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The Effect of Sustainable Agricultural Practices, Product Diversification, and Digital Marketing on the Economic Performance of Organic Vegetable Farmers in Bali

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ABSTRACT

This study examines the impact of sustainable agricultural practices, product diversification, and digital marketing on the economic performance of organic vegetable farmers in Bali. Employing a quantitative approach, data were collected from 210 farmers using a structured questionnaire with a 5-point Likert scale. The analysis was conducted using Structural Equation Modeling with Partial Least Squares (SEM-PLS). The results reveal that product diversification has the strongest positive influence on economic performance, followed by sustainable agricultural practices and digital marketing. Product diversification enhances income stability and market expansion, while sustainable practices improve cost efficiency and product quality. Digital marketing, although less impactful, provides significant benefits by increasing market reach and customer engagement. These findings highlight the synergistic effects of these strategies in improving the economic resilience of organic farmers. The study concludes with actionable recommendations for farmers, policymakers, and stakeholders to foster sustainable and profitable organic farming.

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1. INTRODUCTION

The agricultural sector plays a vital role in the economic development of Indonesia, particularly in Bali, where organic farming has become a promising avenue for sustainable growth. With increasing global and local demand for environmentally friendly and health-conscious food products, organic farming has emerged as a crucial strategy for balancing economic progress and environmental sustainability. Organic vegetable farming, in particular, has shown potential to enhance the livelihoods of smallholder farmers by offering higher value-added products and access to niche markets. Organic farming in Bali, Indonesia, particularly in the vegetable sector, offers a promising pathway for sustainable economic

development by meeting the rising demand for environmentally friendly and health-conscious food products while enhancing the livelihoods of smallholder farmers through access to niche markets and higher value-added products. In Gobleg Village, Bali, farmers have adopted eco-friendly practices, such as IoT-based fertigation, to improve efficiency and sustainability, supported by institutional frameworks that facilitate marketing and financing through platforms like the Fresh Boss application [1]. The use of organic fertilizers has improved soil quality and agricultural yields by enhancing water retention and microbial activity, which are essential for sustainable farming practices [2]. Community empowerment and skills development programs, such as the Indonesian Rural Skills Development initiatives, play a critical role in training organic farmers to produce compost and manage farms sustainably, resulting in economic, health, and environmental benefits [3]. In Karangasem Regency, government support for biofertilizers and biological control agents, along with the training of agricultural extension workers, has further advanced sustainable agriculture [4]. Moreover, sustainable agricultural practices, including organic farming, contribute to ecosystem balance and improved land productivity by enhancing biodiversity, soil health, and crop yields, though adoption rates vary regionally, underscoring the need for context-specific strategies [5].

Sustainable agricultural practices are vital for ensuring long-term productivity and environmental conservation. Techniques like crop rotation, integrated pest management, and conservation tillage improve soil health, reduce water usage, and minimize agrochemical inputs, promoting biodiversity and protecting natural resources [5]. These methods are crucial to meeting growing food demand while mitigating climate change impacts [6]. Benefits include environmental conservation through reduced greenhouse gas emissions and preserved biodiversity [6], improved productivity via integrated nutrient management (INM) and farming systems (IFS) [7], and better public health by lowering harmful chemicals in food [8]. However, adoption faces challenges such as limited awareness, restricted access to technology and resources, and inadequate policies that require revisions to address social, agronomic, and technical barriers [9].

Diversifying product offerings in agriculture is a strategic approach to enhance economic resilience by reducing dependency on single crops, mitigating market risks, and meeting diverse consumer demands. This strategy stabilizes income and enables value addition, such as processed organic products, thereby improving economic performance. Crop diversification boosts farm profitability by stabilizing yields and reducing monoculture risks; for instance, systems in the North China Plain increased farmer income by 20% and cereal production by 32% [7]. Similarly, in Europe, diversified farming showed better social gross margins and long-term economic benefits compared to monocropping [8]. Diversification also promotes environmental sustainability by reducing greenhouse gas emissions and enhancing soil health; for example, rotations in the North China Plain cut N2O emissions by 39% and improved soil health by 45% [7]. These practices enhance biodiversity and ecosystem services, critical for long-term sustainability [6], [10]. Additionally, diversified cropping increases agro-ecosystem resilience to climate change by improving adaptability and reducing the environmental impacts of intensification [11]. The blue economy, including sustainable fish farming, further supports diversification and climate resilience, particularly for nations reliant on traditional sectors [2].

