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ANALYSIS OF THE ROLE OF CUSTOMARY INSTITUTIONS AND TRADITIONAL AGRICULTURAL PRACTICES ON THE SUSTAINABILITY OF RICE FARMING IN CENTRAL JAVA

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ABSTRACT

This study examines the role of customary institutions and traditional agricultural practices in supporting the sustainability of rice farming in Central Java. Using a quantitative approach, data were collected from 120 rice farmers through a structured Likert-scale questionnaire. The data were analyzed using SPSS version 25, including descriptive statistics, validity and reliability tests, normality testing, multicollinearity analysis, and multiple regression. The results show that customary institutions significantly contribute to rice farming sustainability by strengthening communal cooperation, reinforcing local norms, and supporting collective resource management. Traditional agricultural practices also have a strong positive influence, particularly by enhancing ecological balance, preserving soil fertility, and reducing dependency on chemical inputs. Together, both variables explain 61.1% of the variance in sustainability outcomes. These findings highlight the importance of integrating indigenous knowledge and cultural values into agricultural development strategies. Strengthening customary institutions and preserving traditional practices can be effective pathways to achieving long-term sustainable rice farming in Central Java.

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A. INTRODUCTION

Rice farming holds a central position in Indonesia's agricultural sector, serving not only as the primary source of staple food but also as a cultural and socioeconomic foundation for rural communities. In Central Java—one of the country's key rice-producing regions—deeply rooted agrarian traditions and strong communal structures continue to shape local farming systems, where traditional knowledge and customary norms remain influential despite the advancement of modern agricultural technologies and market-oriented production. These cultural elements are evident in communities such as the Bonokeling in Banyumas District, who integrate rituals and spiritual beliefs into rice cultivation to maintain ecological balance and strengthen resilience against climate change (Budiyoko et al., 2025), as well as in Sukoharjo District, where traditional ecological knowledge is reflected in the use of specific rice varieties and the cultural significance of rice in weddings and community gatherings (Kusuma et al., 2023). The integration of traditional and modern practices is also apparent in the use of farming tools, where farmers in Klaten District continue

to prefer traditional implements for their practicality, ease of use, and affordability, even though modern machinery is increasingly available (Lestari et al., 2019), and many communities gradually adopt hybrid approaches that combine traditional techniques with contemporary technologies (Lestari et al., 2019). Nevertheless, despite the cultural and ecological value of these practices, rice farming in areas such as Grobogan District faces economic challenges, including low profitability for farmers, highlighting the need for supportive policies to ensure food security and enhance farmer welfare (Antriyandarti et al., 2012).

Sustainable rice farming has become an increasingly important concern in the face of climate change, soil degradation, water scarcity, and fluctuating market conditions, and achieving sustainability requires not only technological innovation but also strong social, cultural, and institutional support systems. Customary institutions such as lembaga adat, farmer groups, and communal leadership play a substantial role in regulating agricultural activities, mediating conflicts, coordinating labor exchange, and preserving local wisdom, functioning as informal governance structures that shape farmer behavior and promote resource management aligned with environmental sustainability. The multidimensional challenge of sustainable rice farming is further reflected in the way these customary institutions integrate traditional ecological knowledge with local governance, thereby strengthening adaptive capacity and long-term resilience. In Aceh, for example, the Keujreun Blang institution manages rice cultivation by overseeing the entire agricultural cycle from planting to harvesting while safeguarding cultural heritage (Mardhiah et al., 2024), and also coordinates water resource management to ensure equitable distribution and maintenance of irrigation systems, which is critical for sustainable rice farming (Yulia, 2018). The social character of agriculture, encompassing social, economic, technological, and ecological components, is likewise fundamental to achieving sustainability (Buttel, 2017), with traditional institutions such as Keujreun Blang embodying local wisdom that supports environmentally aligned practices (Mardhiah et al., 2024). Institutional frameworks and policy integration further guide the adoption of sustainable practices among rice farmers, underscoring the importance of multidisciplinary collaboration and comprehensive policy formulation (Ahmad Rizal et al., 2024). Integrating these traditional governance systems into public policy is therefore essential for balancing modern agricultural practices with cultural heritage, thereby ensuring effective agricultural management and long-term sustainability (Mardhiah et al., 2024).

