

Human Capital Capability and Sustainable Agricultural Transformation: Extending the Resource-Based View in Rural Indonesia

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Abstract

This study examines the relationships among land fertility, green economy achievement, and food resilience within rural agricultural systems in Indonesia. Drawing on sustainability transformation and resource-based perspectives, the study investigates how environmental resource quality contributes to sustainability-oriented economic development and long-term food resilience. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), data were collected from agricultural stakeholders in Pinrang Regency, South Sulawesi, Indonesia. The findings indicate that land fertility significantly contributes to green economy achievement, while green economy achievement exerts a strong positive influence on food resilience. The results suggest that sustainability transformation is achieved through the effective integration of environmental resource management and sustainability-oriented economic development rather than through isolated environmental interventions alone. This study contributes to the sustainability and development management literature by providing empirical evidence from an emerging economy context and highlighting the strategic role of environmental resource quality in supporting broader sustainability outcomes. The findings further suggest that knowledge development, adaptive capacity, and institutional support may represent important enabling conditions for strengthening sustainability initiatives and long-term resilience. Practical implications emphasize the importance of integrating sustainable land management, green economy strategies, and food resilience policies to support sustainable and inclusive rural development.

Keywords: human capital capability, sustainable agricultural transformation, resource-based view, sustainability, rural development.

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INTRODUCTION

Organizations and production systems increasingly face sustainability pressures that require the effective deployment of strategic resources to maintain long-term performance, resilience, and competitiveness. Across both organizational and community-based contexts, sustainability-oriented practices are widely recognized as important mechanisms for addressing environmental challenges and improving long-term outcomes. However, the effectiveness of such practices depends not only on their adoption but also on the capabilities of the human resources responsible for implementing, adapting, and sustaining them. This challenge is particularly evident in agricultural systems, where climate change, environmental degradation, and food insecurity continue to threaten long-term sustainability, especially in developing economies where rural livelihoods remain highly dependent on agricultural productivity (IPCC, 2022; FAO, 2023).

Within the strategic human resource management (SHRM) literature, human capital is widely recognized as a critical strategic resource that enhances adaptability, innovation, and long-term sustainability (Armstrong, 2025; Collings et al., 2025; Dessler, 2020). Human Capital Theory suggests that knowledge, skills, training, and experience contribute significantly to performance and sustainable development outcomes (Schultz, 1971). Similarly, the Resource-Based View (RBV) argues that valuable, rare, inimitable, and non-substitutable

resources constitute the foundation of sustained competitive advantage (Barney, 1991). Among these resources, human capital capability represents a particularly important asset because it enables organizations and communities to effectively utilize other tangible and intangible resources to achieve desired outcomes.

Recent studies in strategic human resource management increasingly emphasize the role of sustainability-oriented human capital development and Green HRM practices in supporting organizational resilience and environmental sustainability (Renwick et al., 2013; Pham et al., 2020; Miah, 2024). Green HRM practices facilitate capability development, adaptive behavior, and knowledge exchange that strengthen the effectiveness of sustainability-oriented initiatives (Tang et al., 2018). Furthermore, green human capital has been shown to improve sustainability performance through enhanced competencies, learning capabilities, and environmentally responsible behavior (Ali et al., 2022; Shoaib et al., 2021). These findings suggest that sustainability outcomes are strongly influenced by the quality of human capabilities that support the implementation of sustainability-oriented practices.

Despite these advancements, existing studies have primarily examined sustainability initiatives from environmental, economic, or technological perspectives, while the capability-enhancing role of human capital remains insufficiently understood

(Wells & Johnson, 2020; Harish et al., 2021). In particular, limited empirical attention has been given to understanding how human capital capability functions as a strategic resource that strengthens the relationship between sustainability-oriented practices and broader sustainability outcomes. Although recent studies have highlighted the importance of adaptive capability, learning orientation, and continuous capability development in achieving sustainability objectives (Amjad et al., 2021; Úbeda-García et al., 2021; Aboramadan et al., 2022; Brewster et al., 2023; Adisa, 2025), empirical evidence remains limited in resource-constrained environments such as smallholder agricultural systems in emerging economies.

Agricultural systems provide a particularly relevant context for examining this issue because sustainable agricultural transformation requires not only environmentally responsible practices but also continuous capability development among individuals responsible for implementing such practices. Indonesia represents an important setting due to its significant agricultural dependence and ongoing sustainability challenges. As one of the major agricultural producers in Southeast Asia, Indonesia faces increasing pressure to improve food resilience, environmental sustainability, and rural welfare simultaneously. Consequently, understanding how human capital capability enhances the effectiveness of sustainability-oriented

agricultural practices may provide broader insights into the role of strategic resources in facilitating sustainability transformation under resource constraints.

LITERATURE REVIEW

2.1 Human Capital Capability and the Resource-Based View

The Resource-Based View (RBV) argues that organizational performance and long-term sustainability are shaped by the effective deployment of valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). Among these resources, human capital has been widely recognized as a strategic asset because it enables organizations and communities to adapt to environmental changes, develop innovative solutions, and sustain long-term performance (Armstrong, 2025; Collings et al., 2025; Dessler, 2020). Human Capital Theory further suggests that investments in knowledge, skills, training, and experience enhance individual and collective productivity, thereby contributing to sustainable development outcomes (Becker, 1964; Schultz, 1971).

