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Rice Competitiveness Enhancement Fund (RCEF) mechanization and the financial impact on the farmers

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Abstract

This study investigated the benefits of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization and financial impact on rice farmers in Rizal and Occidental Mindoro, focusing on mechanization and capacity-building. Utilizing an exploratory sequential research design, a total of 243 rice farmers served as respondents, with primary data collected through in-depth interviews and validated questionnaires analyzed using thematic coding and statistical measures. Findings indicate that the program yielded very high benefits, enhancing farm productivity, operational efficiency, and technical competence. Financial outcomes were similarly significant, demonstrating notable reductions in production costs and increases in farmers' income. Correlational analysis further revealed that mechanization strongly influences financial performance, while capacity-building contributes significantly to operational effectiveness. Based on these insights, recommendations include establishing cooperative-based machinery management systems, sustaining technical training programs, implementing digital monitoring mechanisms, and strengthening coordination among farmers' cooperatives, local government units, and agencies such as PhilMech and the Agricultural Training Institute. The results provide evidence-based guidance for policymakers, practitioners, and future researchers seeking to improve the efficiency, sustainability, and economic resilience of rice farming through targeted mechanization and capacity-building interventions.

Keywords: Rice Competitiveness Enhancement Fund (RCEF), mechanization, financial impact, enhancing farm productivity, operational efficiency

Rice Competitiveness Enhancement Fund (RCEF) mechanization and the financial impact on the farmers

1. Introduction

The agricultural sector is a cornerstone of the Philippine economy, contributing approximately 10% to the country's Gross Domestic Product (GDP) and employing around 25% of the labor force (Philippine Statistics Authority, 2023). Within this sector, farmer associations and cooperatives play a crucial role in enhancing productivity, facilitating access to resources, and improving market competitiveness for smallholder farmers. These entities serve as vital support systems, enabling farmers to pool resources, share knowledge, and access markets more effectively. However, they often face significant challenges, including limited access to modern agricultural technology, inadequate financial resources, and insufficient training and capacity-building opportunities (Agustin et al. 2021).

The Philippines is characterized by a diverse agricultural landscape, with rice being a staple crop and a primary source of livelihood for millions of Filipinos. The country ranks among the world's largest rice importers, underscoring the need to increase domestic production to achieve food security and self-sufficiency (Philippine Statistics Authority, 2023). The reliance on traditional farming methods has led to low productivity, making it imperative to modernize the agricultural sector through mechanization and technological advancements. The introduction of modern machinery and equipment is essential for improving efficiency, reducing labor costs, and increasing crop yields.

To address these challenges, the Philippine government established the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program in 2019, as part of the Rice Tariffication Law. The program aims to modernize the rice farming sector by providing financial support for acquiring modern machinery and equipment, thereby enhancing the operational capabilities of farmer associations and cooperatives (Department of Agriculture, 2021). The RCEF Mechanization Program is particularly relevant in regions such as Rizal and Occidental Mindoro, where rice farming is a primary source of income for many households. In these areas, mechanization can significantly improve productivity and reduce labor costs (Lahaylahay & Tongol, 2025). Research indicates that agricultural mechanization can lead to substantial improvements in productivity. For instance, a study by Villanueva et al. (2020) found that the introduction of modern machinery led to an average 20% increase in yield among farmer cooperatives in the region. This increase in yield is critical to enhancing food security and improving farmers' livelihoods. Additionally, the study highlighted that mechanization reduced the time required for land preparation and harvesting, allowing farmers to allocate their labor more efficiently. Furthermore, Avila et al. (2025) emphasized the role of cooperatives in facilitating access to technology and financial resources, which are critical for the successful adoption of mechanization.

The RCEF Mechanization Program not only aims to enhance productivity but also to empower farmer associations and cooperatives by providing them with the tools and resources needed to thrive in a competitive agricultural landscape. By investing in modern machinery, the program aims to foster an environment in which smallholder farmers can increase their production capacity, improve their incomes, and ultimately contribute to the overall economic development of their communities (Arbes et al., 2024).

In addition to the economic benefits, the RCEF Mechanization Program is expected to have social implications, such as improving the quality of life for farmers and their families. By reducing the physical labor associated with traditional farming practices, mechanization can lead to better working conditions and increased time for education and community engagement. Moreover, the program aligns with the government's broader goals of promoting sustainable agricultural practices and enhancing resilience to climate change. In conclusion, this study begins with a national perspective—anchored in the legal and developmental vision of Republic Act 11203, which seeks to

modernize the rice sector through mechanization—and narrows to a local perspective, focusing on how these reforms unfold in Rizal, Occidental Mindoro. By examining the real impact of RCEF mechanization on the ground, this study bridges the gap between policy and practice, ensuring that modernization is not only a national goal but also a lived reality for local farmers. Ultimately, the study aspires to contribute toward a more inclusive, efficient, and sustainable rice industry—one that empowers even the smallest farming communities to become truly competitive in the modern agricultural economy.

Statement of the Problem - This study aimed to determine the Rice Competitiveness Enhancement Fund (RCEF) Mechanization and its financial impact on the farmer-members of cooperatives in the Municipality of Rizal, Occidental Mindoro. Specifically, this study sought to answer the following questions: (1) What are the benefits of implementing the Rice Competitiveness Enhancement Fund (RCEF) for farmers in Rizal, Occidental Mindoro? (2) What is the extent of the benefits of implementing the RCEF program for farmers in terms of Mechanization and Capacity Building? (3) What is the level of the financial impact of the RCEF program on the farmers in terms of Production costs, income, and Rice Extension Services? (4) Is there a significant relationship between the extent of the benefits in implementing the RCEF Program and its financial impact on the farmers in terms of Production costs, income, and Rice Extension Services? (5) What programs can be applied to sustain the RCEF Mechanization Program?

Significance of the Study - This study is of considerable importance, as it examines the socio-economic and financial implications of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program within the farming sector. By grounding its analysis on actual field conditions, the study provides meaningful insights into how mechanization shapes productivity, cost efficiency, and income stability among farmers. For individual farmers, the findings provide a practical basis for assessing whether and how mechanized interventions translate into tangible improvements in farm operations and household welfare and for identifying areas where further support may be necessary to reduce production costs and enhance profitability. For Farmer Cooperatives and Associations (FCAs), the study serves as a reflective tool to evaluate their participation and operational effectiveness in delivering mechanization services. It highlights opportunities to strengthen institutional arrangements, improve resource management, and sustain shared services that can amplify collective gains. In the context of local governance, the Municipal Local Government Unit (MLGU) of Rizal, Occidental Mindoro, may use the study's findings as an empirical basis to design more responsive and targeted agricultural support programs. This includes the potential integration of complementary interventions through local policies that address gaps in access, financing, and technical support for smallholder farmers.

At the program implementation level, the Philippine Center for Postharvest Development and Mechanization may benefit from the study as it provides grounded feedback on the actual performance and reach of mechanization initiatives, particularly in assessing whether intended outcomes are realized at the community level. Similarly, the Agricultural Training Institute may draw on the study to evaluate the effectiveness of its capacity-building efforts, particularly to ensure that farmers and cooperatives possess the technical competence to maximize the benefits of mechanization. More broadly, the study contributes to the continuing discourse on agricultural modernization and rural development by identifying persistent constraints and emerging opportunities within mechanization programs. It underscores the need for a more integrated approach that aligns technology provision with institutional support and capacity development. For future researchers, this study provides a relevant reference point for further inquiry into agricultural mechanization, policy evaluation, and rural transformation, offering both empirical data and contextual insights that can inform subsequent studies. Ultimately, the study aspires to support the development of a more efficient, inclusive, and resilient agricultural sector.

