

Impact Assessment of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program on the Agricultural Productivity among Rice Farmers in a Selected Barangay in Davao del Norte

Article History:

Received: 01 November 2024
First Decision: 03 November 2024
Published: 30 December 2024

Josephine L. Arbes¹, Marejen A. Villaremo², Rogelyn A. Cabañog³, Lorna A. Escobar⁴, Mama G. Mindal⁵, Gelyn V. Amilbahar⁶

¹Associate Professor, College of Agriculture, Central Mindanao University, Musuan, Maramag, Bukidnon, Philippines

²Faculty, Ecological Farm & Resource Management Institute, Visayas State University, Visca, Baybay City, Leyte, Philippines

³Teacher 1, Nicaan High School, Libungan East District, School Division Office, Cotabato, Philippines

⁴Agriculturist II, Municipal Agriculture's Office, LGU-Braulio E. Dujali, Davao del Norte, Philippines

⁵Faculty, Cotabato Foundation College of Science and Technology, Pikit Extension Unit, Pikit, Cotabato, Philippines

⁶Faculty, College of Agriculture, University of Southern Mindanao, Kabacan, Cotabato, Philippines

Abstract

The study examines how the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program affected agricultural productivity in Barangay Dujali, Braulio E. Dujali, Davao del Norte. Study participants were 35 rice farmers. A structured questionnaire administered in person by the researchers was tabulated, categorized, and analyzed using SPSS version 21. Data patterns and trends were determined using descriptive and inferential statistics. Socio-demographic results of the study showed that most respondents were middle-aged, married, had large households, and had varying formal education. Farm mechanization was widely adopted, indicating positive response to modern farming. After the program, rice production per bag increased, improving agricultural efficiency and consistency. The program optimized agricultural establishment work to reduce labor expenses. Farm output increased with age, highlighting the value of expertise. Farm size affects productivity, and statistical testing showed that program implementation increased farmers' income and production.

Keywords: Rice Competitiveness Enhancement Fund (RCEF), mechanized farm technologies, farm labor, adoption, farm productivity



Copyright © 2024. The Author/s. Published by VMC Analytik's Multidisciplinary Journal News Publishing Services. Impact Assessment of the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program on the Agricultural Productivity among Rice Farmers in a Selected Barangay in Davao del Norte © 2024 by Josephine L. Arbes, Marejen A. Villaremo, Rogelyn A. Cabañog, Lorna A. Escobar, Mama G. Mindal and Gelyn V. Amilbahar is licensed under **Creative Commons Attribution (CC BY 4.0)**.

INTRODUCTION

Agriculture is crucial to global economic development and food security. Agriculture drives economic growth and employs many of the Philippines' population. The Philippines has implemented numerous initiatives to support farmers and increase their access to innovative agricultural technologies to improve agricultural efficiency and productivity. Rice growers face challenges limiting their output and competitiveness in the market. These include low production, manpower shortages, and large post-harvest losses. The Philippine government developed the Rice Competitiveness Enhancement Fund (RCEF) Program, which includes the RCEF Mechanization Program, to solve these concerns and boost the rice industry's competitiveness. This program encourages rice farmers to use mechanization to further improve their agricultural operations. The

initiative facilitates sophisticated agricultural machinery and equipment acquisition and use. The strategic RCEF Mechanization Program empowers rice farmers and gives them the means to overcome challenges. The initiative aims to boost the competitiveness of the rice industry and sustain Philippine agriculture.

Rice production continues to grow in the southern Philippines' Davao Region. The location has ideal weather and agricultural soil for rice growth. Despite these benefits, the Davao Region, like other regions, faces issues that reduce agricultural productivity. Low yields, inefficient farming, and restricted access to modern technologies hurt the region's agriculture. Due to these issues and the importance of Davao Region's agriculture economy, the Philippine government developed the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program. Rice growers are encouraged to employ mechanization

technologies to address the challenges above. The program helps farmers in the region use innovative agricultural equipment by providing financial and technical support.