Recent developments in strategic human resource management increasingly emphasize the role of human capital capability as a dynamic resource that supports organizational resilience and sustainability transformation (Renwick et al., 2013; Pham et al., 2020; Miah, 2024). Human capital capability encompasses adaptive capacity, knowledge utilization, learning orientation, and the ability to effectively implement sustainability-

oriented practices. Prior studies indicate that capability development enhances the effectiveness of sustainability initiatives by strengthening learning processes, adaptive behavior, and knowledge-sharing mechanisms that facilitate long-term performance improvement (Tang et al., 2018; Ali et al., 2022; Shoaib et al., 2021).

From an RBV perspective, sustainability-oriented practices alone may not be sufficient to generate superior outcomes. Rather, their effectiveness depends on the capability of individuals and communities to adopt, adapt, and sustain such practices over time. Consequently, human capital capability can be conceptualized as a strategic resource that amplifies the effectiveness of sustainability-oriented initiatives and facilitates sustainable transformation in resource-constrained environments.

2.2 Sustainability Transformation and Sustainable Practices

Sustainability transformation refers to the process through which organizations, communities, and production systems adapt their practices to achieve long-term environmental, social, and economic sustainability. Increasing environmental uncertainty, climate change, and resource scarcity have intensified the need for sustainability-oriented practices that support resilience and long-term performance (IPCC, 2022; FAO, 2023). Within this context, sustainable practices are increasingly viewed not merely as environmental initiatives but as strategic

mechanisms that facilitate adaptation and sustainable value creation.

Previous studies indicate that sustainability-oriented practices contribute significantly to environmental performance, resource efficiency, productivity improvement, and long-term system resilience (Wells & Johnson, 2020; Harish et al., 2021). In agricultural systems, sustainable practices such as organic fertilization, environmentally responsible land management, and efficient resource utilization have been shown to improve soil quality, agricultural productivity, and food system stability. These practices also contribute to climate adaptation by reducing environmental vulnerability and enhancing the long-term sustainability of production systems (Bumb & Baanante, 2020).

However, the successful implementation of sustainability-oriented practices depends not only on the availability of technical solutions but also on the capability of individuals and communities to adopt, adapt, and continuously improve such practices. Recent sustainability literature emphasizes that sustainability transformation requires the integration of environmental initiatives with learning processes, adaptive capability, and continuous capability development (FAO, 2023). Consequently, sustainable practices are more likely to generate superior outcomes when supported by strong human capital capability that facilitates knowledge utilization, adaptive behavior, and effective implementation.

2.3 Human Capital Capability in Agricultural Systems

Human capital capability plays a critical role in enabling sustainability transformation, particularly in resource-constrained environments where the effective utilization of knowledge and adaptive capacity determines long-term performance outcomes. From a Resource-Based View (RBV) perspective, human capital capability represents a strategic resource that enhances the ability of individuals and communities to deploy sustainability-oriented practices effectively and consistently (Barney, 1991). Human capital capability encompasses knowledge, technical skills, learning orientation, adaptive capacity, and the ability to utilize available resources to achieve desired outcomes (Becker, 1964; Schultz, 1971).

Within agricultural systems, human capital capability is reflected in farmers' ability to acquire, interpret, and apply knowledge related to sustainable farming practices, environmental management, and resource utilization. Farmers with stronger capabilities are generally more effective in adopting innovations, responding to environmental uncertainty, and implementing sustainability-oriented practices that improve long-term agricultural performance. Consequently, capability development becomes a critical mechanism through which sustainable practices generate meaningful environmental and socio-economic outcomes.

Recent studies in strategic human resource management and sustainability-oriented capability development emphasize the importance of continuous learning, knowledge sharing, and adaptive behavior in supporting long-term sustainability objectives (Renwick et al., 2013; Tang et al., 2018; Pham et al., 2020; Miah, 2024). Similarly, empirical evidence suggests that training programs, extension services, institutional support, and collaborative learning mechanisms significantly enhance adaptive capacity, productivity, and sustainability outcomes within agricultural communities (World Bank, 2021; FAO, 2023). These findings indicate that the effectiveness of sustainability-oriented practices depends not only on the practices themselves but also on the capability of individuals responsible for implementing them.

Despite increasing recognition of the importance of human capital capability, empirical research examining its role as a strategic resource within sustainability-oriented agricultural systems remains relatively limited, particularly in smallholder farming contexts in developing countries. This limitation highlights the need for further investigation into how human capital capability strengthens the relationship between sustainable practices and sustainability outcomes within resource-constrained environments.

2.4 Sustainability Outcomes: Food Resilience, Land Fertility, and Farmer Welfare

Sustainability transformation is ultimately evaluated through its ability to generate long-term environmental, social, and economic outcomes. Within agricultural systems, food resilience, land fertility, and farmer welfare represent critical indicators of sustainability because they reflect the capacity of production systems to maintain productivity, environmental quality, and socio-economic well-being under changing conditions (FAO, 2023; IPCC, 2022).

Food resilience refers to the ability of agricultural systems to sustain stable food production despite environmental, economic, and social disruptions. Previous studies indicate that sustainability-oriented agricultural practices enhance food resilience by improving resource efficiency, reducing environmental vulnerability, and supporting long-term agricultural continuity (Purwanto, 2021; Hossain et al., 2021). Strong food resilience contributes not only to food security but also to the stability of rural livelihoods and community sustainability.

Land fertility represents a fundamental environmental outcome of sustainable agricultural transformation. Sustainable practices such as organic fertilization, integrated soil management, and environmentally responsible land utilization have been shown to improve soil structure, nutrient availability, and long-term agricultural productivity (Wells

& Johnson, 2020; Harish et al., 2021). Improved land fertility strengthens the ecological sustainability of agricultural systems while supporting long-term production capacity.