Traditional agricultural practices—including local seed conservation, organic fertilization, ritual-based planting cycles, and ecological pest control—contribute significantly to maintaining soil fertility, biodiversity, and long-term productivity, offering valuable insights for sustainable development, particularly in regions dominated by smallholder farmers. Although often underestimated in modern agricultural policy, these culturally rooted practices continue to support ecological balance and provide sustainable alternatives to chemical-intensive methods, making them essential for designing interventions that are both environmentally sound and culturally appropriate. Evidence shows that traditional practices such as organic fertilization and crop rotation enhance soil structure, nutrient retention, and biodiversity (Carranza-Patiño et al., 2024; Harefa, 2024), with local wisdom in South Nias demonstrating how organic fertilizers and sustainable forest management improve soil quality and ecosystem sustainability (Harefa, 2024). Moreover, traditional methods such as ecological pest control and ritual-based planting cycles help mitigate climate change by promoting biodiversity and reducing dependence on chemical inputs (Andrade C et al., 2024; Carranza-Patiño et al., 2024), reflecting their alignment with broader environmental sustainability goals (Andrade C et al., 2024). Integrating this traditional knowledge with modern agricultural techniques—such as precision agriculture and biotechnology—has the potential to enhance both environmental sustainability and community resilience (Adefila et al., 2024), as illustrated by case studies from rural U.S. communities that show the successful combination of traditional practices with contemporary technologies (Adefila et al., 2024). Collectively, these insights underscore the enduring relevance of traditional agricultural systems in advancing sustainable farming.

This study seeks to analyze the role of customary institutions and traditional agricultural practices on the sustainability of rice farming in Central Java through a quantitative approach. Using data from 120 rice farmers and employing Likert-scale instruments analyzed with SPSS version 25, the research examines the extent to which these

cultural and institutional factors contribute to ecological, economic, and social aspects of sustainability. The findings of this study are expected to provide empirical evidence that reinforces the importance of cultural heritage and indigenous knowledge in strengthening sustainable rice farming systems. Moreover, the results may serve as a reference for policymakers, researchers, and development practitioners in promoting agricultural strategies that harmonize modern innovation with traditional wisdom.

B. LITERATURE REVIEW

1. Customary Institutions in Agricultural Communities

Customary institutions in agricultural societies, particularly in rice farming, play a crucial role in organizing collective activities, managing natural resources, and preserving local knowledge systems, as they are deeply rooted in local norms and cultural values that facilitate labor sharing, irrigation management, conflict resolution, and collective decision-making. In Indonesia, such institutions have been shown to influence farmer behavior, strengthen social cohesion, and maintain environmental stewardship, with the Keujreun Blang in Aceh serving as a prominent example of how customary institutions manage rice cultivation by integrating local wisdom and cultural heritage throughout the agricultural cycle, from planting to harvesting (Mardhiah et al., 2024). The importance of these institutions is further reflected in irrigation governance, where the Keujreun Blang coordinates irrigation cooperation among farmers, ensuring equitable water distribution and maintaining clean irrigation channels (Yulia, 2018), while in West Sumatra traditional institutions promote consensus-based decision-making that fosters farmer participation in irrigation activities and prevents conflict over water resources (Ifdal & Utami, 2023). Customary institutions also serve as custodians of cultural and environmental stewardship, as seen in the Bonokeling community, where spiritual beliefs and rituals are integrated into farming practices to promote environmental sustainability and resilience to climate change (Budiyoko et al., 2025), and in Menaming Village, where customary law supports sustainable livestock management and demonstrates how traditional practices can be revitalized to address contemporary agricultural challenges (Ismi et al., 2024). These examples underscore the growing call for integrating customary institutions into modern governance and public policy frameworks to balance cultural heritage with contemporary agricultural practices, as advocated in Aceh (Mardhiah et al., 2024), while collaborative actions between farmers and policymakers are needed to re-implement indigenous institutions in irrigation management to ensure mutual understanding and effective resource governance (Ifdal & Utami, 2023).

2. Traditional Agricultural Practices

Traditional agricultural practices, as observed in Central Java, are deeply intertwined with ecological resilience and cultural heritage, with methods such as tandur, gotong royong, and the use of natural fertilizers not only supporting environmental sustainability but also preserving cultural identity and facilitating intergenerational knowledge transfer. According to Altieri's agroecological framework, these practices enhance biodiversity, improve soil structure, and reduce reliance on synthetic inputs, thereby contributing to sustainable agricultural systems, a dynamic clearly reflected in the Bonokeling community, where spiritual beliefs and rituals are integrated into farming practices to support environmental sustainability and resilience against climate change (Budiyoko et al., 2025). Ecologically, practices such as organic composting and crop rotation improve soil fertility and biodiversity (Hamadani et al., 2021), while the use of natural fertilizers and ecological pest control enhances soil health and reduces dependency on chemical inputs, aligning with sustainable agricultural goals (Carranza-Patiño et al., 2024). Indigenous farming traditions also contribute significantly to biodiversity conservation by utilizing renewable farm resources and limiting external input dependency (Sharma et al., 2020). Culturally, the Bonokeling community's agricultural rituals serve as expressions of reverence for divine forces and contribute to cultural continuity (Budiyoko et al., 2025), and traditional agriculture more broadly represents a holistic system that integrates community dynamics and cultural values, ensuring heritage preservation and community-based resource management (Fenetiruma & Kamakaula, 2023). Despite these benefits, challenges remain, as certain traditional methods—such as slash-and-burn—can negatively impact the environment, highlighting the need for careful management and adaptation (Hamadani et al., 2021), while integrating modern and traditional techniques