The main source of livelihood in Barangay Dujali in Braulio E. Dujali is agriculture in which more than 85% of the land is used for cultivation for various crops and rice is the dominant crop in the region. By record, this barangay has almost 95% of the farmers registered under the Registry System for Basic Sector in Agriculture, hence, are beneficiaries of the RCEF seeds component. It also seeks to increase the productivity of rice farmers by offering high quality seeds (Magrobedujali, 2024). Improved germplasm is a key requirement for rice cultivation since best quality of seed can raise the yield by 5-20% (IRRI Rice Knowledge Bank). RCEF program has immensely transformed the lives of rice farmers in the barangay enhancing their yields to average of 6 tons per hectare (Magrobedujali, 2024).

This study is primarily aimed at assessing the impact of the RCEF Mechanization Program on agricultural productivity in the Davao Region. Specifically, it sought to describe the socio-demographic characteristics of rice farmers in the region; determine the adoption of mechanized technologies among rice farmers in the region; ascertain the changes in rice production among rice farmers in Davao Region; ascertain the changes in income among rice farmers in Davao Region; examine the changes in labor requirements among rice farmers in Davao Region; determine the challenges encountered in adopting the RCEF machineries; and analyze the relationship between socio-demographic characteristics and farm productivity.

Successful RCEF Mechanization Program execution is projected to have far-reaching advantages. It can boost rice farmers' crop yields, resource use, efficiency, and economic prospects. In addition, improving the rice industry boosts national food security and ensures a steady supply of this important crop for Filipinos.

Hypotheses. At 0.05 level of significance, the following hypotheses were drawn from the study:

Ho₁. The mean production of farmers before and after the RCEF Mechanization Program do not differ significantly.

Ho₂. The mean income of farmers before and after the RCEF Mechanization Program do not differ significantly.

Ho₃. The mean labor requirements of farmers before and after the RCEF Mechanization Program do not differ significantly.

Ho₄. There is no significant relationship between socio-demographic characteristics and farm productivity.

Conceptual Framework. This study presents a structured approach to evaluating the RCEF Mechanization Program's impact on rice farmers' productivity in in Barangay Dujali, Davao del Norte. The framework consists of two main components. As reflected in Figure 1, the first component examines the socio-demographic characteristics of rice farmers, including age, gender, marital status, education level, household size, farming experience, farm size, and extension visits. The second component focuses on adopting RCEF Farm Mechanized Technologies among rice farmers in the region. This involves assessing the extent to which farmers have adopted different technologies for various farm operations, ranging from land preparation to drying.

These two components directly influence farmers' labor and cost requirements, yield, and income. Ultimately, these factors collectively determine the overall farm productivity. By analyzing the relationship between the farmers' characteristics, the adoption of mechanized technologies, and their impact on productivity, this study aims to provide valuable insights into the effectiveness of the RCEF Mechanization Program in enhancing agricultural productivity among rice farmers in the Davao Region.

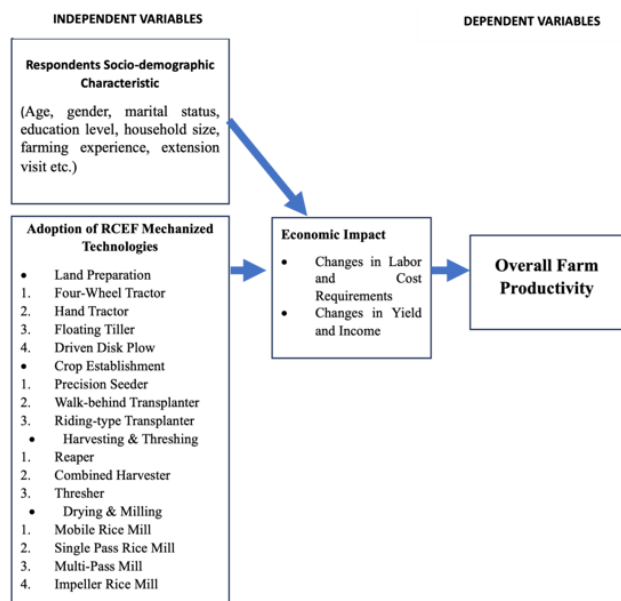


Figure 1
The conceptual framework of the study

LITERATURES

Rice production in Davao and the Philippines.

Rice is essential to the Philippines' agricultural industry and food security. As one of the world's top rice consumers and importers, Filipinos rely on domestic rice production to meet their dietary needs. The local agricultural business relies on rice, which provides revenue for nearby settlements. According to the FAO, the Philippines produced 19.4 million metric tons of rice in 2020, ranking sixth internationally (Agoot, 2020). Despite its high rice production, the country has many challenges that make rice growing difficult.