Farmer welfare constitutes an important socio-economic outcome because sustainable agricultural transformation ultimately seeks to improve the quality of life and economic security of rural communities. Previous studies suggest that improvements in productivity, environmental sustainability, and food resilience contribute positively to income stability, economic well-being, and long-term rural development (Almeida et al., 2022). Farmers with higher levels of welfare are generally more capable of investing in sustainable farming practices, adopting innovations, and maintaining long-term agricultural resilience.

From a Resource-Based View perspective, these outcomes can be understood as manifestations of the effective deployment of strategic resources and capabilities. Sustainability-oriented practices create value when they are supported by human capital capability that enables the consistent adoption, adaptation, and improvement of such practices. Consequently, food resilience, land fertility, and farmer welfare represent important sustainability outcomes through which the effectiveness of human capital capability and sustainability-oriented practices can be evaluated.

2.5 Human Capital Capability as an Enabling Mechanism for Sustainability Transformation

The Resource-Based View (RBV) suggests that superior outcomes are not generated solely by the possession of resources but by the capability to effectively deploy and utilize those resources in achieving strategic objectives (Barney, 1991). Within sustainability-oriented systems, the effectiveness of sustainable practices depends largely on the capability of individuals and communities to implement, adapt, and continuously improve such practices under changing environmental and economic conditions. Consequently, human capital capability can be viewed as an enabling mechanism that enhances the effectiveness of sustainability-oriented practices in generating desired outcomes.

Human capital capability encompasses adaptive capacity, knowledge utilization, learning orientation, and problem-solving ability that facilitate the translation of sustainability-oriented initiatives into tangible environmental, social, and economic benefits (Becker, 1964; Schultz, 1971). Individuals possessing stronger capabilities are generally better equipped to interpret environmental challenges, adopt innovative solutions, and respond effectively to uncertainty. As a result, sustainability-oriented practices are more likely to produce superior outcomes when supported by strong human capital capability.

Recent studies in strategic human resource management and sustainability literature emphasize that capability development strengthens organizational resilience and improves the effectiveness of sustainability initiatives through enhanced learning, adaptive behavior, and knowledge-sharing processes (Renwick et al., 2013; Tang et al., 2018; Pham et al., 2020; Ali et al., 2022). Similarly, sustainability-oriented capability development has been found to strengthen environmental performance, long-term sustainability, and adaptive resilience in various organizational and community contexts (Amjad et al., 2021; Úbeda-García et al., 2021; Aboramadan et al., 2022).

In agricultural systems, human capital capability enables farmers to more effectively utilize sustainable agricultural practices, interpret environmental information, adopt innovative farming techniques, and maintain long-term productivity under resource constraints. Therefore, the relationship between sustainability-oriented practices and sustainability outcomes is expected to be stronger when supported by higher levels of human capital capability. This perspective positions human capital capability not merely as an independent resource but as a strategic enabling mechanism that amplifies the effectiveness of sustainability-oriented practices in achieving sustainability transformation.

2.6 Research Gap and Theoretical Contribution

Despite the growing literature on sustainability transformation, sustainable agricultural practices, and strategic human resource management, several important gaps remain. First, prior studies have predominantly examined sustainability-oriented practices from environmental, technological, or economic perspectives, emphasizing resource efficiency, productivity enhancement, and environmental performance (Wells & Johnson, 2020; Harish et al., 2021). While these studies provide valuable insights, they offer limited understanding of the capability-based mechanisms through which sustainability-oriented practices generate long-term sustainability outcomes.

Second, although Human Capital Theory and the Resource-Based View (RBV) recognize human capability as a strategic resource (Becker, 1964; Schultz, 1971; Barney, 1991), empirical studies have rarely examined how human capital capability strengthens the effectiveness of sustainability-oriented practices in resource-constrained environments. Existing research generally treats human capital as an independent determinant of performance, while limited attention has been given to its role as an enabling mechanism that amplifies the effectiveness of sustainability-oriented initiatives.

Third, recent studies in sustainability-oriented human resource management and Green HRM have emphasized the importance of capability development, adaptive behavior, and knowledge utilization in supporting environmental sustainability and organizational resilience (Renwick et al., 2013; Tang et al., 2018; Pham et al., 2020; Ali et al., 2022; Miah, 2024). However, empirical applications of these perspectives remain concentrated within formal organizational settings, while relatively little is known about how human capital capability operates within smallholder agricultural systems characterized by resource limitations, environmental uncertainty, and sustainability challenges.

To address these gaps, this study develops and tests an integrated framework linking sustainability-oriented agricultural practices, human capital capability, and sustainability outcomes. Specifically, the study examines whether human capital capability functions as a strategic enabling mechanism that strengthens the relationship between sustainable agricultural practices and sustainability outcomes, including land fertility, food resilience, and farmer welfare.

This study contributes to the literature in three important ways. First, it extends the Resource-Based View by demonstrating that human capital capability functions not only as a strategic resource but also as a capability-enhancing mechanism that amplifies the effectiveness of sustainability-oriented practices.

Second, it broadens the application of Human Capital Theory beyond traditional organizational settings by examining how capability development supports sustainability transformation within smallholder agricultural systems. Third, the study provides empirical evidence from an emerging economy context, contributing to the growing discourse on strategic human capital, sustainability transformation, and capability-based approaches to long-term sustainable development.

