of integrating technological advancements with environmental awareness to drive actionable sustainability initiatives. Surprisingly, for H7, the result shows the insignificant moderating effect of technology readiness in the relationship between psychological ownership and sustainability-driven entrepreneurial behavior. This may be attributed to various contextual and behavioral factors. Similar to other developing countries, the low digital literacy of Pakistani farmers, the inability to access reliable technology, high cost and lack of trust they place in new systems may prevent them from considering technology as essential to their entrepreneurial ventures Vasavi et al. (2025), even if they are psychologically invested in it. Likewise, they rely on community networks, traditional knowledge, and practices that are deeply embedded in their routines, which may override other factors like technology readiness in driving sustainable behaviors.

6.1 Theoretical implications

This research offers a range of significant theoretical contributions to the literature on sustainability and entrepreneurship. Firstly, it advances the field by developing and empirically validating a novel conceptual framework that integrates key determinants of sustainability-driven entrepreneurial behavior within the livestock industry. This integration provides a comprehensive understanding of the factors influencing such behaviors, marking a pioneering effort in this domain. Secondly, the study's unique approach to synthesizing the involved determinants into a cohesive framework delivers a fresh perspective on sustainability-related entrepreneurial activities. This distinguishes the research as a groundbreaking contribution in the specific context of the livestock industry, addressing an evident gap in the existing body of knowledge (Cantele and Signori 2023, Saha et al. 2023). Third, this study advances the Resource-Based View (RBV) by conceptualizing pro-environmental knowledge, psychological ownership, and corporate social responsibility (CSR) as interdependent intangible resources that collectively shape entrepreneurial behavior in sustainability-oriented livestock ventures. Departing from prior RBV applications that examine these constructs in isolation, our framework

demonstrates how their integration moderated by technology readiness generates a synergistic resource configuration that enhances sustainable entrepreneurial action. This theoretical integration extends RBV's explanatory power by explaining how entrepreneurs in resource-constrained, high-impact sectors not only possess but actively align intangible assets to pursue competitive advantage through sustainability, thereby offering a novel lens for understanding resource enactment in emerging economies. This contribution bridges an important gap by unpacking the mechanisms through which these factors influence entrepreneurial activities, thereby positioning our study as a critical reference point for future inquiries (Siqueira and Honig 2019). Fourth, by integrating concepts from sustainability, psychology, and entrepreneurship, this research highlights the importance of a multidisciplinary approach in understanding complex behaviors. This cross-disciplinary perspective not only strengthens the framework's theoretical grounding but also opens avenues for researchers from diverse fields to contribute to and build upon the findings. Fifth, the integration of behavioral constructs such as psychological ownership within an organizational framework contributes to a deeper understanding of how individual attitudes and perceptions translate into collective entrepreneurial actions (Suvanto and Lähdesmäki 2023). This integration enriches behavioral theories by situating them within practical organizational contexts. Sixth, the study employs RBV theory as the theoretical foundation for its conceptual framework. This application not only strengthens the validity and robustness of the model but also extends the utility of RBV theory by applying it to a new industrial and geographical context (Junker et al. 2025). This study, therefore, enriches the theoretical scope of RBV theory by demonstrating its relevance and adaptability in explaining entrepreneurial behavior rooted in sustainability concerns, contributing to its broader applicability within the literature. Seventh, the study provides valuable empirical insights by focusing on Pakistan's livestock industry, a context that has been largely underexplored in sustainability and entrepreneurship research. By addressing this regional and industrial gap, the findings offer a nuanced understanding of the interplay between economic, environmental, and cultural dynamics in driving sustainability initiatives. These context-specific insights not only contribute to the global discourse on sustainability and entrepreneurship but also offer actionable implications for policymakers, industry stakeholders, and researchers, particularly in emerging markets. Finally, the study indirectly contributes to the literature on innovation by exploring how pro-environmental knowledge and psychological ownership foster sustainability-driven entrepreneurial behavior, which often serve as precursors to sustainable innovations. This perspective highlights the theoretical linkages between individual drivers and organizational innovation outcomes. Collectively, these contributions reinforce the study's academic significance and practical relevance, positioning it as a foundational work in this evolving area of research.