Due to urbanization and population growth, agricultural land has been shifted to other purposes, limiting land availability. Rice production's sensitivity to climate change, including extreme weather and altered rainfall patterns, threatens the sector's stability and productivity (Blanc & Strobl, 2016). The Philippines produces less rice than other countries (Stuecker et al., 2018). Outdated farming practices, inadequate access to contemporary technologies and tools, and insufficient research and development contribute to this gap. Thus, improving rice farming yield is a key agricultural goal.

The Philippines' Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program addressed these issues. To address these issues, the Philippines launched the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program. This program promotes mechanized farming to boost rice producers' competitiveness.

The southern Philippines' Davao Region is noted for its rice farming sector. Rice farming is good given the temperate temperature and fertile soil. The temperate climate, with lots of rain and moderate temperatures, makes rice growing suitable year-round. Due to topographical advantages, the region greatly impacts rice production nationwide. The provinces of Davao del Norte, Davao del Sur, Oriental, Occidental, Compostela Valley, and Davao City make up the Davao Region. Rice, noted for its great productivity, is the main crop grown in each location (Abaro, 2021).

The Philippine Statistics Authority (2022) reports that rice grows well on Davao's fertile soils. Extensive plains and undulating topography make the region's agricultural settings excellent for rice harvests. This location has great agricultural potential due to its fertile soil and adequate irrigation. Due to its ideal conditions, Davao contributes greatly to the nation's rice output.

RCEF Mechanization Program. The Philippine government launched the Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program to boost rice farmers' competitiveness and encourage sustainable farming methods. The program recognizes mechanization's potential for increasing agricultural productivity, lowering production costs, and addressing the labor-intensive nature of rice farming (RCEF, 2023). The RCEF Mechanization Program's principal goal is to assist rice farmers in adopting modern and mechanized agricultural practices. By providing financial help for acquiring farm gear and equipment, the program aims to address labor-intensive farming processes, raise productivity, and improve overall productivity in rice production.

Rice farmers, according to Abril et al. (2019), can use mechanical farming technology to speed up a variety of agricultural processes, such as land preparation, planting, harvesting, and post-harvest activities. Mechanization speeds up and improves the precision of these procedures, reducing the demand for manual labor and improving overall productivity. Furthermore, mechanization can improve farm management, maximize resource utilization, and improve rice production quality. The RCEF Mechanization Program also aims to reduce production costs for rice farmers. Traditional manual labor in rice farming can be expensive, labor-intensive, and time-consuming.

Farmers can reduce labor expenses, post-harvest losses, and reliance on expensive inputs by shifting to mechanized operations. The program provides financial assistance to alleviate the financial strain of acquiring farm machinery, making mechanization more accessible and affordable for rice farmers. Reducing the labor-intensive nature of rice farming is another significant issue that the RCEF Mechanization Program addresses. Traditional rice farming methods require substantial physical effort and extensive labor throughout various stages of production. Mechanization enables farmers to automate repetitive and physically demanding tasks, reducing the physical strain on them. By reducing labor requirements, mechanization can address the agricultural sector's labor scarcity issues. The RCEF Mechanization Program recognizes the potential of mechanized farming practices to enhance the competitiveness and sustainability of rice farming in the Philippines (Department of Agriculture, 2019).

According to the Department of Agriculture (2023), the RCEF Mechanization Program provides qualifying rice farmers in the Philippines with financial assistance to purchase farm machinery and equipment. Recognizing the value of modern tools and equipment in increasing efficiency and output, the program seeks to make mechanized farming practices more accessible. Farmers participating in the RCEF Mechanization

Program can acquire machinery and equipment specifically for rice production. These include hand tractors, which are versatile and widely used for land preparation, soil cultivation, and the transportation of agricultural inputs. Hand tractors can significantly reduce the time and effort required for manual land preparation tasks, such as plowing and harrowing.