RESEARCH METHOD

3.1 Research Design

This study employs a quantitative research design using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the relationships among sustainability-oriented agricultural practices, human capital capability, land fertility, food resilience, and farmer welfare within the context of sustainability transformation. PLS-SEM was selected because of its suitability for exploratory and prediction-oriented research involving complex structural relationships and latent constructs (Hair et al., 2019; Latan et al., 2023). In addition, PLS-SEM is appropriate for studies with relatively limited sample sizes and does not require strict assumptions of multivariate normality, making it widely applicable in strategic management, sustainability, and human capital research.

The study adopts a theory-development and predictive research approach grounded in Human Capital Theory and the Resource-Based View (RBV). Specifically, the study examines whether human capital capability functions as a strategic enabling mechanism that strengthens the effectiveness of sustainability-oriented agricultural practices in generating sustainability outcomes. Accordingly, the analysis focuses on explaining predictive relationships among the constructs and extending understanding of capability-based sustainability transformation in resource-constrained environments rather than pursuing statistical generalization.

3.2 Data Collection and Sample

The study was conducted in Pinrang Regency, South Sulawesi, Indonesia, a region characterized by strong agricultural dependence and increasing implementation of sustainability-oriented farming practices, including organic fertilizer utilization and environmentally responsible land management. The region provides a relevant empirical setting for examining sustainability transformation because it combines agricultural productivity objectives with growing environmental and socio-economic sustainability challenges.

Data were collected from 39 respondents representing key stakeholders involved in agricultural sustainability initiatives, including farmers, agricultural extension officers, academics, and local development practitioners. These

respondents were selected because of their direct knowledge, experience, and involvement in sustainable agricultural practices and rural development activities. The inclusion of multiple stakeholder groups was intended to capture diverse perspectives regarding sustainability-oriented practices, capability development, and sustainability outcomes within the local agricultural system.

A purposive sampling technique was employed to ensure that respondents possessed substantial expertise and practical experience relevant to the research objectives. Rather than seeking broad population representation, the study focuses on obtaining informed assessments from individuals actively engaged in sustainability-oriented agricultural activities. This approach is consistent with exploratory and theory-development research that aims to examine relationships among latent constructs and generate insights regarding capability-based sustainability transformation.

Although the sample size is relatively limited, PLS-SEM is considered appropriate because the method emphasizes prediction, variance explanation, and theory development rather than covariance-based parameter estimation (Hair et al., 2019; Latan et al., 2023). Furthermore, the sample satisfies the minimum requirements commonly recommended for exploratory PLS-SEM applications and is consistent with previous studies examining sustainability and human capital relationships in

specialized stakeholder settings. Consequently, the selected sample is considered adequate for evaluating the proposed structural relationships and exploring the role of human capital capability within sustainability transformation processes.

3.3 Measurement of Variables

This study employs reflective latent constructs measured using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). The measurement model consists of sustainability-oriented agricultural practices, human capital capability, land fertility, food resilience, and farmer welfare.

Sustainability-oriented agricultural practices refer to the extent to which environmentally responsible farming activities are implemented, including organic fertilizer utilization, sustainable land management, efficient resource use, and environmentally conscious agricultural decision-making. These practices represent sustainability-oriented initiatives intended to enhance long-term environmental and socio-economic outcomes.

Human capital capability is conceptualized as a strategic capability encompassing knowledge, technical competence, adaptive capacity, learning orientation, training participation, and the ability to effectively implement and sustain environmentally responsible agricultural practices. Consistent with Human Capital Theory and the Resource-Based View (RBV), human

capital capability reflects the capacity of individuals to acquire, utilize, and apply knowledge and skills in support of sustainability transformation.

Land fertility refers to the perceived capacity of agricultural land to maintain soil quality, nutrient availability, and long-term productivity. Food resilience reflects the ability of agricultural systems to sustain stable food production under environmental, economic, and social uncertainty. Farmer welfare represents perceived improvements in productivity, income stability, economic well-being, and overall quality of life resulting from sustainability-oriented agricultural activities.

Measurement items were adapted from prior studies on sustainability, agricultural development, human capital, and strategic management to ensure content validity, theoretical consistency, and contextual relevance. All constructs were operationalized using indicators that capture respondents' perceptions of sustainability-oriented practices, capability development, and sustainability outcomes within the context of rural agricultural systems.

3.4 Data Analysis Technique

Data analysis was conducted using SmartPLS software following the two-stage analytical procedure commonly recommended in Partial Least Squares Structural Equation Modeling (PLS-SEM) research (Hair et al., 2019; Latan et al., 2023). Consistent with the study's objective of examining predictive relationships and extending theory within

a sustainability transformation context, PLS-SEM was considered appropriate due to its prediction-oriented nature and suitability for exploratory research involving complex latent constructs.

The first stage involved evaluation of the measurement model to assess the reliability and validity of the constructs. Indicator reliability was examined using outer loadings, while internal consistency reliability was assessed through Composite Reliability (CR). Convergent validity was evaluated using the Average Variance Extracted (AVE), with values exceeding 0.50 indicating acceptable convergent validity. Discriminant validity was assessed using both the Fornell–Larcker criterion and the Heterotrait–Monotrait Ratio (HTMT) to ensure empirical distinctiveness among the latent constructs.

The second stage involved assessment of the structural model to evaluate the hypothesized relationships among sustainability-oriented agricultural practices, human capital capability, land fertility, food resilience, and farmer welfare. Path coefficients, t-statistics, and p-values were estimated using a bootstrapping procedure with 5,000 resamples. Statistical significance was determined based on a t-value greater than 1.96 and a p-value below 0.05.