6.2 Managerial implications

The research findings offer significant managerial implications. First, having knowledge about the environment and related pressing issues is essential for creating more sustainable outcomes. As

highlighted by Ting (2023), knowledge sharing is more effective when driven by various actors within the ecosystem (e.g., government, NGOs, farmers). Based on this, we recommend that civil society organizations and community leaders collaborate with farmers and experts who possess strong environmental knowledge to organize eco-environmental training courses. Additionally, governments and NGOs should allocate more resources to respond to rapid changes in the broader livestock and related sectors. To support this, governments should provide sufficient financial assistance (e.g., through initiatives like Livestock Cards) to promote the adoption of climate-smart practices such as rotational grazing, agroforestry, zero-tillage, green values awareness, and the use of digital tools for real-time livestock management (e.g., "vet in your pocket").

Second, psychological ownership plays a critical role in driving CSR and entrepreneurial behavior by fostering intrinsic motivation. Brown et al. (2014) argued, and Kurki and Lähdesmäki (2023) empirically demonstrated that complex and meaningful work fosters psychological ownership. In the context of livestock farming, the multifaceted nature of sustainability, such as managing animal health, resource use, and environmental impacts, demands creative problem-solving and long-term thinking, which can deepen farmers' emotional investment in their work. By promoting sustainability through supportive extension services, inclusive cooperative structures, clear community goals, and giving farmers a direct stake in outcomes, practitioners and policymakers can enhance livestock farmers' psychological ownership. For example, include recognition programs for ethical farming or shared equity models to increase accountability and long-term engagement. This, in turn, can boost commitment, self-efficacy, satisfaction, and responsible behaviors that align with CSR and sustainable entrepreneurship.

Third, our results illustrate that technology readiness plays a crucial role in enhancing both cognitive and affective factors that influence sustainable entrepreneurship systems and processes. Pro-environmental knowledge and psychological ownership alone may not be sufficient to drive meaningful change in the livestock industry. Therefore, stakeholders should adopt a holistic approach to social innovation. Governments and IT firms must consider technology readiness when designing technology interfaces, as many livestock farmers and related professionals may not perceive new technologies as useful or easy to use. Stakeholders should prioritize clear communication of the benefits of these technologies, especially to groups that are typically hesitant or resistant to adoption. Furthermore, livestock users often assess technology based on their personal perceptions of quality, value, and satisfaction. As a result, service providers introducing technologies to the broader livestock sector must proactively educate users about their specific advantages. For example, by establishing local community-based innovation hubs where farmers co-develop and test sustainable livestock technologies (e.g., digital pasture monitoring, organic feed tracking systems) with researchers and tech providers. This is important because without adequate support, farmers often rely on general beliefs

about technology, as well as traditional knowledge and practices that are deeply embedded in their routines, when deciding whether to adopt new tools.

Finally, from the findings, investments in pro-environmental knowledge, psychological ownership, and CSR extend far beyond the livestock sector, offering valuable insights for a wide range of industries (e.g., agriculture, tourism, and manufacturing) seeking to align economic growth with environmental and social responsibility. For example, employing these strategies in agriculture to enhance soil health and biodiversity Ting (2023), as well as in tourism to preserve cultural heritage and enhance community well-being (Shekari et al. 2024).

6.3. Limitations and directions for future research

Despite the comprehensive approach taken to examine the relationships involved, this study is not without limitations. First, this study was conducted exclusively on the livestock industry within Pakistan, potentially limiting its generalizability to other cultural and national settings. Although elements of the sustainability-driven entrepreneurial behavior model have shown transferability across cultures, validation through studies conducted in diverse cultural and geographical contexts is necessary. Future research could extend the investigation to other regions to strengthen cross-cultural applicability and confirm the robustness of the finding. Second, this study utilized a cross-sectional research design, which restricts the ability to observe temporal or dynamic effects, and this design also limits the internal validity of the findings. Future research should consider adopting a qualitative and longitudinal research approach to capture changes and developments over time. Such a method would provide a deeper understanding of how pro-environmental knowledge, psychological ownership and CSR initiatives evolve and influence sustainability-driven entrepreneurial behavior with the moderating role of technology readiness. Third, future research could investigate the contextual dimensions of entrepreneurial sustainability, particularly in the livestock sector of developing countries. For example, a more comprehensive understanding of enabling factors and constraints can be gained by exploring how regulatory frameworks, government support mechanisms, and access to finance affect the adoption and scalability of sustainable practices.