Tillers are another type of machinery the program supports, designed to streamline land preparation activities further. These machines help break up soil clumps, smooth the surface, and prepare seedbeds. Farmers can achieve a more uniform and well-prepared soil by using tillers, essential for proper seed germination and optimal crop growth. Transplanters are also included in the list of supported machinery and equipment. Transplanters automate planting rice seedlings, ensuring consistent spacing and proper depth, which can lead to improved crop establishment and uniform growth. Farmers can save significant time and labor by utilizing transplanters compared to manual transplanting methods. Harvesters are another crucial component of the mechanization program. These machines automate the harvesting of mature rice crops, increasing efficiency and reducing post-harvest losses. Harvesters can significantly speed up harvesting, ensuring timely and efficient crop removal from the fields. In addition to these main types of machinery, the RCEF Mechanization Program may also support the acquisition of other mechanized tools and equipment relevant to rice farming. This may include crop drying, milling, threshing, and storage equipment. These tools can help farmers improve post-harvest handling and processing, preserving the quality of harvested rice and minimizing losses.

Adoption of Mechanized Farming Practices Among Rice Farmers. A research group at the University of the Philippines Los Baños conducted a study revealing that various factors shape rice farmers' decisions and capabilities, influencing their adoption of mechanical farming technologies. According to a study conducted by a research group at the University of Philippines Los Baños (UPLB), farmers who

have access to irrigation infrastructure are more likely to use automated farming practices due to the higher potential for higher yields and more frequent cropping cycles. The study also revealed that farmers with access to farm machinery and inputs are more inclined to accept automated farming because it reduces labor needs (Peng et al., 2022).

Another critical aspect of the adoption of mechanization is credit availability. According to studies conducted in the Philippines, farmers, particularly small-scale farmers, need help acquiring essential gear and equipment due to a lack of affordable loans. Improving access to financing through financial institutions or government assistance programs can play a critical role in boosting mechanization among rice farmers in the Davao Region (Mariano et al., 2012). Training and technical assistance are also necessary in implementing mechanized farming practices. According to research conducted in the Philippines, it is critical to provide farmers with training programs on the appropriate usage and maintenance of machinery (Yamagishi et al., 2021). Training programs that emphasize efficient farm management approaches and the incorporation of mechanization into farming systems have been shown to be beneficial in increasing adoption and maximizing the benefits of mechanization. Farm size is another factor that promotes the adoption of mechanization. Larger farms typically possess greater financial capacity and economies of scale, enabling them to invest more efficiently in machinery. However, small-scale farmers in the Davao Region may need help adopting mechanization due to limited resources and higher investment prices (Baconguis, 2022). Policies and programs tailored to the needs of small-scale farmers can help overcome these constraints and enhance automation adoption. Education level, age, and farming experience are all socioeconomic criteria influencing the adoption of mechanized agriculture practices. Cruz et al. (2016) discovered that younger and better-educated farmers are more inclined to adopt automation because they are more open to innovation and have a better awareness of its potential benefits. Understanding the

socioeconomic characteristics of rice farmers in the Davao Region might provide insight into the region's distinct problems and prospects for mechanization adoption.

While studies conducted specifically in the Davao Region may be limited, drawing on research from the broader Philippine context and studies highlighting regional differences can provide valuable insights into the factors influencing mechanization adoption. These findings can inform strategies and interventions aimed at promoting mechanized farming practices among rice farmers in the Davao Region and addressing the unique challenges faced by farmers in the area.

Impact of the RCEF Mechanization Program.

Evaluating the impact of the RCEF Mechanization Program on rice farmers' productivity in the Davao Region is crucial to understanding the program's effectiveness and its contributions to agricultural development. Previous research in various contexts has shed light on the positive effects of similar mechanization projects, providing significant insights into the possible consequences of the RCEF Mechanization Program. Adoption of mechanical farming technologies has a favorable impact on production, income levels, and agricultural efficiency, according to research undertaken in many regions and countries. According to the World Bank (2017), mechanization reduces labor requirements, boosts agricultural activity timeliness, and improves the overall efficiency of farm processes. These variables, in turn, boost productivity by allowing farmers to accomplish operations more efficiently, cover more land, and lower post-harvest losses. Rice yields increased dramatically due to mechanical farming practices, according to research looking at the benefits of mechanization projects (Hasan et al., 2020).