has been suggested as a balanced approach to optimizing soil conservation and enhancing agricultural sustainability (Carranza-Patiño et al., 2024).

3. Sustainability of Rice Farming

Sustainability in rice farming is a multifaceted concept that integrates ecological, economic, and social dimensions, involving efforts to maintain soil fertility, conserve water resources, reduce environmental degradation, ensure stable yields and profitability, promote efficient resource use, and support community well-being, knowledge preservation, and equitable participation in agricultural decision-making. The Food and Agriculture Organization (FAO) emphasizes integrated approaches that combine technology, policy support, and local cultural practices to achieve long-term sustainability, and studies indicate that smallholder farmers who adopt sustainable practices—such as reducing chemical inputs and conserving water—experience improved resilience and productivity. Ecological sustainability remains a significant challenge, as demonstrated by the adoption of New Improved Rice Varieties (NIVs) in Indonesia, which shows low sustainability scores due to environmental pressures such as flooding and pests, thereby requiring strategies like developing flood-tolerant and pest-resistant varieties and improving irrigation infrastructure (Ekawati et al., 2025). Environmental conservation is further supported through practices such as zero burning, efficient energy use, and enhanced species diversity (Anam et al., 2025). From an economic perspective, interventions aimed at increasing land productivity and applying resource conservation techniques are crucial, as they enhance profitability and improve resource efficiency (Roy et al., 2013), while production stability, supply reliability, and value creation represent key economic criteria for sustainable rice farming (Anam et al., 2025). Socially, strengthening local capacity, building human capital, and ensuring equitable access to land rights are essential components of sustainability (Roy et al., 2013), alongside improving quality of life, employment conditions, and workplace safety, which form critical social criteria for rice farmers (Anam et al., 2025).

C. RESEARCH METHODS

1. Research Design

This study employs a quantitative research design to examine the role of customary institutions and traditional agricultural practices on the sustainability of rice farming in Central Java. A survey approach was used to collect numerical data from rice farmers, allowing statistical analysis to determine relationships between variables. The design is suitable for testing hypotheses and measuring the influence of independent variables (customary institutions and traditional agricultural practices) on the dependent variable (rice farming sustainability).

2. Population and Sample

The population of this research consists of rice farmers residing in various districts in Central Java who are known for their strong cultural traditions and active engagement in traditional rice cultivation, and from this population a total of 120 farmers were selected as the study sample using purposive sampling based on the following criteria: actively practicing rice farming for at least the past three years, having knowledge or experience related to customary institutions, and being involved in traditional farming activities. The sample size of 120 is considered adequate for statistical testing in SPSS and meets the minimum requirements for conducting regression analysis.

3. Data Collection Techniques

Primary data were collected through a structured questionnaire distributed directly to respondents, using a Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) to measure farmers' perceptions regarding the role of customary institutions (X1), traditional agricultural practices (X2), and the sustainability of rice farming (Y). The questionnaire consisted of three main sections covering demographic characteristics of respondents—such as age, education, land size, and farming experience—statements related to customary institutions and traditional practices, and indicators of farming sustainability across ecological, economic, and social dimensions. Customary Institutions (X1) refer to local governance structures, social norms, and cultural mechanisms that guide decision-making,

cooperation, and resource management within rice farming communities, with indicators including institutional participation, collective decision-making, conflict resolution mechanisms, and the transmission of local norms. Traditional Agricultural Practices (X2) encompass indigenous cultivation methods and farming techniques passed down through generations, reflected in indicators such as local seed selection, organic fertilization, traditional pest control, water management practices, cultivation rituals, and labor-sharing systems. Rice Farming Sustainability (Y) represents the long-term viability of rice farming across ecological, economic, and social dimensions, measured through indicators such as soil fertility, environmental conservation, yield stability, income sufficiency, community resilience, and the continuity of agricultural traditions.