To evaluate the predictive and explanatory capability of the model, coefficients of determination (R^2) were examined for all endogenous constructs. In addition, predictive relevance was assessed using blindfolding procedures

and Stone–Geisser’s Q^2 values. These measures provide insights into the model’s ability to explain and predict sustainability outcomes within the context of sustainability transformation.

Given the study’s theoretical focus on the enabling role of human capital capability, moderation effects were further examined to assess whether human capital capability strengthens the relationship between sustainability-oriented agricultural practices and sustainability outcomes. Bootstrapping procedures were employed to evaluate the robustness and stability of the estimated relationships, thereby supporting the study’s objective of extending the Resource-Based View (RBV) through empirical evidence from a resource-constrained environment.

3.5 Hypothesis Development

Drawing upon the Resource-Based View (RBV) and Human Capital Theory, this study proposes that sustainability-oriented agricultural practices contribute to sustainability outcomes by improving environmental quality, production stability, and socio-economic well-being. Sustainable practices such as organic fertilization, efficient resource utilization, and environmentally responsible land management are expected to enhance land fertility, strengthen food resilience, and improve farmer welfare through more sustainable agricultural systems.

Previous studies indicate that sustainability-oriented practices improve soil quality and long-term agricultural productivity (Wells & Johnson, 2020;

Harish et al., 2021). Improved land fertility subsequently supports more stable food production and strengthens resilience against environmental uncertainty. Furthermore, sustainable agricultural practices contribute directly to farmer welfare by enhancing productivity, income stability, and long-term sustainability outcomes.

Based on these arguments, the following hypotheses are proposed:

H1 : Sustainability-oriented agricultural practices positively influence land fertility.

H2 : Land fertility positively influences food resilience.

H3 : Sustainability-oriented agricultural practices positively influence farmer welfare.

H4 : Sustainability-oriented agricultural practices positively influence food resilience.

In addition to the direct effects, this study positions human capital capability as a strategic enabling mechanism that strengthens the effectiveness of sustainability-oriented agricultural practices. Consistent with the Resource-Based View, the effectiveness of sustainability-oriented practices depends not only on the practices themselves but also on the capability of individuals to implement, adapt, and continuously improve such practices under changing environmental conditions. Human capital capability, reflected through knowledge, adaptive capacity, learning orientation, technical competence, and training

participation, is therefore expected to enhance the impact of sustainability-oriented practices on sustainability outcomes.

Accordingly, the following moderation hypotheses are proposed:

H5 : Human capital capability positively moderates the relationship between sustainability-oriented agricultural practices and land fertility.

H6 : Human capital capability positively moderates the relationship between sustainability-oriented agricultural practices and food resilience.

H7 : Human capital capability positively moderates the relationship between sustainability-oriented agricultural practices and farmer welfare.

The proposed hypotheses collectively reflect the study's theoretical argument that human capital capability functions as a strategic resource that amplifies the effectiveness of sustainability-oriented practices in generating sustainability outcomes, thereby extending the Resource-Based View within the context of sustainability transformation in rural agricultural systems.

RESULT

4.1 Measurement Model Assessment

The measurement model was evaluated to assess construct reliability, convergent validity, and discriminant validity prior to examining the structural relationships among the latent constructs. The assessment included sustainability-

oriented agricultural practices, human capital capability, land fertility, food resilience, and farmer welfare.

The results of Cronbach's Alpha, rho_A, Composite Reliability (CR), and Average Variance Extracted (AVE). All constructs demonstrated satisfactory internal consistency reliability, with Cronbach's Alpha and Composite Reliability values exceeding the recommended threshold of 0.70 (Hair et al., 2019). Composite Reliability values ranged from 0.916 to 0.945, indicating strong construct reliability across all latent variables.

Furthermore, all AVE values exceeded the minimum threshold of 0.50, confirming adequate convergent validity. These results indicate that the indicators adequately represent their respective constructs and capture a substantial proportion of construct variance.

Discriminant validity was assessed using both the Fornell–Larcker criterion and the Heterotrait–Monotrait Ratio (HTMT). The results confirmed that each construct was empirically distinct from the others, indicating satisfactory discriminant validity. This finding suggests that sustainability-oriented agricultural practices, human capital capability, land fertility, food resilience, and farmer welfare represent conceptually and empirically separate dimensions within the proposed framework.

Overall, the measurement model demonstrates acceptable reliability and validity, supporting further evaluation of the structural model and the hypothesized relationships among

sustainability-oriented practices, human capital capability, and sustainability outcomes.

4.2 Structural Model Results

The structural model was evaluated to examine the relationships among land sustainability, land fertility, farmer welfare, agricultural yield improvement, green economy achievement, and food resilience. Path coefficients, t-statistics, and p-values obtained through the bootstrapping procedure are presented in Table 1.

The results indicate that land sustainability does not have a statistically significant effect on green economy achievement ($\beta = 0.302$, $t = 0.942$, $p = 0.347$). Although the relationship is positive, the statistical evidence suggests that sustainability-oriented land management practices alone are insufficient to directly enhance green economy outcomes within the studied context.

Land fertility demonstrates a positive and statistically significant influence on green economy achievement ($\beta = 0.367$, $t = 2.355$, $p = 0.019$). This finding suggests that improvements in soil quality, nutrient availability, and long-term land productivity contribute significantly to the successful implementation of green economy initiatives. The result highlights the importance of environmental resource quality as a foundation for sustainability-oriented development.