Scope and Delimitation of the Study - This study centers on the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program and its financial implications for cooperative farmer-members in the Municipality of Rizal, Occidental Mindoro. It examines how access to mechanization support influences key economic variables—particularly production costs, farm income, and overall financial outcomes—within the context of organized farmer groups. In addition, the study considers the extent to which the program is implemented at the

local level, including the provision of machinery and the conduct of training and capacity-building activities intended for farmer-members. The study was undertaken from August 1, 2025, to February 28, 2026, a period that captures crucial stages of the rice production cycle, specifically harvest operations and land preparation for the succeeding cropping season. This timing allowed the researcher to observe how mechanization is applied in actual farm settings and to assess its immediate implications on efficiency, labor dynamics, and cost management. While this timeframe bounded data collection, respondents, in some instances, drew on prior experiences, offering a more nuanced understanding of mechanization practices over time.

To provide both depth and analytical rigor, the study adopted an exploratory-sequential research design. The qualitative phase involved in-depth interviews with 20 key informants, including cooperative leaders, farmer members, and local agricultural stakeholders, to elicit practical insights and lived experiences regarding program implementation. These narratives informed the subsequent quantitative phase, where structured survey instruments were administered across five cooperatives. The sample size was proportionally determined to ensure that farmer-members were adequately represented. This combination of approaches enabled the study to capture not only measurable trends but also the underlying realities shaping those outcomes. The study is deliberately confined to farmer members of cooperatives in Rizal and Occidental Mindoro. As such, the findings reflect the conditions, experiences, and financial outcomes specific to this group. Farmers who operate independently of cooperatives, as well as other support programs beyond mechanization, fall outside the scope of this inquiry. Similarly, the study does not attempt to conduct long-term cost–benefit analyses of mechanization investments; instead, it focuses on observable financial effects within the study period.

Certain constraints are acknowledged. Limitations in time, resources, and access to complete financial records may have influenced the extent of data gathered. Differences in farm size, access to machinery, and management practices among respondents also introduce variability in outcomes. External factors—such as weather disturbances, input price fluctuations, and shifting market conditions—may have further shaped the financial results reported by farmer-members. Given these considerations, the findings should be interpreted within the specific context of Rizal and may not be directly generalized to other areas with differing agricultural and institutional environments.

2. Methodology

Research Design - This study employed an exploratory sequential design to assess the impact of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program on farmers in the Municipality of Rizal, Occidental Mindoro. The exploratory sequential design is a mixed-method research approach in which qualitative data collection and analysis are conducted first, followed by quantitative data collection and analysis. This approach allowed the researcher to initially explore the participants' experiences and perspectives and subsequently examine the findings using quantitative data from a larger group (Creswell & Plano Clark, 2018). The research began with a qualitative exploratory phase to gain an in-depth understanding of the farmers' experiences of the mechanization program. The themes and insights from the survey formed the basis for identifying key variables used in the quantitative phase to measure the extent and impact of the RCEF Program.

Respondents of the Study - The study respondents consisted of officers and members of Farmer Cooperatives and Associations (FCAs) who were direct beneficiaries of the RCEF Mechanization Program. For the qualitative phase, twenty (20) key participants were purposively selected from the list of trial respondents, including cooperative leaders, machine operators, and local agricultural stakeholders, to obtain a broad range of perspectives and experiences related to mechanization, training, and farm operations. For the quantitative phase, a sample size of 243 respondents was determined using the Raosoft sample size calculator to ensure adequate representation of the population. The target population consisted of 618 cooperative officers and farmer-members who were directly involved in mechanized rice production and post-harvest activities across RCEF-assisted cooperatives in the Municipality of Rizal, Occidental Mindoro. A 95% confidence level and a 5% margin of error were applied in the computation, with a 50% response distribution used to maximize the reliability of the sample size.

Research Instrument - To generate a comprehensive assessment of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program, this study utilized both qualitative and quantitative research instruments consistent with its exploratory-sequential design. For the qualitative phase, an approved interview guide consisting of one open-ended question was administered to twenty (20) selected participants, including farmer-members, cooperative officers, and key agricultural stakeholders. This enabled the respondents to articulate their experiences, insights, and observations regarding the implementation of mechanization interventions and their corresponding financial implications. The responses were analyzed using thematic analysis to identify recurring patterns and to establish core themes relevant to the study. The variables explored in this phase focused on access to and utilization of mechanization, capacity-building experiences, and perceived financial outcomes.

For the quantitative phase, a researcher-developed questionnaire was used to systematically collect data from farmer members. The instrument was structured into two main parts. The first part focused on the level of implementation of the RCEF Mechanization Program, particularly regarding mechanization support and capacity-building initiatives. The second part examined the program's financial impact, specifically regarding production costs, income, and rice extension activities. Each construct was represented by multiple indicators designed to capture the breadth of program effects on farm operations and economic performance. Respondents were asked to rate each item using a four-point Likert scale: (4 – Strongly Agree; 3 – Agree; 2 – Disagree; 1 – Strongly Disagree). To ensure consistency in interpretation, corresponding verbal descriptions were assigned to the computed mean scores: 3.25–4.00 was interpreted as Strongly Agree (Very High); 2.50–3.24 as Agree (High); 1.75–2.49 as Disagree (Low); and 1.00–1.74 as Strongly Disagree (Very Low). This scaling framework provided a clear and systematic basis for interpreting the extent of program implementation and its financial effects.

The researcher-made instrument underwent content validation by five (5) experts to ensure its relevance, clarity, and alignment with the objectives of the study. The validators included two Agricultural Extension Managers—one from the Municipal Agriculture Office of Rizal and one from the Department of Agriculture for Occidental Mindoro—as well as three faculty members from the Graduate School of Divine Word College of San Jose. Their comments and recommendations were carefully reviewed and incorporated into the final version of the questionnaire. Following validation, the researcher secured permission from the appropriate local authorities and cooperative leaders to conduct a reliability test. The questionnaire, consisting of forty (40) items distributed across five constructs—Mechanization, Capacity Building, Production Costs, Income, and Rice Extension Services—was pilot-tested among thirty (30) respondents who were not included in the final survey. The instrument was administered once, and its internal consistency was evaluated using Cronbach's Alpha. This method was employed to determine the degree to which the items within each construct were closely related and reliably measured the intended variables. The resulting coefficients indicated acceptable levels of reliability, confirming that the instrument was suitable for full-scale data collection. The computed reliability coefficients are presented in the succeeding table.

Table 1
Result of Reliability Analysis

Indicators	Number of Items	Reliability Coefficients	Interpretation
RCEF Program			
Mechanization	8	.948	Very High Reliability
Capacity Building	8	.948	Very High Reliability
Financial Impact			
Production Costs	8	1.000	Excellent Reliability
Income	8	.934	Very High Reliability
Rice Extension Services	8	.943	Very High Reliability

**Based on Standardized Items

The scales for the five components yielded Cronbach's Alpha values ranging from 0.934 to 0.948, indicating very high internal consistency. The standardized Alpha values also suggested that the items had similar variances and contributed effectively to the overall constructs. The Production Cost scale showed a perfect correlation, with each item correlating perfectly (1.000) with every other item. Although such perfect correlation is uncommon, it indicates that the data points for these items were identical across all respondents. Overall, all five scales

demonstrated very high internal consistency, with Cronbach's Alpha values exceeding the 0.90 threshold. This confirmed that the instrument used to collect the data was highly reliable and that the items within each scale measured the same underlying construct. Therefore, the instrument was deemed suitable for further statistical analysis.