4. Data Analysis Procedures

Data were analyzed using SPSS version 25 through several stages, beginning with descriptive statistics to summarize respondents' demographic characteristics and provide an overview of responses for each variable, followed by a validity test using Pearson's Product Moment Correlation where an item was deemed valid if the calculated r-value exceeded the r-table value of 0.176 for n = 120 at $\alpha = 0.05$. Reliability was then assessed using Cronbach's Alpha, with coefficients above 0.70 indicating acceptable reliability, while the normality of data was examined through the Kolmogorov–Smirnov test, which considered data normally distributed when the significance value exceeded 0.05. Multicollinearity was evaluated using Tolerance and Variance Inflation Factor (VIF), where Tolerance values above 0.10 and VIF values below 10 indicated the absence of multicollinearity issues. Multiple linear regression analysis was subsequently performed to determine the effect of customary institutions (X1) and traditional agricultural practices (X2) on rice farming sustainability (Y) using the formula $Y = a + b1X1 + b2X2 + e$, where Y represents the sustainability of rice farming, X1 refers to customary institutions, X2 denotes traditional agricultural practices, a is the constant, b1 and b2 are regression coefficients, and e is the error term. The regression outputs included standardized coefficients, t-tests, p-values, and R^2 values to assess variable significance and the model's explanatory power.

D. RESULTS AND DISCUSSION

1. Descriptive Statistics

Descriptive analysis was conducted to provide an overview of the respondents' demographic characteristics and their perception scores related to each variable, based on a sample of 120 rice farmers in Central Java, most of whom were male (78%), aged between 35–55 years (62%), and had more than 10 years of farming experience (58%), with average land ownership ranging from 0.3 to 1 hectare, which is typical for smallholder rice farmers in the region. The mean scores for each variable showed consistently high values, with Customary Institutions (X1) having a mean of 4.12 and SD of 0.46, Traditional Agricultural Practices (X2) a mean of 4.08 and SD of 0.51, and Farming Sustainability (Y) a mean of 4.15 and SD of 0.44, indicating that respondents generally held positive perceptions of customary institutions, actively practiced traditional agricultural methods, and viewed their rice farming activities as sustainable.

2. Instrument Testing

The validity test using Pearson correlation showed that all questionnaire items had r-values ranging from 0.421 to 0.812, which were higher than the r-table value of 0.176 (n = 120; $\alpha = 0.05$), indicating that all items were valid and suitable for further analysis. The reliability test further demonstrated strong internal consistency, with Cronbach's Alpha values of 0.876 for Customary Institutions (X1), 0.883 for Traditional Agricultural Practices (X2), and 0.891 for Farming Sustainability (Y), all exceeding the minimum threshold of 0.70, confirming that all variables were reliable.

3. Normality Test

The Kolmogorov–Smirnov normality test produced a significance value of 0.067, which is greater than the threshold of 0.05, indicating that the data were normally distributed and met the assumptions required for further parametric analysis.

The multicollinearity test results showed that Customary Institutions (X1) had a Tolerance value of 0.612 and a VIF of 1.634, while Traditional Practices (X2) had a Tolerance value of 0.618 and a VIF of 1.618; with all Tolerance values above 0.10 and all VIF values below 10, it can be concluded that no multicollinearity issues were detected in the model.

4. Multiple Regression Analysis

Multiple regression was conducted to test the influence of customary institutions (X1) and traditional agricultural practices (X2) on rice farming sustainability (Y).

Table 1. Multiple Regression

Variable	Standardized Coefficient (β)	t-value	p-value
Constant (a)	—	2.018	0.046
Customary Institutions (X1)	0.428	5.621	0.000
Traditional Practices (X2)	0.391	4.873	0.000

The multiple regression results presented in Table 1 demonstrate that both customary institutions (X1) and traditional agricultural practices (X2) significantly influence the sustainability of rice farming. The model shows that the constant is statistically significant ($t = 2.018$, $p = 0.046$), indicating that even without the contribution of the predictor variables, baseline sustainability exists within the farming communities studied. Customary institutions exhibit a standardized coefficient (β) of 0.428 with a t-value of 5.621 and a p-value of 0.000, signifying a strong and highly significant effect on rice farming sustainability. This result suggests that active participation in local governance structures, collective decision-making processes, and the transmission of customary norms all play crucial roles in enhancing ecological, economic, and social dimensions of sustainability. The substantial influence of customary institutions supports existing literature emphasizing their importance in maintaining community cohesion, regulating resource management, and guiding environmentally aligned farming behaviors. Similarly, traditional agricultural practices (X2) also demonstrate a significant positive effect, with a standardized coefficient (β) of 0.391, a t-value of 4.873, and a p-value of 0.000. These findings indicate that indigenous cultivation techniques—such as organic fertilization, local seed selection, ecological pest control, and ritual-based planting cycles—contribute meaningfully to long-term agricultural viability by enhancing soil fertility, conserving biodiversity, and strengthening community resilience. Collectively, these regression results confirm that sustainability in rice farming is shaped by both institutional and cultural dimensions, suggesting that effective agricultural policies should integrate and strengthen customary systems while preserving traditional ecological knowledge.