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Figures

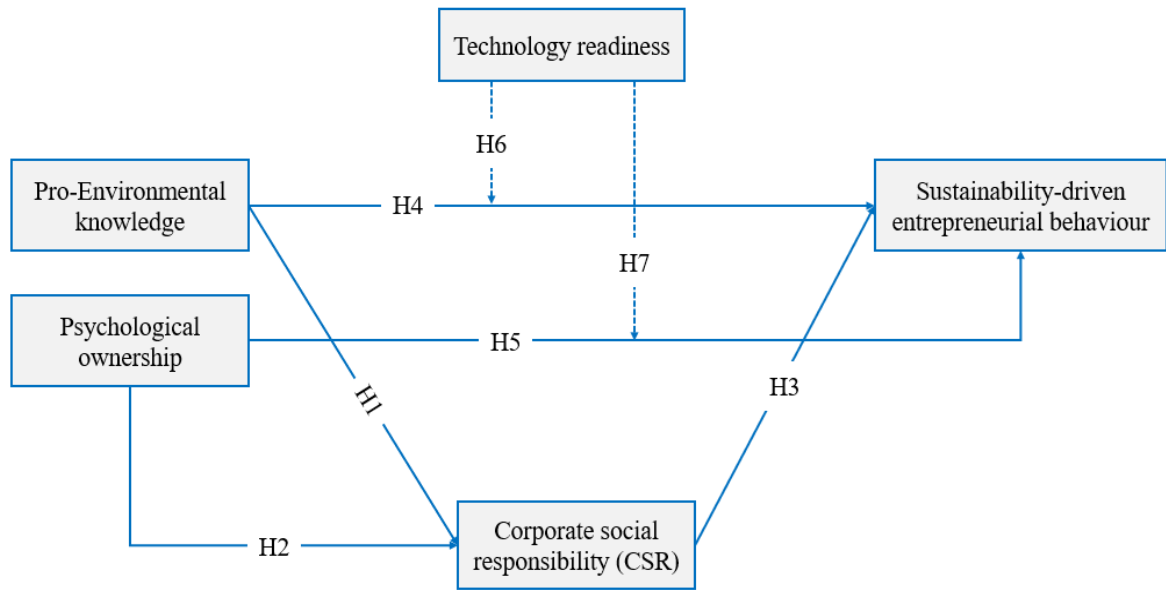


Figure 1: Conceptual Framework (Authors' own work)