According to Spielman et al. (2008), using machines can save up to 50% on labor expenses while minimizing losses associated with manual procedures. The study also discovered that mechanized agriculture could yield higher revenues. The study did discover, however, that

the use of mechanical agriculture is only sometimes suited for some farming systems. The cost of machinery may be prohibitive in certain circumstances, and in others, the use of machinery may be incompatible with specific crops or agricultural practices. Furthermore, the Department of Agriculture (2022) offered a complete summary of the RCEF Mechanization Program and its prospective impact on Davao Region rice producers. The RCEF program has the potential to dramatically enhance rice farmers' productivity, income levels, and overall farm performance. They also emphasized that the program could help rice producers in the Davao Region manage climate change, human resource shortages, and high production costs.

Challenges Faced by Rice Farmers in Adopting Mechanized Farming Practices and in Accessing the RCEF Mechanization Program.

Adopting mechanized farming practices and accessing the RCEF Mechanization Program can face various challenges that must be addressed to ensure effective implementation and maximize the program's impact on agricultural productivity in the Davao Region. One of the issues is rice farmers' need for more awareness and expertise regarding automation. Many farmers may need to become more familiar with the benefits and possibilities of mechanical farming operations, which may lead to apprehension or resistance to adopting such practices. Addressing this challenge requires targeted awareness campaigns and educational programs highlighting the advantages of mechanization, demonstrating successful case studies, and providing information on available support programs like the RCEF Mechanization Program (Department of Agriculture - RO XI, 2022).

The International Food Policy Research Institute [IFPRI] (2023) reported on the challenges and opportunities of financing agricultural mechanization in developing countries. The high costs of acquiring farm machinery and equipment can be a significant barrier to adoption. Mechanized farming equipment can be expensive, and the financial burden may be challenging for small-scale farmers with limited resources. Facilitating access to

affordable credit or exploring innovative financing mechanisms can help farmers overcome this challenge. Collaborations with financial institutions and providing subsidies or loans at low interest rates can make mechanization financially more accessible for rice farmers. Limited credit availability is another challenge hindering farmers' access to the RCEF Mechanization Program. Small-scale farmers, in particular, may need more collateral or an insufficient credit history to secure loans or credit. Expanding access to credit through targeted programs, microfinance institutions, or government initiatives can help farmers overcome this challenge and enable them to invest in mechanization.

According to the Food and Agriculture Organization (2016), inadequate infrastructure, such as poor road networks, limited access to irrigation, and insufficient storage facilities, can pose challenges to effectively adopting mechanized farming practices. Lack of infrastructure can impede the efficient use of machinery, the transportation of equipment, and the proper storage of harvested crops. Addressing these infrastructure gaps requires investments in rural infrastructure development, including road networks, irrigation systems, and post-harvest facilities, to support the successful implementation of mechanization. Limited training and technical support can also hinder the adoption of mechanized farming practices. Farmers may need more knowledge and skills to operate and maintain the machinery effectively. Providing comprehensive training programs, technical assistance, and extension services is essential to equipping farmers with the required expertise and ensuring the sustainable adoption of mechanization. Collaborations with agricultural research institutions, agricultural extension offices, and local farming associations can facilitate the dissemination of knowledge and offer ongoing support to farmers.

METHODOLOGY

Locale of the Study. The study was conducted in Barangay Dujali, a vibrant and significant

agricultural community in Braulio E. Dujali, Municipality of Davao del Norte. This specific location was carefully chosen as the research site due to its suitability for representing the broader context of the Davao Region and providing valuable insights into the RCEF Mechanization Program's impact on rice farmers' agricultural productivity.

Respondents of the Study. The study's respondents were rice farmers who were recipients of RCEF program from Barangay Dujali, Municipality of Braulio E. Dujali. These farmers were purposely selected and identified through the Office of Municipal Agriculturists to give focused insights into the impact of the RCEF Mechanization Program.

Research Instrument. The research instrument was designed to assess the progress of the RCEF Mechanization Program implementation and its effects. It is divided into two parts: socio-demographic data, such as age, education levels, farming experience, and access to machinery as precondition attributes to establish the respondent context, while mechanized technologies, changes in labor demand, technologies applied, and challenges encountered in the program were the adoption attributes used to assess the program changes. Quantitative information regarding income and harvest is gathered from pre- and post-program with self-administered questionnaires. Changes in shifts are observed from pre- and post-program surveys, and adoption levels are taken with the Likert scale. These include four-wheel tractors and precision seeders with a special focus on issues of cost and availability of inputs.