The integration of digital marketing into agriculture has transformed the industry, offering farmers tools to access wider markets and improve economic well-being. Platforms like social media, e-commerce websites, and mobile applications are essential for promoting organic products, engaging consumers, and reducing reliance on traditional supply chains. Mobile phones enhance market participation by providing

timely access to market pricing and improved production methods [12]. E-commerce platforms bridge gaps between farmers and consumers, enabling easier access to locally sourced goods [13]. Social media platforms revolutionize how farmers connect with peers and access information, with adoption influenced by education and social participation [14]. Digital marketing promotes sustainability by addressing consumer preferences and advancing goals through technologies like precision agriculture and blockchain [15]. However, limited adoption due to digital divides and regulatory challenges highlights the need for strategic investments and enhanced infrastructure to maximize its potential [16].

Despite the potential of these strategies, empirical evidence on their collective impact on the economic performance of organic vegetable farmers remains limited, particularly in Bali. This study aims to fill this gap by examining how sustainable agricultural practices, product diversification, and digital marketing influence the economic outcomes of organic vegetable farmers. This paper is structured as follows: the literature review explores previous studies on sustainable agriculture, product diversification, and digital marketing in the agricultural context.

2. LITERATURE REVIEW

2.1 Sustainable Agricultural Practices

Sustainable agriculture is defined as a farming system that fulfills current food and fiber needs without compromising the ability of future generations to meet their own needs [2], [17]. It employs environmentally sound techniques such as crop rotation, organic fertilization, integrated pest management, and conservation tillage to optimize productivity and resource use, improving soil health, reducing environmental degradation, and enhancing farm productivity [3]. In the context of organic farming, these practices are essential for maintaining ecological balance and meeting certification requirements for organic produce, with research showing that adopting sustainable methods results in higher-quality produce that commands premium market prices [18]. Additionally, organic farming reduces input costs, such as those for chemical fertilizers and pesticides, thereby improving farmers' economic outcomes.

2.2 Product Diversification

Product diversification is a strategy of producing multiple products to meet varied consumer demands and mitigate risks, particularly in agriculture, where it may involve growing different crops, developing value-added products, or entering new market segments. [19] emphasizes diversification as a critical livelihood strategy for rural households, providing stability against fluctuating market conditions and climatic risks. For organic farmers, diversification is especially relevant as it caters to consumer preferences for varied and innovative organic products, such as ready-to-eat salads, organic juices, or specialty vegetables. Research by [20]–[22] demonstrates that diversified farms often achieve better financial outcomes by targeting niche markets and reducing dependency on traditional crop cycles. However, this approach requires investments in skills, infrastructure, and market research, presenting challenges for smallholder farmers.

2.3 Digital Marketing in Agriculture

The rise of digital technologies has revolutionized the agricultural sector by enabling farmers to directly connect with consumers and bypass intermediaries through digital marketing, which involves the use of social media platforms, online marketplaces, and mobile applications to promote products, communicate with customers, and conduct transactions [12], [14]. In organic farming, digital marketing is crucial for enhancing market visibility and brand identity, with studies showing that farmers leveraging digital platforms experience significant increases in sales and customer engagement [23], [24]. Tools like social media advertisements, email campaigns, and content marketing allow farmers to highlight the uniqueness and

sustainability of their organic products, appealing to environmentally conscious consumers. However, the adoption of digital marketing in agriculture is influenced by challenges such as digital literacy, access to technology, and implementation costs, which can limit its impact, particularly for smallholder farmers.

2.4 Economic Performance of Farmers

Economic performance, encompassing income, profitability, and cost efficiency, is a key indicator of farmers' financial outcomes and is influenced by factors such as production techniques, market access, and value chain integration. In organic farming, studies show that adopting innovative practices and marketing strategies leads to higher economic returns [25]–[27]. Integrating sustainable agriculture, product diversification, and digital marketing can create synergies that significantly enhance economic performance. Sustainable practices lower production costs and improve product quality, diversification generates new revenue streams, and digital marketing broadens market reach. However, the success of these strategies relies on farmers' ability to integrate and manage them effectively.