Data Gathering Procedure - The study started with securing the necessary permit to conduct the study and gather data. The research commenced with the qualitative phase, during which the researcher obtained formal approval from the Municipal Agriculture Office (MAO) and the identified Farmers' Cooperative Associations (FCAs). In-depth interviews were conducted with selected key respondents over 2 days to generate descriptive and narrative data on the implementation and outcomes of the RCEF Mechanization Program. With the participants' consent, all interviews were audio-recorded and transcribed for thematic analysis. The insights from this phase informed the development of a structured, validated survey instrument for the quantitative phase. The survey was administered to 243 farmer-members of the cooperative by the researcher, with the assistance of the Agricultural Extension Workers of Rizal, over 15 days, face-to-face during farmers' meetings, following a brief orientation on the study's objectives and confidentiality protocols. The collected responses were encoded, organized, and subjected to appropriate statistical analyses. In the final integration phase, qualitative and quantitative results were synthesized, with emergent themes used to interpret and substantiate statistical findings, thereby providing a comprehensive and empirically grounded understanding of the impacts of the RCEF Mechanization Program.

Statistical Treatment of the Data - Thematic analysis was employed to identify and synthesize key themes related to the implementation of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program, with a particular focus on mechanization support, capacity-building experiences, and perceived financial outcomes among farmer-members. The coded themes derived from the qualitative phase served as the basis for structuring the variables used in the quantitative analysis. The weighted mean was utilized to determine the average responses of the respondents with respect to the extent of RCEF Mechanization Program implementation, specifically in terms of mechanization and capacity building, as well as its financial impact, including production costs, income, and rice extension activities. This statistical tool enabled the researcher to assess the overall level of agreement and interpret the extent to which the program is implemented and experienced by farmer-members. To determine whether there is a significant relationship between the extent of RCEF mechanization interventions and the corresponding financial outcomes, WarpPLS version 7.0 was utilized. The Partial Least Squares Structural Equation Modeling (PLS-SEM) approach was applied to analyze the relationships among variables and to examine whether the level of program implementation significantly influences the financial outcomes of farmer-members. This method is particularly appropriate for exploratory models and allows the simultaneous analysis of multiple relationships within the study's conceptual framework.

Ethical Considerations - The researcher adhered to ethical protocols to ensure the integrity of the study. Before data collection, informed consent was obtained from all participants, ensuring that they were fully aware of the study's purpose, procedures, and their rights, including the right to participate voluntarily and to withdraw at any stage without consequence. Participants' confidentiality and anonymity were strictly maintained throughout the research process, and all information gathered was used solely for academic purposes. In compliance with the Data Privacy Act of 2012, the researcher ensured that no personal or identifiable information was disclosed. All data were handled with care, securely stored, and accessed only for this study. The instruments used, including the questionnaire and interview guide, were designed to be non-biased and gender-sensitive, ensuring fairness and respect for all respondents. Furthermore, the researcher obtained formal authorization from the appropriate local authorities to conduct the study. Permission was sought from cooperative leaders and relevant municipal agricultural offices to administer the survey questionnaires and conduct interviews among farmer-members. These steps ensured that proper protocols were observed and that the research was conducted with institutional support. These measures ensured compliance with ethical standards, upheld respect for participants, and fostered trust and cooperation among all individuals involved in this research.

3. Results and Discussions

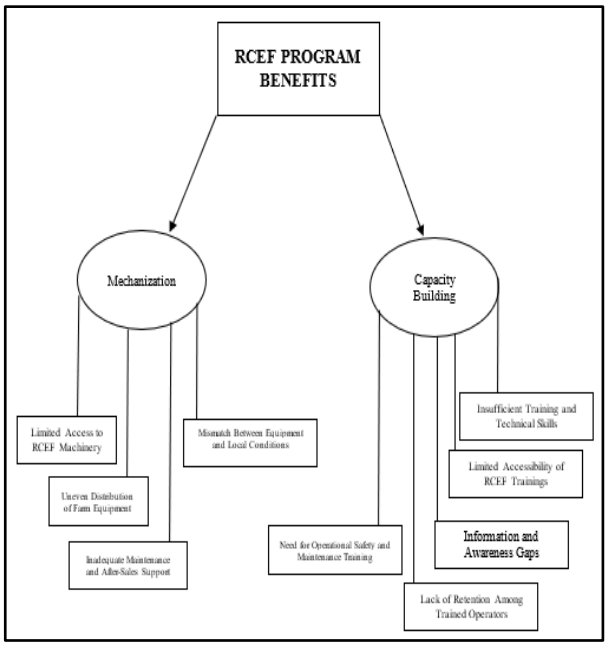

Figure 1. Initial Thematic Map of RCEF Program Benefits

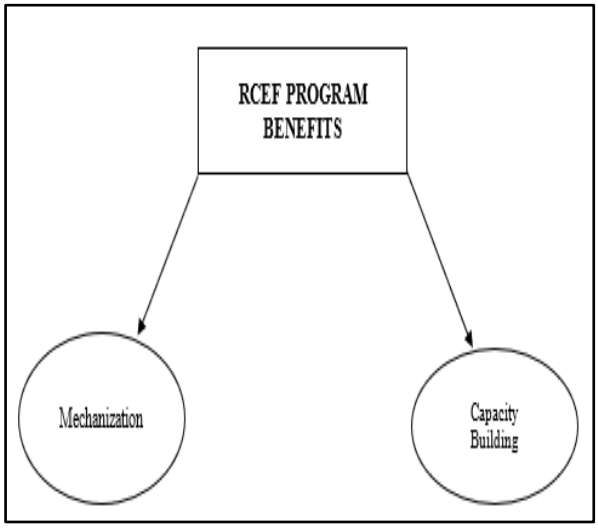

Figure 2. Final Thematic Map of RCEF Program Benefits

The initial thematic map in Figure 1 presents the consolidated insights from participants' responses on the implementation of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program. These insights were generated from in-depth interviews guided by the question, "What are the benefits of implementing the Rice Competitiveness Enhancement Fund (RCEF) for farmers in Rizal, Occidental Mindoro? The responses were carefully transcribed, organized, and systematically coded to surface recurring patterns and shared perspectives among the participants. As shown in Figure 1, farmers consistently pointed to a range of practical benefits that can be grouped into two major areas: mechanization and capacity building. Regarding mechanization, respondents emphasized the noticeable improvement in the efficiency of farm operations. Tasks that previously required significant labor and time—particularly land preparation and harvesting—became faster and more manageable with the use of machinery. Many participants also associated mechanization with reduced dependence on manual labor and more predictable farm operations, which are critical during peak agricultural periods. On the capacity-building side, farmers highlighted the value of the training activities provided under the program. These interventions helped them better understand how to operate and maintain equipment, while also improving their overall approach to farm management. For many, the training component not only builds technical skills but also increases their confidence in adopting more modern and efficient farming practices (Mgendi et al., 2020).

Beyond operational improvements, participants also described broader economic benefits. These included perceived reductions in production costs, particularly in labor expenses, and opportunities to increase income through more efficient, timely farming activities. At the cooperative level, respondents noted better coordination in the use of shared machinery and a more structured approach to service delivery among members. These outcomes suggest that the benefits of the program are not limited to individual farmers but extend to collective farming systems. These observations are consistent with earlier findings indicating that access to mechanization, when paired with appropriate training, improves productivity and cost efficiency in rice farming. In particular, initiatives implemented through the Philippine Center for Postharvest Development and Mechanization have expanded farmers' access to machinery, supporting more efficient farm operations at the local level.

Figure 2 presents the final thematic map, which integrates qualitative insights with the survey results. The refinement of themes into mechanization, training, and capacity building reflects a clearer understanding of how

the program delivers value. Mechanization captures the direct, tangible improvements in farm operations, while training is the enabling component that allows farmers to utilize these technologies fully. Taken together, these findings suggest that the effectiveness of the RCEF Mechanization Program lies not only in the provision of equipment but also in strengthening farmers' capacity to use these resources productively. Supporting this, studies have shown that mechanization, when complemented by sustained capacity-building efforts, leads to more efficient resource use and improved farm outcomes. Hidaya (2025) underscores the importance of continuous training to ensure that technological interventions translate into long-term gains in productivity and income for smallholder farmers.