Data Collection and Analysis. The study employed a structured questionnaire administered by the researcher. Face-to-face interviews were conducted, enabling a deeper understanding of the respondents' perspectives and allowing for a more comprehensive questioning process. The collected data were carefully tabulated, categorized, and analyzed using Statistical Package for the Social Sciences (SPSS) version 21. Descriptive statistics, such as frequency and percentage,

were utilized to provide a clear overview of the data and uncover patterns and trends. This approach facilitated a comprehensive analysis of the research objectives. Pearson Product-Moment Correlation and t-test for dependent samples were employed to test the study hypotheses. Pearson Product-Moment Correlation was conducted to explore the relationships between the respondents' socio-demographic characteristics and farm productivity. Also, paired sample t-test analysis ensured that the findings were statistically valid and provided meaningful insights into the impact of the RCEF Mechanization Program on agricultural productivity in the Davao Region.

RESULTS AND DISCUSSIONS

1. Socio-demographic Characteristics of Rice Farmers.

Age. Table 1 shows the respondents' ages, ranging from 37 to 76 years old. Based on the data, slightly more than two-thirds (34%) of the farmers were aged 51–60, while more than one-fourth (29%) were aged 41–50. Data reveals that a substantial portion of farmers fall within the middle-age range, and a notable proportion are in their 50s. The findings concurred with a study by Aguilar (2017), which found that the average age of rice farmers in the Philippines is 53 years. This suggests that the majority of rice farmers are middle-aged. The study also found that the average age of rice farmers is increasing, which is a concern for the future of rice farming.

Table 1
Age distribution of farmer-respondents

Age	Frequency	Percentage
Below 30 years old	1	3
31-40 years old	1	3
41-50 years old	1	29
51-60 years old	10	34
Above 60 years old	11	31
Total	35	100

Gender. Figure 2 presents the gender distribution of the farmer-respondents. More than three-fifths (63%) of the farmers were male, while females constituted more than two-thirds (37%). The finding suggests that male farmers were the predominant contributors to rice production. This is consistent with the results of Pradhan and Jena (2016), who found that men are more likely to be involved in rice farming than women.

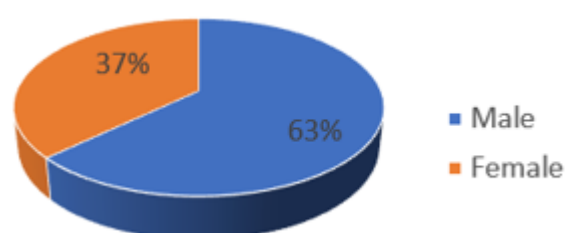


Figure 2
Gender distribution of the farmer-respondents

Marital Status. Table 2 illustrates the distribution of the farmers according to marital status. Most (89%) of the farmers were married. This suggests that the farmers have families to care for and support. The International Rice Research Institute found that 90% of the rice farmers in the Philippines were married and viewed marriage as a critical component of social and economic stability.

Table 2
Marital status distribution of farmer-respondents

Marital Status	Frequency	Percentage
Single	1	3
Married	31	88
Widowed	3	9
Total	35	100

Educational Attainment. Figure 3 indicates the educational attainment distribution of the farmer-respondents. The respondents in this survey attained notably different levels of formal education. Two-fifths (40%) of the farmers were high school graduates, more than one-fourth (29%) graduated from elementary, and 9% completed a college degree. This shows that many farmers have limited formal education. According to Reyes (2016), farmers

with lower levels of education are less likely to embrace and adopt new farming practices and modern agricultural technologies.

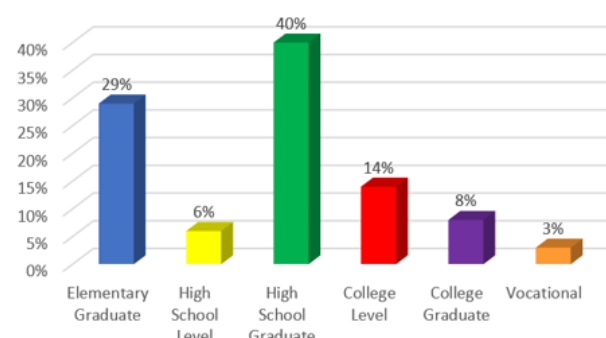


Figure 3
Educational attainment distribution of farmers-respondents

Household Size. Figure 4 shows the household size distribution of the farmer-respondents. Almost three-fourths (74%) of the farmers had 4-6 household members, while only 14% had 1-3 household members. The family size of the respondent households varied from a minimum of 1 to a maximum of over 10 members, with a mean of 5. According to the Philippine Statistics Authority (PSA)'s 2020 Census of Population and Housing (CPH), the average household size in the Philippines is 4.1 persons. This suggests that the farmer respondents have a large household.