The relationship between farmer welfare and green economy achievement is

positive but statistically insignificant ($\beta = 0.152$, $t = 0.425$, $p = 0.671$). Similarly, the effect of agricultural yield improvement on green economy achievement is also positive but not statistically significant ($\beta = 0.177$, $t = 0.974$, $p = 0.330$). These findings suggest that improvements in socio-economic conditions and agricultural output alone may not automatically translate into broader green economy outcomes without complementary institutional, environmental, and capability-related support mechanisms.

The strongest relationship identified in the model is the effect of green economy achievement on food resilience ($\beta = 0.933$, $t = 26.214$, $p < 0.001$). This result indicates that successful implementation of green economy initiatives substantially strengthens the ability of agricultural systems to maintain stable food production and resilience under changing environmental and economic conditions.

Overall, the findings suggest that land fertility represents a critical driver of green economy achievement, while green economy achievement serves as a powerful mechanism for enhancing food resilience. The results further imply that sustainability transformation requires more than improvements in welfare or production output alone; rather, effective sustainability outcomes depend on the integration of environmental quality, sustainable resource management, and broader green economy development strategies.

4.3 Structural Model Visualization

Figure 1 presents the structural model generated from the PLS-SEM analysis, illustrating the relationships among land sustainability, land fertility, farmer welfare, agricultural yield improvement, green economy achievement, and food resilience. The model provides a visual representation of the hypothesized relationships and their respective statistical significance.

The structural model indicates that land fertility serves as the only exogenous variable with a statistically significant direct influence on green economy achievement. This finding suggests that maintaining soil quality, nutrient availability, and long-term land productivity represents a critical foundation for achieving sustainability-oriented economic development within agricultural systems. In contrast, land sustainability, farmer welfare, and agricultural yield improvement demonstrate positive but statistically insignificant relationships with green economy achievement, indicating that these factors alone may not be sufficient to generate broader green economy outcomes.

The model further reveals that green economy achievement exerts a very strong positive influence on food resilience. This relationship represents the strongest path within the structural model and highlights the importance of sustainability-oriented economic development in supporting stable food production systems and long-term

agricultural resilience. The finding suggests that successful implementation of green economy initiatives contributes significantly to the capacity of agricultural systems to withstand environmental and economic challenges while maintaining food security.

From a sustainability transformation perspective, the structural model demonstrates that environmental resource quality, particularly land fertility, plays a fundamental role in facilitating green economy development, which subsequently strengthens food resilience. The model therefore supports the view that sustainable agricultural development requires not only productivity enhancement but also effective management of environmental resources and sustainability-oriented economic strategies.

Overall, the structural model confirms that green economy achievement functions as a key mechanism linking environmental sustainability with food resilience outcomes. The findings reinforce the importance of integrating sustainable land management, environmental stewardship, and green economy policies to support long-term agricultural sustainability and rural development.

Figure 1. Structural Model of Sustainable Agricultural Practices, Land Fertility, Food Resilience, Farmer Welfare, Agricultural Productivity, and Strategic Human Capital

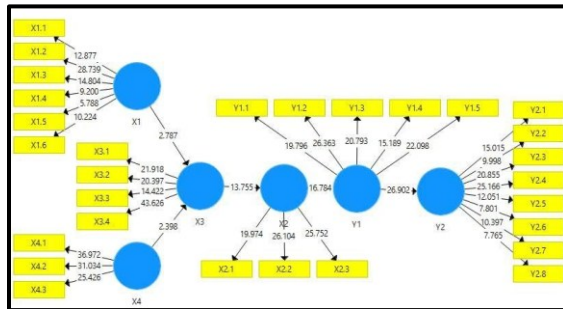


Figure 1. Structural Model Linking Green Economy, Land Fertility, Food Resilience, and Farmer Welfare.

The structural model presented in Figure 1 provides empirical evidence regarding the relationships among land sustainability, land fertility, farmer welfare, green economy achievement, and food resilience. The findings indicate that land fertility plays a significant role in supporting green economy achievement, while green economy achievement exerts a strong positive influence on food resilience. Although land sustainability, farmer welfare, and agricultural yield improvement demonstrate positive relationships with green economy achievement, their effects are not statistically significant within the present model. Overall, the results highlight the importance of environmental resource quality and sustainability-oriented economic development in strengthening food resilience and supporting long-term agricultural sustainability. These findings

underscore the need to integrate sustainable land management practices and green economy strategies into agricultural development policies and rural sustainability initiatives.

DISCUSSION

The findings of this study provide important empirical evidence regarding the relationships among land sustainability, land fertility, farmer welfare, agricultural yield improvement, green economy achievement, and food resilience within rural agricultural systems. The results indicate that land fertility plays a significant role in supporting green economy achievement, while green economy achievement exerts a strong positive influence on food resilience. These findings reinforce previous studies emphasizing the importance of environmental resource quality and sustainability-oriented economic development in strengthening long-term agricultural resilience and food security. More importantly, the results suggest that sustainability transformation operates through interconnected environmental and socio-economic mechanisms rather than through isolated interventions alone.

A central contribution of this study lies in its emphasis on the mechanisms through which sustainability-oriented outcomes can be achieved within rural agricultural systems. The findings demonstrate that environmental resource quality, particularly land fertility, plays a significant role in supporting green economy achievement, which

subsequently strengthens food resilience. This result highlights the importance of viewing sustainability transformation as an integrated process linking environmental sustainability, economic development, and long-term food system stability. Rather than relying solely on productivity enhancement or short-term economic gains, sustainable transformation appears to depend on the effective management of environmental resources that support broader sustainability objectives.