Table 2

Mean Extent of Benefits of the RCEF Program in terms of Mechanization

Mechanization	Weighted Mean	Interpretation
The machine I use reduces the amount of heavy work.	3.80	Very High
I use tractors for farm operations.	3.75	Very High
I use a combine harvester to save labor.	3.76	Very High
I prefer a harvester to a laborer.	3.68	Very High
The mechanized technologies increase my rice yield.	3.67	Very High
The mechanized equipment I use improves the efficiency of my field operations.	3.77	Very High
7. The availability of machinery in my cooperative allows for timely farm operations.	3.74	Very High
8. Mechanization reduces my overall production cost compared with manual labor.	3.79	Very High
Composite Mean	3.74	Very High

Scale: 3.25-4.00 Very High; 2.50-3.24 High; 1.75-2.49 Moderate; 1.00-1.74 Low

The data presented in Table 2 reveal an overall mean of 3.74, interpreted as Very High, indicating that farmers strongly perceive the benefits of mechanization under the Rice Competitiveness Enhancement Fund (RCEF) program. This finding underscores that mechanization has significantly enhanced operational efficiency, labor productivity, and cost management among farmers in Rizal. More importantly, it reflects a gradual shift toward more modern, efficient farming practices, in which reliance on manual labor is reduced, and farm activities are carried out more promptly and in a more organized manner. Among the indicators, the highest ratings were recorded in the reduction of heavy labor (3.80), as well as in the use of tractors (3.75) and combine harvesters (3.76) for labor-saving purposes. These results clearly demonstrate that mechanization directly addresses one of the most pressing concerns in rice farming—labor intensity. The availability of machinery allows farmers to perform critical operations such as land preparation and harvesting more efficiently, thereby reducing physical strain and improving workflow. These findings are consistent with earlier studies, which show that modern machinery, including rice transplanters, threshers, and harvesters, significantly reduces labor requirements and enhances operational efficiency (Rahman & Salim, 2020; Magrini et al., 2018; Kumar et al., 2019).

On the other hand, the lowest-rated indicators, though still within the High category, include the preference for mechanized harvesting over manual labor (3.68) and the perceived contribution of mechanization to increased rice yields (3.67). While these are comparatively lower, they still indicate a positive perception among farmers. The slightly lower ratings suggest that some benefits, particularly those related to yield improvement, may not be immediately realized or may vary depending on farm-specific conditions. Nevertheless, other indicators, such as improved efficiency in field operations (3.77), timely completion of farm activities (3.74), and reduced production costs relative to manual labor (3.79), further reinforce the overall effectiveness of mechanization. In the Philippine context, RCEF mechanization initiatives implemented through the Philippine Center for Postharvest Development and Mechanization have expanded access to farm machinery among Farmer Cooperatives and Associations (FCAs), contributing to improved productivity and financial stability, particularly for older farmers and those managing larger farms (Arbes et al., 2024). Cooperative-based machinery management, characterized by shared access and coordinated scheduling, further enhances efficiency and reduces individual investment costs.

From a theoretical standpoint, these findings may be viewed through the lens of resilience, where farming systems adapt to external pressures and uncertainties (Darnhofer, 2021). Mechanization supports this adaptive

capacity by reducing dependence on manual labor and improving the efficiency of farm operations, enabling farmers to sustain productivity despite labor shortages, climate variability, and market disruptions. However, sustaining these benefits requires continuous technical support and capacity building to ensure the proper operation and maintenance of machinery (Alvaro et al., 2021). Financially, mechanization has been associated with reduced production costs—estimated at approximately ₱3.00 per kilogram of palay—alongside reductions in post-harvest losses of up to 5% and increases in farm income of around ₱9,000 per hectare (Arbes et al., 2024; Kim et al., 2022). Despite these gains, persistent challenges such as limited access to credit, small farm sizes, and inadequate infrastructure continue to constrain the full realization of mechanization's benefits (Lowder et al., 2025; Hassan et al., 2025). In conclusion, the consistently Very High ratings across all mechanization indicators demonstrate that the RCEF program plays a crucial role in modernizing rice production in Rizal. By integrating access to machinery, technical training, and cooperative-based management systems, the program provides a viable pathway to improved productivity, greater cost efficiency, and higher income for farmer-members.

Table 3

Mean Extent of Benefits of the RCEF Program in terms of Capacity Building

Capacity Building	Weighted Mean	Interpretation
1. My training enhances my knowledge of mechanized rice farming.	3.79	Very High
2. I learned the proper way to operate farm machinery.	3.78	Very High
3. I attend learning tutorials on the agricultural learning site.	3.75	Very High
4. I learned how to prepare a business plan in the seminar I attended.	3.70	Very High
5. The training programs I attend improve my decision-making in farm management.	3.73	Very High
6. The workshops help me adopt new agricultural technologies more effectively.	3.79	Very High
7. The technical assistance from experts improves my competence in mechanized farming.	3.78	Very High
8. The capacity-building activities increase my confidence in implementing improved farm practices.	3.77	Very High
Composite Mean	3.76	Very High

Scale: 3.25-4.00 Very High; 2.50-3.24 High; 1.75-2.49 Moderate; 1.00-1.74 Low

The data presented in Table 3 reveal an overall mean of 3.76, interpreted as "Very High," indicating that farmer-members strongly perceive the benefits of the Rice Competitiveness Enhancement Fund (RCEF) program for capacity building. This suggests that the program has played a critical role in enhancing not only farmers' technical competencies but also their confidence in managing mechanized rice production. In practical terms, the findings indicate that farmers are becoming better able to operate within a modernized agricultural system, where knowledge and skills are just as important as access to machinery. Among the indicators, the highest ratings were observed for the enhancement of knowledge on mechanized rice farming (3.79) and the improved adoption of new technologies through training and technical assistance. These results highlight that capacity-building interventions are not merely supplementary but are central to the effective utilization of mechanization. The ability to operate, maintain, and troubleshoot machinery directly influences productivity and reduces inefficiencies in farm operations (Van Loon et al., 2020).

On the other hand, the lowest-rated indicators—participation in seminars on business planning (3.70) and improvements in decision-making related to farm operations (3.73)—remain within the High category. This indicates that while farmers recognize the value of managerial and planning-related training, these areas may not yet be as well developed or as immediately impactful as technical training. Nevertheless, other indicators, such as participation in learning sessions (3.75) and increased confidence in applying improved farm practices (3.77), further affirm that the program contributes to the well-rounded development of farmers' capabilities. These findings are supported by the existing literature, which emphasizes that capacity building is a critical complement to mechanization initiatives. Training programs that include hands-on machinery operation, preventive maintenance, and post-harvest management significantly enhance farmers' ability to maximize the benefits of technology (Rahman & Salim, 2020). Studies also show that cooperatives that receive structured, continuous training demonstrate higher adoption rates and more efficient use of mechanized equipment (Cayetano et al., 2023; Agustin et al., 2021).

In the Philippine context, initiatives implemented by the Agricultural Training Institute, particularly the Rice Extension Services Program (RESP), provide experiential learning platforms, such as Farmer Field Schools, that promote peer-to-peer knowledge sharing and practical skill development. These interventions enhance competencies not only in mechanized operations but also in broader aspects of farm management, including pest control, nutrient management, and seed production (PhilRice, 2022). International evidence further supports the view that integrating mechanization with capacity building contributes to increased productivity, improved rural livelihoods, and stronger institutional learning systems (Nguyen et al., 2019; Cabral & Orden, 2020). Moreover, the train-the-trainer approach used in many extension programs ensures that knowledge is sustained and expanded within farming communities, as trained individuals disseminate what they have learned to other members (PhilRice, 2022). Empirical evidence from local studies, such as those conducted in Davao del Norte, shows that combining mechanization with structured training significantly enhances both productivity and income among farmers (Arbes et al., 2024). Similarly, reports from the Philippine Center for Postharvest Development and Mechanization indicate that trained farmers are better able to minimize machine downtime, reduce production costs, and lower post-harvest losses, resulting in tangible financial gains (PhilMech, 2025).