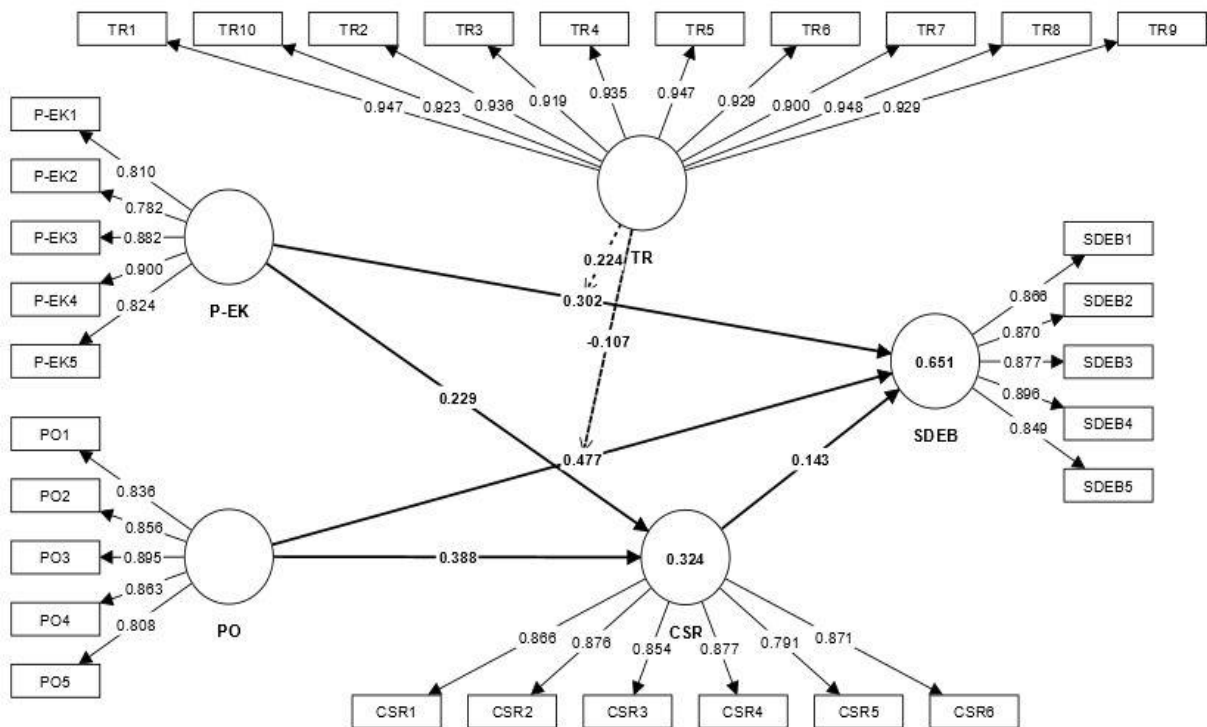


Figure 2: Measurement Model (Authors' own work)

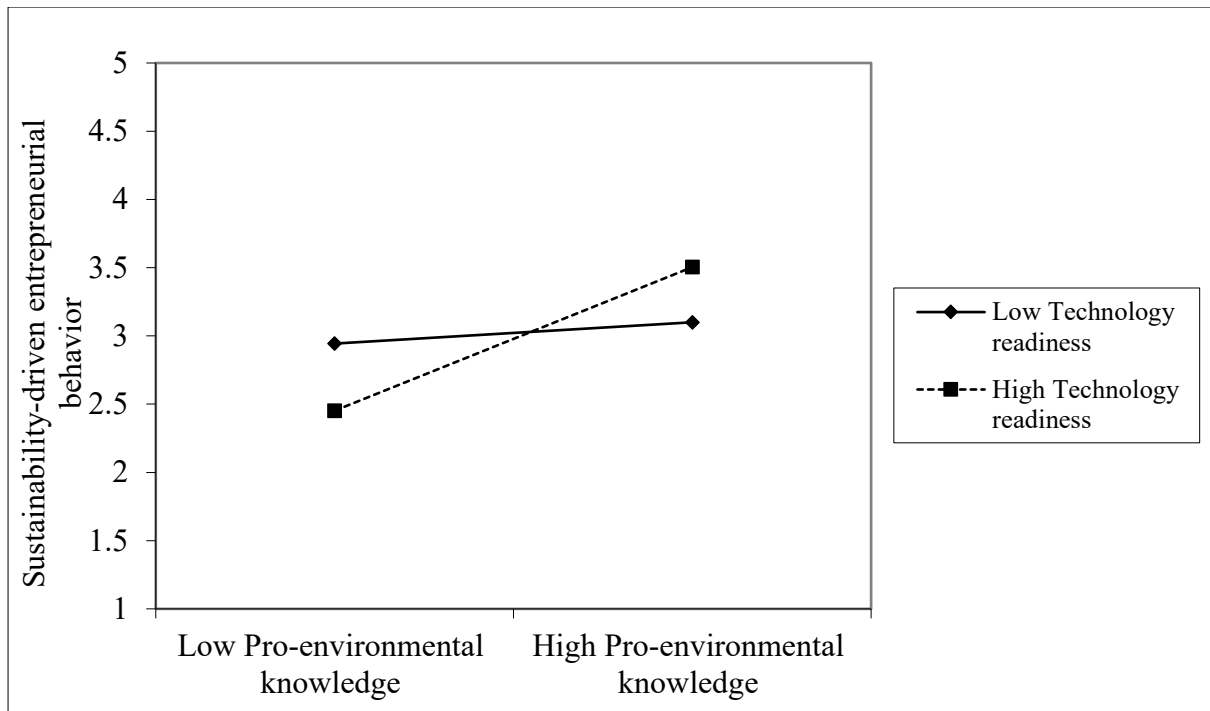


Figure 3: Moderating Result (Authors' own work)