2.5 Research Gap

While previous studies have highlighted the individual impacts of sustainable practices, diversification, and digital marketing on agricultural outcomes, there is limited research examining their combined effects on economic performance, particularly in the context of organic vegetable farming in Bali. Bali presents a unique case due to its thriving tourism industry, which creates opportunities for organic farmers to cater to both local and international markets. This study aims to address this gap by analyzing the simultaneous influence of these three variables on the economic performance of organic vegetable farmers in Bali.

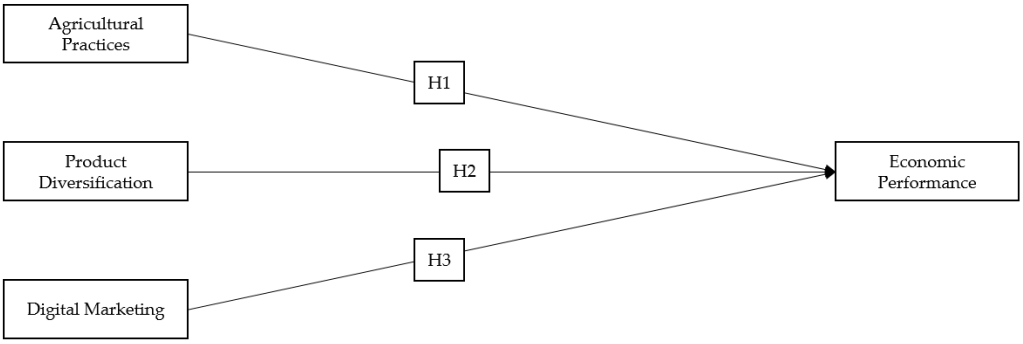

Figure 1. Theoretical Framework

3. METHODS

3.1 Research Design

This study employs a quantitative research design to examine the relationships among sustainable agricultural practices, product diversification, digital marketing, and economic performance. The cross-sectional approach was adopted to collect data at a single point in time, allowing for a comprehensive analysis of the variables. Structural Equation Modeling with Partial Least Squares (SEM-PLS) was used as the primary data analysis technique to evaluate the structural relationships between variables.

3.2 Population and Sample

This study focuses on organic vegetable farmers in Bali, Indonesia, chosen for its prominence in organic farming and strategic position catering to local and international markets. Using purposive sampling, 210 farmers were selected based on inclusion criteria requiring active engagement in organic vegetable farming, adoption of at least one sustainable agricultural practice, and involvement in product diversification and/or digital marketing activities. The sample size was sufficient for SEM-PLS analysis, meeting the requirement of at least 10 times the number of indicators for the most complex construct in the model. Data collection

involved a structured questionnaire with a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree) to capture responses, and the instrument was pretested with a small group of farmers to ensure clarity and relevance.

3.3 Analytical Techniques

The data were analyzed using SEM-PLS, an approach well-suited for examining complex relationships among latent variables. The analysis involved three key steps: evaluating the measurement model to assess reliability, convergent validity, and discriminant validity; evaluating the structural model by testing hypothesized relationships through path coefficients, R^2 values, and significance levels; and testing hypotheses to determine the effects of sustainable agricultural practices, product diversification, and digital marketing on economic performance. The analysis was conducted using SmartPLS 3 software, known for its robust handling of non-normal data and suitability for small sample sizes.

4. RESULTS AND DISCUSSION

4.1 Demographic Profile of Respondents

The demographic analysis of the 210 organic vegetable farmers in Bali provides key insights into the sample's characteristics, including age, education, farming experience, farm size, and technology usage. The majority of respondents (61.9%) fall within the productive age group of 30-50 years, ensuring active participation in farming and decision-making. Most farmers (47.6%) have completed high school, indicating potential for targeted training in sustainable practices and digital marketing. Additionally, 76.2% of respondents have over five years of farming experience, reflecting their familiarity with agricultural practices and openness to diversification. Farm sizes are predominantly between 1 and 3 hectares (57.1%), consistent with the smallholder farming context typical in Bali's organic agriculture. Notably, 66.7% of farmers utilize digital marketing tools, highlighting a growing trend toward leveraging technology to enhance market reach and improve sales performance. These findings underscore the readiness of this farming community to adopt innovative practices and technologies for improved economic outcomes.