In conclusion, the consistently Very High ratings across all capacity-building indicators demonstrate that the RCEF program's integrated approach—combining technical training, hands-on learning, and institutional support—effectively strengthens farmers' competencies and operational confidence. More than just improving skills, these interventions enable farmers to fully utilize mechanization, enhance decision-making, and operate more efficiently within cooperative systems. As such, capacity building is a critical driver for sustaining productivity gains, improving income potential, and reinforcing the long-term resilience and competitiveness of rice farming in Rizal.

Table 4

Mean Level of Financial Impact in terms of Production Costs

Production Costs	Weighted Mean	Interpretation
1. The use of RCEF-provided machinery has lowered my production expenses per kilogram of palay.	3.79	Very High
2. Mechanized operations have reduced my production cost per hectare compared with manual practices.	3.78	Very High
3. Cooperative-operated machinery services allow me to access mechanized operations at lower rates than commercial rentals.	3.79	Very High
4. Mechanization minimizes post-harvest losses, reducing the cost impact of wastage.	3.77	Very High
5. The efficiency of mechanized services has helped me avoid additional costs associated with delays in farm operations.	3.77	Very High
6. Using cooperative-owned machines has significantly reduced my dependence on high-priced private service providers.	3.77	Very High
7. The overall decrease in production cost has improved the financial stability of my farming activities.	3.78	Very High
8. The availability of RCEF machinery within the cooperative has made my farm operations more cost-efficient.	3.79	Very High
Composite Mean	3.78	Very High

Scale: 3.25-4.00 Very High; 2.50-3.24 High; 1.75-2.49 Moderate; 1.00-1.74 Low

The data presented in Table 4 reveal an overall mean of 3.78, interpreted as "Very High," indicating that farmer-members strongly perceive the financial benefits of the Rice Competitiveness Enhancement Fund (RCEF) program in terms of reduced production costs. This suggests that mechanization has made a tangible difference in lowering farm expenses and improving cost efficiency, both at the individual farm level and within cooperative operations. In practical terms, farmers are not only spending less on key production activities but are also managing their resources more efficiently across the cropping cycle. Among the indicators, the highest ratings (3.79) were observed for the reduction in production expenses per kilogram of palay, the affordability of cooperative-operated machinery relative to commercial rentals, and the overall improvement in cost efficiency due to the availability of RCEF-supported equipment (Cayetano et al., 2023). These findings highlight how shared access to machinery through cooperatives enables farmers to avoid high service fees and benefit from more organized, cost-effective farm operations. The results indicate that mechanization not only improves productivity but also directly

contributes to better financial management among farmer-members (Takeshima et al., 2020).

Meanwhile, the lowest-rated indicators, though still within the Very High category (3.77), include reduced post-harvest losses, decreased reliance on private service providers, and avoided additional costs from delays in farm operations. While slightly lower, these results remain consistently strong, indicating that farmers continue to recognize the financial advantages of mechanization across different stages of production. The consistency of high ratings across all indicators suggests that cost-saving benefits are experienced broadly rather than in isolated aspects of farming.

These findings are supported by empirical evidence showing that mechanized operations in land preparation, planting, harvesting, and post-harvest handling significantly reduce labor-related expenses—ranging from ₱0.88 to ₱2.92 per kilogram of palay, equivalent to savings of ₱3,608 to ₱11,972 per hectare (Alvaro et al., 2021; Philippine Center for Postharvest Development and Mechanization, 2025). Cooperative-managed mechanization further ensures the timely completion of farm activities, reduces inefficiencies associated with manual labor, and minimizes unnecessary operational costs (Department of Agriculture, 2025; PhilMech, 2025). By reducing dependence on expensive private service providers, cooperatives can reallocate financial resources to more productive investments, such as equipment maintenance, service expansion, and capacity-building initiatives. From a strategic perspective, the reduction in production costs strengthens the financial resilience of both farmers and cooperatives. Improved cost efficiency enables better budgeting, more effective resource allocation, and enhanced farm profitability. It also creates opportunities for cooperatives to achieve economies of scale, optimize service delivery, and improve overall member satisfaction. More importantly, the savings generated from mechanization provide a practical basis for reinvestment in productivity-enhancing activities, supporting the long-term sustainability of rice farming systems (Islam, 2020).

In conclusion, the consistently Very High ratings across all indicators affirm that the RCEF program delivers substantial financial benefits by reducing production costs. By lowering operational expenses and improving efficiency, the program not only enhances farm-level competitiveness but also strengthens cooperative financial management. These gains position mechanization as a key driver in building a more sustainable, efficient, and economically resilient rice production sector in Rizal.

The data presented in Table 5 reveal an overall mean of 3.72, interpreted as Very High, indicating that farmer-members strongly perceive the financial benefits of the Rice Competitiveness Enhancement Fund (RCEF) program in terms of income. This suggests that mechanization has meaningfully improved farm productivity and, in turn, enhanced household income among cooperative members. Beyond cost savings, the results indicate that farmers are beginning to experience more stable, potentially higher earnings due to more efficient, timely farm operations. Among the indicators, the highest rating was observed in the ability of cooperative mechanized services to help farmers save more and retain higher income (3.78). This highlights the role of cooperative-based service delivery in reducing operational expenses while maximizing returns. By lowering production costs and improving efficiency, farmers can retain a larger share of their earnings, thereby reinforcing the economic value of collective access to mechanization (Wu et al., 2025).

Table 5
Mean Level of Financial Impact in terms of Income

Income	Weighted Mean	Interpretation
1. My net income increases after mechanization reduced my labor costs.	3.77	Very High
2. The cooperative's mechanized service fees enable me to save more and retain a higher income.	3.78	Very High
3. The reduction in post-harvest losses contributes to higher income from my produce.	3.78	Very High
4. Using RCEF machinery has improved my income per hectare compared with previous seasons.	3.63	Very High
5. I benefit financially from the cooperative's earnings generated through machinery services.	3.68	Very High
6. Mechanization frees time that I can use for other income-generating activities.	3.69	Very High

7. The increase in my income allows me to reinvest in farm inputs and improvements.	3.64	Very High
8. Overall, mechanization has improved the profitability of my farming operations.	3.77	Very High
Composite Mean	3.72	Very High

Scale: 3.25-4.00 Very High; 2.50-3.24 High; 1.75-2.49 Moderate; 1.00-1.74 Low

On the other hand, the lowest-rated indicator, although still within the Very High category, is the improvement in income per hectare (3.63). This suggests that while farmers generally experience income gains, the extent of increase per unit area may vary depending on factors such as farm size, yield performance, and access to complementary inputs. Nevertheless, the consistently high ratings across all indicators indicate that the income-related benefits of mechanization are broadly felt among farmer-members. These findings are supported by empirical studies highlighting the economic advantages of agricultural mechanization. Arbes et al. (2024) found that the adoption of mechanized technologies under the RCEF program improves operational efficiency and reduces labor costs, ultimately increasing farm productivity and income. Similarly, Belton et al. (2021) emphasized that access to mechanization services through cooperatives enables smallholder farmers to lower production costs while improving efficiency and income opportunities. Diao et al. (2020) further explained that mechanization contributes to rural economic growth by enhancing labor productivity and allowing farmers to allocate time to other income-generating activities. Taken together, these findings reinforce the view that mechanization, particularly when delivered through cooperative systems, plays a critical role in improving farm profitability and strengthening farmers' financial resilience. It not only enhances productivity but also creates opportunities for more efficient use of resources and time, ultimately supporting more sustainable livelihood outcomes. In conclusion, the consistently Very High ratings across all income indicators demonstrate that the RCEF Mechanization Program delivers substantial financial gains at the farm level. By improving efficiency, reducing costs, and enabling better income retention, the program contributes to a more resilient and economically viable rice farming sector in Rizal.