From a theoretical perspective, these findings can be interpreted through the lenses of Human Capital Theory (Schultz, 1971) and the Resource-Based View (Barney, 1991). Although human capital capability was not directly measured in the structural model, the successful achievement of green economy outcomes and food resilience likely depends on the ability of agricultural actors to acquire, utilize, and apply relevant knowledge in managing environmental resources effectively. Previous studies in strategic human resource management and sustainability literature emphasize that capability development, continuous learning, and adaptive competencies strengthen the implementation of sustainability-oriented initiatives and contribute to long-term resilience (Renwick et al., 2013; Pham et al., 2020; Ali et al., 2022). Consequently, the present findings suggest that environmental sustainability and green economy development may be further enhanced when supported by strong

human capital capability within agricultural communities.

The strong relationship between land fertility and food resilience highlights the critical role of environmental resource quality in supporting sustainable food systems. Fertile land provides the foundation for stable agricultural production by improving soil quality, nutrient availability, and long-term productivity. As a result, agricultural systems characterized by higher levels of land fertility are better positioned to maintain production stability and withstand environmental and economic disruptions. This finding is consistent with previous sustainability research emphasizing that long-term food resilience depends on the preservation of ecological resources and the sustainable management of agricultural land. The result further suggests that environmental sustainability should be viewed not only as an ecological objective but also as a strategic prerequisite for achieving food security and long-term rural resilience.

An interesting finding of this study is that farmer welfare demonstrates a positive but statistically insignificant relationship with green economy achievement. This result suggests that improvements in socio-economic conditions alone may not automatically translate into broader sustainability-oriented economic outcomes. While farmer welfare remains an important objective of rural development, the transition toward a green economy appears to require additional supporting factors, including

environmental resource quality, institutional support, sustainability-oriented policies, and effective governance mechanisms. This finding implies that sustainability transformation extends beyond individual economic improvements and depends on the integration of environmental, social, and institutional dimensions. Consequently, policies aimed at strengthening green economy development should not focus exclusively on welfare enhancement but should also promote sustainable resource management and broader sustainability-oriented development strategies.

From a managerial and policy perspective, the findings suggest that achieving green economy objectives and strengthening food resilience require more than environmental interventions alone. Effective sustainability transformation depends on the capacity of agricultural stakeholders to implement, maintain, and continuously improve sustainability-oriented practices. In this regard, human capital capability becomes an important supporting factor that enables the effective utilization of environmental and institutional resources. Human resource development initiatives, including farmer training programs, agricultural extension services, knowledge-sharing systems, and collaborative learning mechanisms, can enhance adaptive capacity and improve the implementation of sustainability-oriented agricultural practices. Consistent with the strategic human resource management (SHRM)

perspective, investments in capability development may strengthen the long-term effectiveness of sustainability policies and contribute to more resilient and sustainable agricultural systems.

The integrated framework reinforces the importance of adopting a holistic sustainability-oriented approach that combines environmental sustainability, socio-economic development, and effective governance mechanisms. The findings indicate that land fertility serves as a critical environmental foundation for green economy achievement, while green economy development contributes substantially to strengthening food resilience. These relationships highlight the interconnected nature of sustainability transformation within rural agricultural systems, where environmental resource quality and sustainability-oriented economic development jointly support long-term resilience and food security.

This study contributes to the sustainability and development management literature by providing empirical evidence on the relationships among land sustainability, land fertility, green economy achievement, and food resilience within an emerging economy context. Unlike previous studies that often examine environmental, economic, or social dimensions separately, the present research highlights the importance of integrating these dimensions within a unified sustainability framework. The findings further suggest that human capital capability, institutional support, and knowledge development

may serve as important enabling factors that strengthen the effectiveness of sustainability-oriented initiatives and therefore represent promising directions for future research.

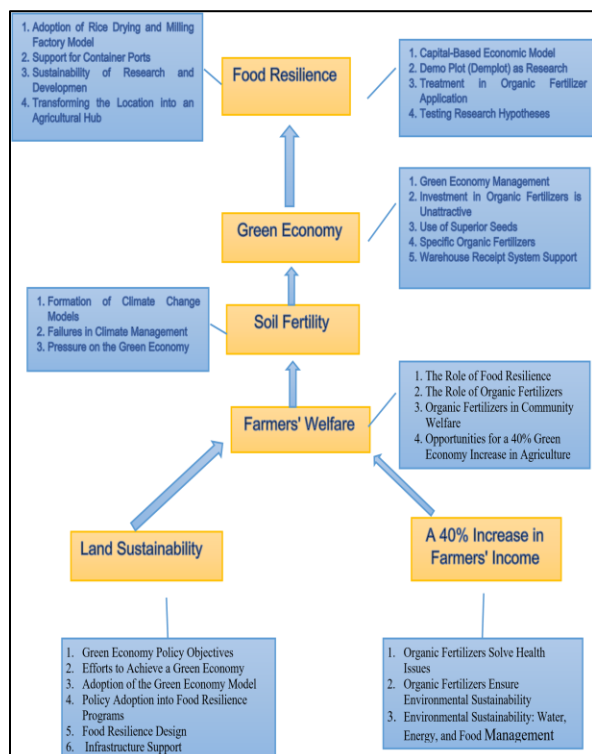
From a practical perspective, policymakers and agricultural practitioners should prioritize integrated sustainability strategies that combine sustainable land management, green economy development, and food resilience enhancement. Investments in farmer training, agricultural extension services, knowledge-sharing systems, and collaborative governance mechanisms can strengthen the implementation of sustainability-oriented practices and support long-term sustainability outcomes. Furthermore, strengthening institutional capacity, rural infrastructure, and sustainability-oriented policy frameworks may enhance the effectiveness of green economy initiatives and contribute to more resilient agricultural systems in developing country contexts.