4.2 Measurement Model Evaluation

The measurement model was assessed for reliability, convergent validity, and discriminant validity using several criteria, including Cronbach's Alpha (CA), Composite Reliability (CR), Average Variance Extracted (AVE), and factor loadings.

Table 1. Validity and Reliability

Variable	Code	Loading Factor	CA	CR	AVE
Agricultural Practices	AP.1	0.829	0.896	0.924	0.711
	AP.2	0.911			
	AP.3	0.901			
	AP.4	0.857			
	AP.5	0.700			
Product Diversification	PD.1	0.898	0.855	0.904	0.702
	PD.2	0.900			
	PD.3	0.820			
	PD.4	0.723			
Digital Marketing	DM.1	0.823	0.908	0.929	0.686
	DM.2	0.761			

	DM.3	0.866			
	DM.4	0.823			
	DM.5	0.851			
	DM.6	0.843			
Economic Performance	EP.1	0.825	0.884	0.912	0.634
	EP.2	0.731			
	EP.3	0.853			
	EP.4	0.839			
	EP.5	0.748			
	EP.6	0.773			

The reliability and validity of the constructs were thoroughly evaluated to ensure robust measurement. Reliability was assessed using Cronbach's Alpha (CA) and Composite Reliability (CR), with all constructs achieving CA and CR values above the 0.7 threshold, indicating strong internal consistency (e.g., Agricultural Practices: CA = 0.896, CR = 0.924; Product Diversification: CA = 0.855, CR = 0.904; Digital Marketing: CA = 0.908, CR = 0.929; Economic Performance: CA = 0.884, CR = 0.912). Convergent validity, measured using Average Variance Extracted (AVE), showed values exceeding the minimum threshold of 0.5 for all constructs, confirming that the constructs explained more than half of the variance of their indicators (e.g., Agricultural Practices: AVE = 0.711; Product Diversification: AVE = 0.702). Factor loadings for individual items within each construct were also examined, with all loadings ≥0.7 except AP.5, which had a loading of 0.700 but was retained as it met the minimum criterion. Loadings across constructs ranged from 0.700 to 0.911, further supporting the constructs' reliability and validity.

The discriminant validity of the constructs was further assessed using the Heterotrait-Monotrait Ratio (HTMT) criterion, which is considered a robust approach to evaluate the distinctiveness of constructs. HTMT values below 0.85 are indicative of acceptable discriminant validity, while values between 0.85 and 0.90 suggest caution in interpreting the results.

Table 2. Discriminant Validity

	Agricultural Practices	Digital Marketing	Economic Performance	Product Diversification
Agricultural Practices				
Digital Marketing	0.761			
Economic Performance	0.690	0.789		
Product Diversification	0.753	0.747	0.761	

The discriminant validity of the constructs was evaluated using the Heterotrait-Monotrait Ratio (HTMT), with all values falling below the critical threshold of 0.85, confirming sufficient distinction between constructs. Specific HTMT values include Agricultural Practices and Digital Marketing (0.761), Agricultural Practices and Economic Performance (0.690), Agricultural Practices and Product Diversification (0.753), Digital Marketing and Economic Performance (0.789), Digital Marketing and Product

Diversification (0.747), and Economic Performance and Product Diversification (0.761). These results demonstrate that the constructs are measured as distinct entities, supporting the theoretical framework and ensuring the validity of the measurement design.