The data presented in Table 6 reveal an overall mean of 3.74, interpreted as "Very High," indicating that farmer-members strongly recognize the financial and operational benefits of rice extension services under the Rice Competitiveness Enhancement Fund (RCEF) program. This suggests that extension services serve as a critical support mechanism, enhancing the effectiveness of mechanization by equipping farmers with the knowledge and skills needed to maximize its use. In practical terms, farmers are not only provided with machinery but are also guided on how to utilize these technologies efficiently, leading to better farm outcomes. Among the indicators, the highest rating was observed in the improvement of farmers' knowledge on rice production technologies through training programs (3.79). This highlights the central role of extension services in building technical competence, enabling farmers to better understand and apply improved farming practices. As farmers become more knowledgeable, they are better able to make informed decisions that directly influence productivity and income.

Table 6

Mean Level of Financial Impact in terms of Rice Extension Services

Rice Extension Services	Weighted Mean	Interpretation
1. Training programs under RCEF improve my knowledge of rice production technologies.	3.79	Very High
2. Capacity-building activities help me operate and maintain machinery properly.	3.79	Very High
3. I have access to learning sites that demonstrate updated farming practices.	3.77	Very High
4. Extension services support my adoption of good agricultural practices.	3.78	Very High
5. The recommendations from extension specialists improve my farm decision-making.	3.67	Very High
6. The training sessions help reduce machine downtime through proper maintenance.	3.61	Very High
7. I benefit from the instructional materials provided by Rice Extension Programs.	3.77	Very High
8. Overall, extension services strengthen my ability to manage mechanized rice farming.	3.77	Very High
Composite Mean	3.74	Very High

Scale: 3.25-4.00 Very High; 2.50-3.24 High; 1.75-2.49 Moderate; 1.00-1.74 Low

On the other hand, the lowest-rated indicator, although still within the Very High category, is the role of training in reducing machine downtime (3.61). While slightly lower, this still reflects a strong acknowledgment of the importance of training in maintaining operational efficiency. It may suggest that, while farmers recognize the value of training, challenges with machine maintenance and technical troubleshooting still require more targeted or ongoing support. Nonetheless, the consistently high ratings across all indicators indicate that extension services provide comprehensive and sustained benefits. These findings are supported by existing studies emphasizing the importance of structured agricultural extension programs. Arbes et al. (2024) found that hands-on training and field demonstrations significantly improve farmers' technical skills and decision-making capabilities, particularly when integrated with mechanization initiatives. Similarly, Kim et al. (2022) reported that cooperative-based extension services enhance operational efficiency and reduce machinery downtime, ultimately increasing farm income. These results affirm that extension services play a vital role in bridging the gap between technology provision and effective utilization.

Moreover, extension programs facilitate the adoption of good agricultural practices, strengthen farm-level decision-making, and promote the use of updated production technologies. Learning sites and demonstration farms provide farmers with opportunities to observe actual applications of mechanized operations, reinforcing both skill development and confidence. As noted in previous studies, when extension services are aligned with cooperative-managed mechanization, they contribute to reduced operational costs, improved efficiency, and enhanced farm profitability (Arbes et al., 2024; Kim et al., 2022). In summary, the consistently Very High ratings across all indicators confirm that rice extension services are a key driver of the RCEF program's benefits. By providing continuous technical guidance, practical training, and advisory support, these services enable farmers and cooperatives to fully utilize mechanization, improve farm management practices, and sustain productivity gains. Ultimately, extension services strengthen not only operational efficiency but also the long-term financial resilience and competitiveness of rice farming in Rizal.

The data presented in Table 7 reveal the structural relationships between the components of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program and the financial outcomes of farmer members. The results indicate that mechanization has a statistically significant and positive influence on production costs, farmers' income, and rice extension activities. Specifically, mechanization shows a significant effect on production cost ($\beta = 0.278$, $p < .001$), farmers' income ($\beta = 1.000$, $p < .001$), and rice extension services ($\beta = 1.000$, $p < .001$), suggesting that it is the strongest predictor of financial performance within the model. These findings imply that access to machinery and mechanized services directly translates into tangible economic gains for farmers, particularly in terms of cost reduction and income improvement. The strong influence of mechanization stems from its ability to streamline farm operations, reduce labor dependence, and improve efficiency across the different stages of rice production. Mechanized activities such as land preparation, planting, harvesting, and post-harvest processing significantly lower labor costs and enhance operational productivity. Empirical evidence supports this, showing that mechanization reduces labor expenses by approximately ₱0.88 to ₱2.92 per kilogram of palay, equivalent to savings of ₱3,608 to ₱11,972 per hectare (PhilMech, 2025). In addition, improved post-harvest systems increase milling recovery rates, allowing farmers to generate higher output and income from the same level of production (Department of Agriculture, 2025). These outcomes reinforce the role of mechanization as a direct driver of financial improvement among farmer-beneficiaries.

Table 7
Path Coefficients and p-values for H_0

Path	Beta (β) Coefficient	*p*-value*	Interpretation
Ho: Extent of RCEF Program→Level of Financial Impact			
MECH→PRODCOST	0.278	<.001	Highly Significant
MECH→INCOME	1.000	<.001	Highly Significant
MECH→RICEXT	1.000	<.001	Highly Significant
CAPBLDG→PRODCOST	0.719	<.001	Highly Significant
CAPBLDG→INCOME	-0.000	.500	Not Significant
CAPBLDG→RICEXT	0.000	.500	Not Significant

*Significant at $p < .05$

In contrast, capacity-building interventions, while important, do not exhibit a direct significant effect on income and rice extension services in the structural model. This suggests that training programs, workshops, and technical assistance primarily function as enabling mechanisms rather than immediate sources of financial gain. Although they do not directly increase income, these interventions enhance farmers' technical knowledge, decision-making skills, and ability to manage machinery effectively. As supported by previous findings, capacity-building initiatives improve farmers' competence in operating and maintaining equipment, thereby indirectly contributing to better financial outcomes through more efficient use of mechanized technologies (PhilMech, 2025; Tran & Pham, 2021). These results align with earlier findings in the study, where mechanization consistently demonstrated strong positive effects on cost reduction and income generation. At the same time, capacity-building reinforced these benefits by improving operational efficiency. Studies have shown that training programs, including hands-on demonstrations and learning site visits, strengthen farmers' ability to maximize the benefits of mechanization, even when the financial impact is not immediately observable (Cayetano et al., 2023; Kim et al., 2022). In this context, capacity-building serves as a critical support system that sustains and enhances the long-term effectiveness of mechanization.

Overall, the statistical evidence leads to the rejection of the null hypothesis, confirming a significant relationship between the RCEF Mechanization Program and the financial outcomes of farmer-members. While not all individual paths are directly significant, the structural model as a whole demonstrates that the program substantially influences production costs, income, and extension-related outcomes. The combined effect of mechanization, training, and cooperative-based service delivery creates a synergistic impact that strengthens both operational efficiency and financial resilience. In conclusion, the findings affirm that the RCEF Mechanization Program plays a vital role in improving the economic performance of rice farmers in Rizal. Mechanization emerges as the primary driver of financial gains, while capacity building enhances the effective use of these technologies. Together, these components contribute to reduced production costs, increased income, and more sustainable farming practices, positioning the program as a key instrument for agricultural modernization and long-term rural development.