Tables

Table 1. Details of Demographic Statistics (Authors' own work)

Description	Frequency	Percentage (%)
Gender		
Male	164	71
Female	67	29
Highest Education Level		
High school or equivalent	62	26.84
Bachelor's degree	141	61.04
Master's degree	24	10.39
Doctorate degree	04	1.73
Livestock Farm Age (years)		
Less than 1 year	19	8.23
1-5	30	12.99
6-10	56	24.24
11-15	40	17.32
More than 15 years	86	37.23
Land Holding/Farm Size		
Marginal (Up to One Acre)	91	39.39
Small (2- 5 Acre)	71	30.74
Medium (6-8 Acre)	33	24.24
Large (More than 8 Acre)	36	14.29
Livestock Type		
Cattle (Beef)	43	18.61
Cattle (Dairy)	29	12.55
Sheep	27	11.69
Goats	23	9.96
Buffalo	34	14.72
Poultry	54	23.38
Others	21	9.09

Table 2: Results of Internal Consistency Reliability and Convergent Validity (Authors' own work)

Constructs	Items	Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
Pro-Environmental Knowledge	P-EK1	0.810	0.897	0.914	0.707
	P-EK2	0.782			
	P-EK3	0.882			
	P-EK4	0.900			
	P-EK5	0.824			
Psychological Ownership	PO1	0.836	0.905	0.910	0.726
	PO2	0.856			

	PO3	0.895			
	PO4	0.863			
	PO5	0.808			
Corporate Social Responsibility	CSR1	0.866	0.927	0.932	0.733
	CSR2	0.876			
	CSR3	0.854			
	CSR4	0.877			
	CSR5	0.791			
	CSR6	0.871			
Sustainability-driven-Entrepreneurial Behavior	SDEB1	0.866	0.921	0.922	0.760
	SDEB2	0.870			
	SDEB3	0.877			
	SDEB4	0.896			
	SDEB5	0.849			
Technology Readiness	TR1	0.947	0.983	0.991	0.868
	TR2	0.936			
	TR3	0.919			
	TR4	0.935			
	TR5	0.947			
	TR6	0.929			
	TR7	0.900			
	TR8	0.948			
	TR9	0.929			
	TR10	0.923			

Table 3: Discriminant Validity (HTMT Criterion) (Authors' own work)

	CSR	SDEB	P-EK	PO	TR
CSR					
SDEB	0.576				
P-EK	0.524	0.748			
PO	0.586	0.808	0.747		
TR	0.220	0.184	0.151	0.274	

Table 4: Discriminant Validity (Fornell & Larcker Criterion) (Authors' own work)

	CSR	EB	P-EK	PO	TR
CSR	0.856				
EB	0.535	0.872			
P-EK	0.495	0.693	0.841		
PO	0.545	0.743	0.686	0.852	
TR	0.211	0.179	0.144	0.263	0.931

Table 5: Results of Hypotheses Testing (Direct and Moderation Effects) (Authors' own work)

Hypotheses	Relationships	Beta (β)	St. Error	t-values	p-values	Decision
H1	P-EK -> CSR	0.229	0.092	2.484	0.013	Supported
H2	PO -> CSR	0.388	0.096	4.024	0.000	Supported
H3	CSR -> SDEB	0.143	0.059	2.430	0.015	Supported
H4	P-EK -> SDEB	0.302	0.068	4.413	0.000	Supported
H5	PO -> SDEB	0.477	0.077	6.167	0.000	Supported
H6	TR x P-EK -> SDEB	0.224	0.080	2.789	0.005	Supported
H7	TR x PO -> SDEB	-0.107	0.086	1.242	0.214	Not Supported