Taken together, the findings suggest that sustainability transformation within rural agricultural systems is driven by the interaction between environmental resource quality and sustainability-oriented economic development. The significant role of land fertility in supporting green economy achievement, combined with the strong influence of green economy achievement on food resilience, demonstrates that long-term agricultural sustainability depends on the effective integration of environmental stewardship and sustainability-oriented

development strategies. While socio-economic improvements remain important, the results indicate that achieving sustainable outcomes requires a broader systemic approach that incorporates environmental management, institutional support, knowledge development, and collaborative governance. Consequently, sustainability transformation should be viewed as a multidimensional process that links ecological sustainability, economic resilience, and long-term food security within rural communities.

Beyond environmental practices, the framework also incorporates supporting factors such as institutional support, infrastructure development, research capability, and knowledge-sharing mechanisms. These elements strengthen adaptive capacity, facilitate the implementation of sustainability-oriented initiatives, and support the long-term sustainability of agricultural systems. The findings therefore suggest that achieving sustainable agricultural transformation requires an integrated approach that combines environmental sustainability, socio-economic development, effective governance, and continuous capability development. Such integration is essential for strengthening green economy achievement and enhancing long-term food resilience within rural agricultural communities.

Figure 2. Integrated Sustainability Framework Linking Green Economy Achievement, Food Resilience, and Rural Agricultural Development



The integrated framework reinforces the importance of adopting a holistic sustainability-oriented approach that combines environmental sustainability, socio-economic development, and effective institutional support. The findings highlight the interconnected relationships among land fertility, green economy achievement, and food resilience, demonstrating that sustainable agricultural transformation requires more than isolated environmental or economic interventions. By integrating environmental resource quality and

sustainability-oriented economic development within a unified framework, this study contributes to the growing literature on sustainability transformation, green economy development, and rural resilience in emerging economies.

From a practical perspective, the findings suggest that policymakers and agricultural practitioners should prioritize integrated sustainability strategies that strengthen environmental resource management while promoting green economy development and food resilience. Investments in farmer training programs, agricultural extension services, knowledge-sharing systems, and institutional support mechanisms may enhance the effectiveness of sustainability-oriented initiatives and strengthen adaptive capacity within rural communities. Furthermore, investments in rural infrastructure, research capability, and collaborative governance are essential for supporting long-term sustainability outcomes and strengthening the resilience of agricultural systems in developing-country contexts.

CONCLUSION

This study concludes that land fertility plays a significant role in supporting green economy achievement, while green economy achievement exerts a strong positive influence on food resilience within rural agricultural systems. The findings demonstrate that environmental resource quality represents an important foundation for

sustainability-oriented economic development and long-term food system resilience. More broadly, the results suggest that sustainability transformation operates through interconnected environmental and socio-economic mechanisms rather than through isolated interventions alone.

The study contributes to the growing literature on sustainability transformation, green economy development, and rural resilience by providing empirical evidence from an emerging economy context. The findings highlight the importance of integrating environmental sustainability and sustainability-oriented economic development within a unified framework. In particular, the results demonstrate that improvements in land fertility contribute to broader sustainability outcomes and that green economy achievement functions as a key mechanism linking environmental sustainability with food resilience outcomes. These findings emphasize that sustainable agricultural development requires not only improvements in environmental resource management but also the effective integration of sustainability-oriented economic strategies and institutional support systems.

Although human capital capability was not directly examined within the empirical model, the findings suggest that knowledge development, adaptive capacity, and learning mechanisms may play important supporting roles in facilitating sustainability transformation. Consequently, future sustainability

initiatives should not focus solely on environmental interventions but should also strengthen the capabilities of agricultural stakeholders to effectively implement and sustain sustainability-oriented practices. This perspective is consistent with Human Capital Theory and the Resource-Based View, which emphasize the importance of capability development in supporting long-term sustainability outcomes.

From a practical perspective, the findings imply that policymakers and agricultural practitioners should prioritize integrated strategies that strengthen land fertility, promote green economy development, and enhance food resilience. Investments in agricultural extension services, farmer training programs, knowledge-sharing systems, rural infrastructure, and collaborative governance mechanisms can strengthen the effectiveness of sustainability-oriented initiatives and support long-term rural resilience. Such efforts are particularly important in developing-country contexts, where environmental sustainability and food security remain closely interconnected.

Despite its contributions, this study has several limitations. First, the relatively small sample size may limit the generalizability of the findings. Second, the study focuses on a single regional context, which may not fully represent the diversity of agricultural systems across different regions and countries. Therefore, the findings should be interpreted as context-specific insights

that contribute to theory development rather than universal conclusions.

Future research is encouraged to examine broader geographical contexts, incorporate larger samples, and investigate additional factors that may influence sustainability transformation and food resilience. In particular, future studies may explicitly explore the roles of

human capital capability, institutional capability, organizational learning, and knowledge-sharing mechanisms as potential moderating or mediating factors within sustainability-oriented agricultural systems. Such research would provide a more comprehensive understanding of how environmental, economic, institutional, and human capability factors interact to support long-term sustainability outcomes.

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