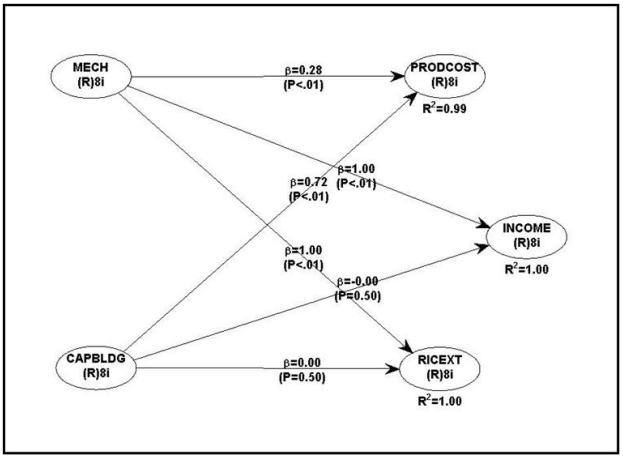

Figure 3. Structural Model of the Relationship Between Extent of RCEF Program and Level of Financial Impact on Respondents

Based on the structural model presented in Figure 3, the exogenous variables—Rice Competitiveness Enhancement Fund (RCEF) program components in terms of mechanization (MECH) and capacity building (CAPBLDG)—are directly linked to the endogenous variables representing financial impact, specifically production costs (PRODCOST), income, and rice extension services (RICEXT). The analysis of path coefficients indicates varying degrees of influence, with beta (β) values ranging from 0.00 to 1.00, suggesting that mechanization exerts a stronger and more direct effect on financial outcomes compared to capacity building, which tends to operate as a supporting mechanism. The coefficient of determination (R^2) values further demonstrate the model's strong explanatory power, with 100% ($R^2 = 1.00$) of the variance in income and rice extension services

and 99% ($R^2 = 0.99$) of the variance in production costs explained by the model, indicating an exceptionally high level of predictive accuracy. While significance levels range from $p < .01$ to $p = .50$, implying that not all relationships are equally strong, the overall results confirm that the RCEF program components are comprehensive and sufficient in explaining the financial variations among farmer-respondents, underscoring the program's substantial role in shaping cost efficiency, income generation, and extension-related outcomes.

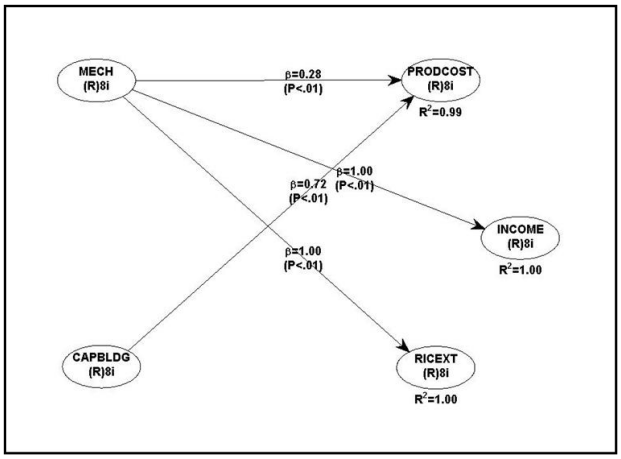

Figure 4. Emergingl Model of the Relationship Between Extent of RCEF Program and Level of Financial Impact on Respondents

The emerging model displayed in Figure 4 isolates the statistically significant pathways that define the relationship between the RCEF program components and financial impact. The new model represents the refined framework where only verified relationships were retained. The four direct pathways reveal low to perfect positive beta coefficients from 0.28 to 1.00 which are duly supported by the significance level, $p < .01$. As regards predictive strength, the emerging model retains an extremely high explanatory power (R2=1.00) for income and rice extension services and (R2=0.99) for production cost, indicating that these variables almost perfectly account for the financial changes observed in the respondents.

Table 8

Standardized Estimates of the Path in the Emerging Model

Hypothesis	Standardized Estimates (β)	Standard Error	*p*-value*	Effect Coefficient**	Effect Size
Ho: Extent of RCEF Program→Level of Financial Impact					
MECH→PRODCOST	0.278	0.061	<0.001	.274	Medium
MECH→INCOME	1.000	0.054	<0.001	1.000	Large
MECH→RICEXT	1.000	0.054	<0.001	1.000	Large
CAPBLDG→PRODCOST	0.719	0.057	<0.001	.714	Large

*Significant at $p < 0.05$

**Effect size coefficient: 0.02 – small, 0.15 – medium, 0.30 – large

The results presented in Table 8 show the standardized estimates of the emerging structural model, indicating refined relationships between the Rice Competitiveness Enhancement Fund (RCEF) program components and financial outcomes. The standard errors, ranging from .054 to .061, suggest precise and reliable estimates. At the same time, non-significant paths—specifically, from capacity building to income and to rice extension services ($\beta = 0.000$, $p = .500$)—were removed to improve model fit. The findings reveal that mechanization is the strongest predictor of farmers' financial status, with a perfect beta coefficient ($\beta = 1.000$), indicating a direct and substantial contribution to increased income and enhanced extension service outcomes. In contrast, its positive but lower effect on production costs ($\beta = 0.278$) reflects manageable increases associated with machinery use.

In contrast, capacity building has a significant influence, primarily on production costs ($\beta = 0.719$), suggesting that training and technical support encourage the adoption of more advanced, input-intensive farming practices that may initially raise costs but support long-term productivity gains. These results are consistent with earlier findings showing that mechanization reduces labor costs, improves efficiency, and increases profitability, with

savings estimated at ₱0.88 to ₱2.92 per kilogram of palay, while also enhancing post-harvest outcomes such as milling recovery rates (Rahman & Salim, 2020; Kumar et al., 2019; Arbes et al., 2024; Kim et al., 2022). At the same time, capacity-building initiatives strengthen farmers' technical knowledge and decision-making, enabling more effective use of mechanized technologies and encouraging investments in improved inputs. Overall, the findings support rejecting the null hypothesis and confirm that the RCEF program significantly influences financial outcomes, with mechanization serving as the primary driver of income and efficiency and capacity building shaping the evolving cost structure of modern rice farming systems.

Table 9
Sustainability Plan for the RCEF Program

Sustainability Program	Description	Expected Outcome	Timeframe	Responsible Implementers
1. Cooperative-Based Machinery Management System	Establish a structured machinery management framework, including scheduling, monitoring, and maintenance protocols with designated operators.	Improved machinery utilization, reduced downtime, and extended lifespan	Year 1–5 (continuous)	Cooperative Officers, Machine Operators, MAO
2. Machinery Maintenance and Replacement Fund	Create a dedicated fund from service fees for preventive maintenance, spare parts, and equipment upgrading.	Sustainable financing and reduced risk of obsolescence	Year 1–5 (continuous)	Cooperative Treasurer, Chairperson
3. Continuous Capacity-Building Program	Institutionalize regular training on mechanized farming, maintenance, and agribusiness management.	Enhanced technical competence and productivity	Quarterly (Year 1–5)	AEWs, MAO, PhilMech
4. Mechanization Service Enterprise Development	Operate machinery services as income-generating enterprises for members and nearby farmers.	Increased cooperative income and service access	Year 1–5 (scaling phase)	Cooperative Officers
5. Integrated Rice Productivity Enhancement Program	Combine mechanization with improved seeds, nutrients, and water management practices.	Higher productivity and farm income	Cropping seasons (Year 1–5)	AEWs, Farmers, MAO
6. Digital Monitoring and Farm Data System	Implement digital tracking of machinery use, production, and maintenance schedules.	Data-driven decision-making and transparency	Year 1–3 (establishment), Years 4–5 (optimization)	MAO, IT Support, Cooperative
7. Credit Access and Financing Support	Facilitate access to agricultural loans and cooperative financing schemes.	Increased investment capacity and profitability	Year 1–5 (ongoing)	MAO, Financial Institutions, Cooperative
8. Multi-Stakeholder Collaboration Program	Strengthen partnerships among LGUs, DA agencies, cooperatives, and farmer groups.	Sustained institutional support and coordination	Year 1–5 (continuous)	MAO, DA, PhilMech, Cooperatives