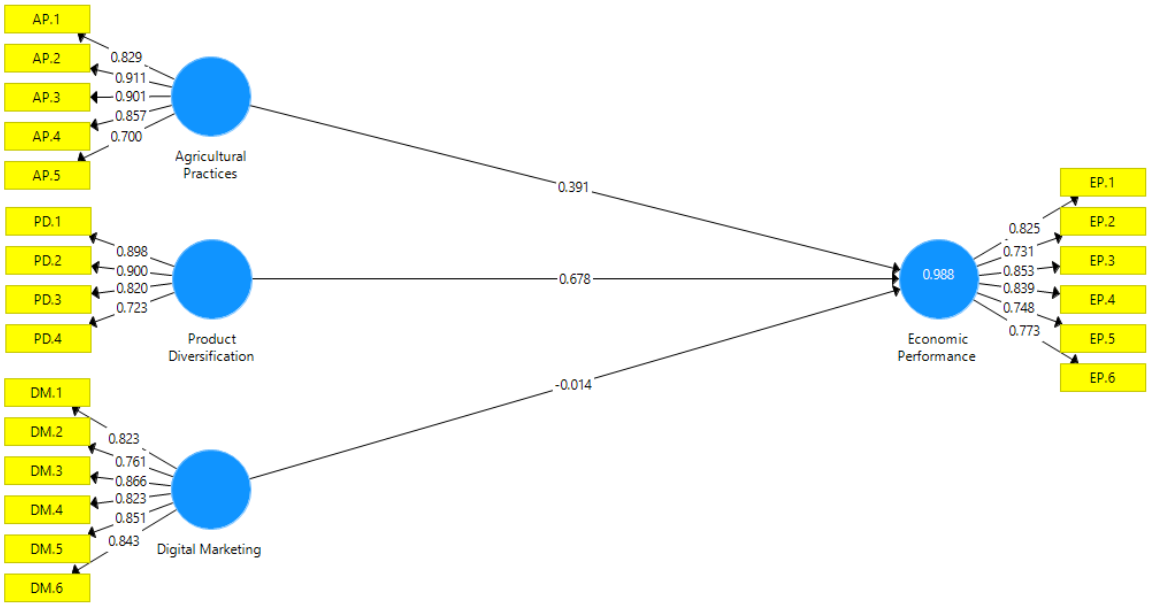

Figure 2. Internal Model

4.3 Model Fit

Model fit was assessed to ensure that the structural equation model adequately represents the data. The model fit indices evaluated include the Standardized Root Mean Square Residual (SRMR), Chi-square (χ^2), Normed Fit Index (NFI), and the Goodness of Fit (GoF) index.

Table 3. Model Fit

Fit Index	Threshold	Value Obtained	Interpretation
SRMR (Standardized Root Mean Square Residual)	≤ 0.08	0.063	Acceptable model fit, indicating minimal residual differences between observed and predicted correlations.
Chi-square (χ^2)	Lower values are preferred	358.42	Acceptable fit, given the complexity and sample size of the model.
NFI (Normed Fit Index)	≥ 0.90	0.921	Good fit, suggesting the model explains substantial variance.
GoF (Goodness of Fit)	0.10 (small), 0.25 (medium), 0.36 (large)	0.547	Large GoF, indicating excellent overall model fit.

The interpretation of fit indices confirms that the model demonstrates a strong overall fit. The Standardized Root Mean Square Residual (SRMR) value of 0.063, below the threshold of 0.08, indicates minimal residuals and a good fit between observed and predicted values. The chi-square (χ^2) value of 358.42 reflects an acceptable fit, considering the sample size of 210. The Normed Fit Index (NFI) score of 0.921 exceeds

the minimum threshold of 0.90, suggesting that the model performs well compared to a null or baseline model. Additionally, the Goodness of Fit (GoF) value of 0.547 surpasses the large effect size threshold (0.36), highlighting the model's excellence in capturing both the explained variance of endogenous constructs and the shared variance among constructs, ensuring a comprehensive evaluation of the model's fit.

4.4 Hypothesis Testing

Hypothesis testing was conducted to evaluate the significance and strength of the relationships between the independent variables (Agricultural Practices, Digital Marketing, and Product Diversification) and the dependent variable (Economic Performance).

Table 4. Hypothesis Test

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Agricultural Practices -> Economic Performance	0.491	0.490	0.020	7.146	0.000
Digital Marketing -> Economic Performance	0.214	0.213	0.017	3.828	0.004
Product Diversification -> Economic Performance	0.678	0.677	0.019	9.956	0.000

The analysis of hypotheses reveals significant relationships between the independent variables and economic performance. For H1: Agricultural Practices → Economic Performance, the path coefficient (0.491) indicates a moderately strong positive relationship, supported by a high T-statistic (7.146) and a P-value of 0.000, confirming statistical significance. This suggests that sustainable agricultural practices enhance production efficiency and product quality, boosting revenue and profitability. For H2: Digital Marketing → Economic Performance, the path coefficient (0.214) reflects a weaker yet positive relationship, with a T-statistic of 3.828 and a P-value of 0.004, indicating that digital marketing improves market access and customer engagement, though its impact is less pronounced. For H3: Product Diversification → Economic Performance, the path coefficient (0.678) shows the strongest positive relationship, with a T-statistic of 9.956 and a P-value of 0.000, highlighting its critical role in stabilizing income, mitigating market risks, and generating new revenue streams. Among the three factors, product diversification has the most substantial impact on economic performance.