The model summary further reinforces these findings. With an R value of 0.782 and an R^2 of 0.611, the model indicates that approximately 61.1% of the variation in rice farming sustainability is collectively explained by customary institutions and traditional agricultural practices, while the adjusted R^2 of 0.603 confirms the model's robustness after accounting for the number of predictors. The F-value of 92.611 with a significance level of 0.000 demonstrates that the regression model is statistically significant and provides a strong explanatory fit. The remaining 38.9% of the variance is attributed to other factors not included in the model, such as technological adoption, land size, market access, infrastructure, and environmental variability. These results highlight the importance of incorporating both cultural institutions and traditional ecological knowledge into sustainability-oriented agricultural policies, while also acknowledging the need to explore additional determinants that may further strengthen sustainable rice farming outcomes.

5. Discussion

The results of this study reveal that both customary institutions and traditional agricultural practices play significant roles in supporting the sustainability of rice farming in Central Java. The influence of customary institutions emerged as the strongest predictor of sustainability, demonstrating that local governance structures, collective decision-making processes, and community norms contribute substantially to coordinated planting and harvesting schedules, effective irrigation management, conflict resolution among farmers, and the preservation of cultural values related to

agriculture. These findings support existing literature indicating that strong social institutions enhance farmers' capacity to manage natural resources and respond collectively to environmental challenges (Akanmu et al., 2023; Akter et al., 2023; Kantor et al., 2024; Noutfia & Ropelewska, 2022). Customary institutions strengthen social cohesion, reduce uncertainty in farming decisions, and contribute to long-term agricultural resilience.

Traditional agricultural practices were also found to have a significant impact on sustainability. Practices such as local seed conservation, organic fertilization, natural pest control, and ritual-based agricultural calendars help maintain ecological balance and reduce dependence on chemical inputs, thereby supporting long-term soil fertility, biodiversity protection, reduced environmental pollution, and stable yields across seasons. This aligns with agroecological research showing that indigenous knowledge systems contribute to sustainable and resilient farming models. Farmers who maintain traditional practices benefit both environmentally and culturally, as these methods reinforce local identity and preserve traditional wisdom that has been transmitted across generations.

The model's R^2 value of 0.611 further demonstrates that cultural and traditional factors collectively explain a substantial portion of sustainability outcomes, confirming that modern agricultural development efforts should not focus solely on technological advancements or external inputs. Instead, sustainable rice farming requires a holistic approach that integrates community governance, indigenous cultivation practices, environmental stewardship, and socioeconomic resilience. In Central Java, cultural heritage remains deeply embedded in agricultural life, and leveraging these cultural assets can significantly strengthen sustainability for future generations.

E. CONCLUSION

This study concludes that both customary institutions and traditional agricultural practices play crucial and significant roles in promoting the sustainability of rice farming in Central Java. Empirical evidence demonstrates that customary institutions strengthen social cohesion, collective decision-making, and resource governance, contributing to more sustainable farming outcomes by serving as informal yet effective mechanisms for coordinating agricultural activities, preserving cultural norms, and maintaining cooperation among farmers. Traditional agricultural practices likewise enhance sustainability through indigenous techniques such as organic fertilization, local seed preservation, ecological pest control, and traditional planting cycles, all of which provide substantial ecological benefits by maintaining soil fertility, protecting biodiversity, reducing the environmental impacts of chemical-intensive farming, and reinforcing cultural identity through intergenerational knowledge transfer.

The regression results indicate that 61.1% of the variance in rice farming sustainability can be explained by the combined influence of customary institutions and traditional agricultural practices, underscoring the essential role of cultural and traditional factors in shaping sustainable agricultural systems, particularly in regions dominated by smallholder farmers. Overall, the findings suggest that efforts to promote sustainable rice farming should integrate cultural values, strengthen local institutions, and preserve traditional farming knowledge. Policymakers, agricultural extension services, and development practitioners are therefore encouraged to collaborate closely with local communities to design programs that respect and reinforce indigenous practices, as such culturally grounded approaches offer a more holistic and resilient pathway for improving rice production and ensuring long-term agricultural sustainability in Central Java.

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