The sustainability of the RCEF Mechanization Program is anchored on economic, technical, and institutional strategies that ensure long-term operational efficiency and financial viability for farmer cooperatives. Economically, cooperatives are trained to operate mechanization services as income-generating enterprises, collecting service fees that are reinvested in maintenance, operations, and capacity building (Liao et al., 2022). Technical sustainability is reinforced through continuous training programs, strategic allocation of mechanization resources, and targets to increase mechanization intensity per hectare, ensuring that farmers maintain proficiency in equipment operation and maximize farm productivity (Tran & Pham, 2021; Gupta et al., 2023). Institutional strategies include cooperative-based machinery management, coordinated scheduling, and multi-stakeholder collaboration with local government units, national agencies, and extension services. Market-oriented approaches and international collaborations further enhance sustainability by promoting mechanization services, repair operations, and off-season utilization, ensuring both business viability and operational resilience (Tran & Pham,

2021). The proposed sustainability programs were derived from the analysis of survey results (Tables 2–7), particularly the consistently "Very High" ratings across financial, operational, and capacity-building indicators. These were further supported by key informant insights, existing RCEF implementation guidelines, and best practices in cooperative-based mechanization models. The integration of empirical findings and literature-based frameworks ensured that the proposed interventions are both evidence-based and context-responsive. The proposed budget follows a proportional allocation scheme, wherein 40% is allocated to machinery maintenance and spare parts, 30% to capacity-building and training, 20% to cooperative-led mechanization enterprises, and 10% to monitoring and evaluation. The actual monetary value of each component will depend on the total funding available to the cooperative or program, which may be sourced from service fees, government support, and external financing (Jayeola et al., 2022).

The primary implementers of the sustainability plan include the cooperative chairpersons and officers, who are responsible for enterprise management, machinery operations, and fund administration. Agricultural Extension Workers (AEWs) and technical specialists play a critical role in delivering training programs, providing technical support, and monitoring farm-level adoption of mechanization technologies. Meanwhile, the Municipal Agriculture Office (MAO) serves as the coordinating body, ensuring policy alignment, overseeing monitoring and evaluation, and facilitating linkages with national agencies such as the Department of Agriculture and the Philippine Center for Postharvest Development and Mechanization to support program implementation and sustainability. In summary, the integrated sustainability framework—combining economic incentives, continuous technical support, institutional coordination, and collaborative partnerships—ensures that mechanization services remain financially viable, technically proficient, and resilient. This approach supports the long-term modernization and competitiveness of the rice sector by enabling cooperatives to efficiently manage mechanization assets, sustain income-generating operations, and continuously improve technical capacity (Cayetano et al., 2023).

4. Conclusions

Based on the summary of findings presented, the following conclusion was drawn: The implementation of the Rice Competitiveness Enhancement Fund (RCEF) Program in the Municipality of Rizal, Occidental Mindoro, generates substantial benefits for rice farmers, particularly by improving access to mechanization services and enhancing technical capacity. These benefits are primarily anchored on the program's integrated approach, which combines mechanization, capacity-building interventions, and cooperative-based service delivery. Mechanization provides the necessary operational support by reducing labor intensity, improving efficiency, and enabling timely farm operations. At the same time, training and technical assistance strengthen farmers' knowledge, skills, and confidence in adopting modern farming practices. At the same time, cooperative management systems facilitate shared access to resources, promote coordination, and improve the overall delivery of mechanized services.

In terms of financial impact, the RCEF Program significantly reduces production costs and enhances cost efficiency among farmer-members. The use of cooperatively managed machinery allows farmers to access mechanized services at lower costs than private providers, resulting in reduced operational expenses and improved income retention. Furthermore, extension services play a vital role in reinforcing these gains by promoting the adoption of improved agricultural practices and updated production technologies, thereby increasing productivity, improving yield quality, and raising revenue.

These outcomes demonstrate that the program not only improves farm operations but also strengthens the financial viability of rice farming at both the individual and cooperative levels. However, the findings indicate that, while the overall extent of RCEF program implementation does not exhibit a significant direct relationship with overall financial impact, a more detailed analysis reveals that mechanization is the primary driver of financial outcomes. It consistently leads to reductions in production costs, improvements in income, and greater access to rice extension services. In contrast, capacity-building interventions, although significant, primarily affect the cost structure of farming operations by encouraging the adoption of improved but potentially more resource-intensive practices. This suggests that capacity building functions as a complementary mechanism that enhances the

effective utilization of mechanization rather than directly generating financial gains. Overall, the results highlight that the strength of the RCEF Program lies in the synergy between its components. Mechanization delivers immediate and tangible economic benefits, while capacity-building ensures that these gains are sustained through improved knowledge, technical skills, and farm management practices. The integration of these elements creates a balanced framework that supports both short-term productivity and long-term agricultural sustainability. To ensure the continued effectiveness of the program, the integration of digital monitoring systems, improved access to agricultural credit, adoption of productivity-enhancing technologies, and strengthened collaboration among stakeholders are essential. These strategies will support better program tracking, facilitate investment in mechanization, and enhance coordination among farmers, cooperatives, and implementing agencies. Ultimately, sustaining and scaling these interventions will reinforce the competitiveness, resilience, and long-term growth of the rice sector in Rizal and Occidental Mindoro.

Recommendations - In view of the findings and conclusions presented, the following recommendations are proposed to enhance the effectiveness of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program and its financial impact on farmers in Rizal and Occidental Mindoro. Farmer cooperatives may take a more active role in program planning, particularly in machinery allocation, scheduling, and service delivery, to ensure that mechanization interventions are aligned with actual farm-level needs. Strengthening cooperative-based management systems, including clear protocols for utilization and maintenance, may improve the efficiency and sustainability of mechanized services. To reinforce the gains from mechanization, continuous, structured capacity-building programs may be institutionalized. Agricultural Extension Workers (AEWs) and technical personnel may provide regular hands-on training, technical assistance, and monitoring to strengthen farmers' competencies in operating and maintaining machinery and managing farms. Training programs may also be made more outcome-oriented, focusing on improving productivity, cost efficiency, and income generation, ensuring that knowledge gained translates into measurable financial benefits. Access to affordable agricultural financing may be expanded through stronger linkages with financial institutions and government support programs. Cooperatives may be encouraged to develop mechanization-based service enterprises as additional income streams. In contrast, extension services may integrate financial literacy and resource management training to enhance farmers' decision-making and optimize resource use. These efforts may improve cost efficiency, increase productivity, and strengthen income stability among farmer-members.

The Municipal Agriculture Office (MAO) may take the lead in strengthening coordination, policy alignment, and program monitoring, including collaboration with national agencies such as the Department of Agriculture and the Philippine Center for Postharvest Development and Mechanization. The integration of digital monitoring systems for machinery usage, service delivery, and farm productivity may be adopted to improve transparency, tracking, and evaluation of program outcomes. Multi-stakeholder collaboration among cooperatives, government agencies, extension services, and local institutions can be further strengthened to ensure more cohesive and responsive program implementation. By aligning technical support, financing, and institutional efforts, the program may sustain its impact and enhance the competitiveness of the rice sector. Finally, future researchers may conduct longitudinal and comparative studies to assess the long-term impacts of the RCEF Mechanization Program across different localities. Further research may also explore areas such as technology adoption behavior, cooperative governance, and climate resilience to provide a more comprehensive understanding of the program's broader development outcomes. These recommendations, when effectively implemented, may help sustain the financial viability, operational efficiency, and long-term resilience of rice farming in Rizal and Occidental Mindoro.

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