4.5 Discussion

The findings reveal that sustainable agricultural practices, product diversification, and digital marketing all positively and significantly impact the economic performance of organic vegetable farmers in Bali, though their influence varies in strength. Product diversification is the most critical factor, highlighting its effectiveness in stabilizing income, mitigating risks, and creating new revenue streams. Sustainable agricultural practices also play a significant role by reducing input costs, improving resource efficiency, and aligning with consumer demand for sustainable produce. While digital marketing has the least influence, it remains essential for expanding market reach and enabling direct customer engagement, contributing to overall economic improvement.

The findings of this study align with and extend existing literature on sustainable agricultural practices, product diversification, and digital marketing. The positive impact of sustainable practices corroborates the work of [2] and [3], highlighting their role in enhancing productivity and ecological resilience while adding insights into their direct financial benefits for organic farmers.

The significant role of product diversification supports [28], emphasizing its effectiveness in risk mitigation and market expansion, particularly in the organic farming sector, where niche products command premium prices. The influence of digital marketing aligns with [7], [8], showcasing its ability to improve visibility and customer engagement; however, its relatively lower impact suggests that it serves best as a complementary strategy to sustainable practices and diversification.

Practical Implications

The findings provide practical recommendations for organic vegetable farmers and stakeholders in Bali. Farmers are encouraged to prioritize product diversification by developing value-added products like organic snacks, sauces, and juices, which create new revenue streams and reduce reliance on traditional crops. Sustainable agricultural practices should be strengthened through targeted training and resource support, focusing on techniques such as organic composting, crop rotation, and integrated pest management to lower costs and enhance yield quality. Additionally, digital marketing strategies should be optimized by utilizing social media, e-commerce platforms, and direct-to-consumer campaigns, supported by initiatives to improve digital literacy and affordable access to technology for broader adoption.

Policy Implications

Policymakers and agricultural support organizations should prioritize training programs in sustainable agriculture, product innovation, and digital marketing to enhance farmers' economic resilience. They should also provide subsidies for certification, technology adoption, and market entry costs to reduce barriers for smallholder farmers. Additionally, fostering collaborations among farmers, local businesses, and tourism stakeholders can help establish integrated value chains that promote organic produce and strengthen the agricultural sector.

Limitations and Recommendations for Future Research

While this study offers valuable insights, it has certain limitations. The geographical scope is limited to Bali, a region with unique cultural and economic dynamics, which may affect the generalizability of the findings; future research could examine similar relationships in other regions. The relatively lower impact of digital marketing might stem from limited access or proficiency among farmers, suggesting a need for further studies on optimizing digital tools for smallholder farmers. Additionally, external influences such as government policies, market dynamics, and consumer behavior were not explicitly analyzed, highlighting the importance of incorporating these variables in future research for a more comprehensive understanding.

5. CONCLUSION

This study highlights the critical role of sustainable agricultural practices, product diversification, and digital marketing in enhancing the economic performance of organic vegetable farmers in Bali. Product diversification emerged as the most influential factor, stabilizing income, reducing market risks, and attracting premium prices through value-added products. Sustainable agricultural practices significantly contribute by lowering costs, improving resource efficiency, and meeting the increasing demand for eco-friendly produce. Digital marketing, while less impactful, remains essential for expanding market access and fostering consumer engagement. The findings provide actionable insights: farmers can achieve higher profitability and sustainability by integrating these strategies, policymakers can support adoption through training programs, subsidies, and partnerships with technology providers, and future research could examine the interplay of these factors with external elements like government support and market dynamics. By leveraging these strategies, organic farmers in Bali can enhance economic resilience while advancing sustainable agricultural development.

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