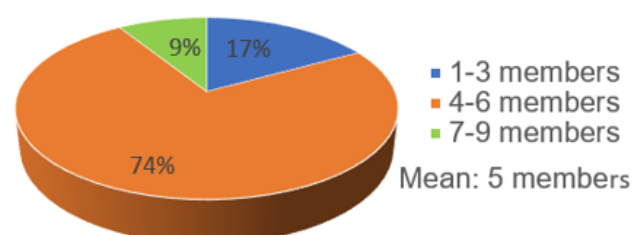


Figure 4
Household size distribution of the farmer-respondents

Land Tenurial. Table 3 shows the land tenure distribution of farmer-respondents. Almost two-thirds (62%) of the farmers were landowners, while one-fifth (20%) were tenants. This implies that many farmers have the security of land tenure. This accords with the World Bank's (2017) statement that secure land tenure is vital for farmers to invest in their land and improve their productivity. Furthermore, according to IFPRI (2016), when farmers have

secure land tenure, they are more likely to adopt new technology and techniques, leading to increased yields and incomes.

Table 3
Land tenurial distribution of the farmer-respondents

Land tenurial	Frequency	Percentage
Owner	33	94
Tenant	2	6
Total	35	100

Farming Experience. Figure 5 shows the distribution of farmers according to farming experience in rice production. Over half (57%) of the farmers farmed for 10 to 30 years, while less than one-fourth (20%) cultivated their farms for 31–50 years. The most extended farming experience was 56 years, while the shortest was three years, with a mean of 25 years. This implies that participants are well-experienced in farming. According to Claeys et al. (2017), the wide range of farming experience shows a diversity of knowledge and abilities among the farmers, which can be a valuable resource for the agricultural community.

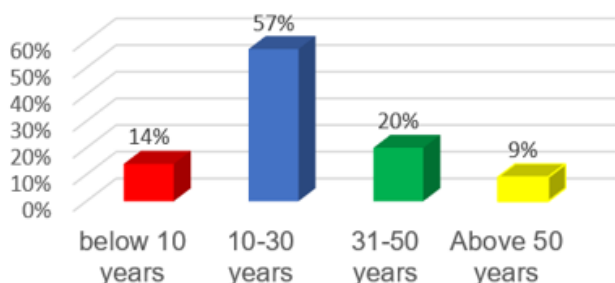


Figure 5
Farming experience distribution of farmer-respondents

Farm Size. Table 4 reflects the farm size distribution of the farmer-respondents. Three-fifths (60%) of the farmers have 1.0–2.0 hectares, while less than one-fourth (23%) have less than 1.0 hectares. The largest farm was 3.5 hectares, and the smallest was 0.25 hectares, with an average farm size of 1.58 hectares. This indicates that the farmers cultivated a relatively small land area. According to the Philippine Statistics Authority (PSA), the average farm size in the Philippines in 2021 was 1.29 hectares. The PSA also reported that the number of farms in the Philippines decreased by 0.7% in 2021.

Table 4
Farm size distribution of the farmer-respondents

Farming Size	Frequency	Percentage
below 1 hectare	8	23
1–2 hectares	21	60
3–4 hectares	5	14
5 hectares and above	1	3
Total	35	100

Mean: 1.58 hectares

Adoption of Farm Mechanization. As reflected in Table 5, all respondents were adopters of farm mechanization. During land preparation, all rice farmers used floating tillers, while more than three-fourths (77%) used hand tractors, and only 14 % used four-wheel tractors. The result also shows that the level of mechanization in different stages of rice cultivation is very high, aside from crop establishment, where only two-fifths (40%) of the rice farmers used walk-behind transplanters, followed by riding-type transplanters (6%), and precision seeder (3%).

Table 5
Machinery adopted during rice cultivation

Farm Activities and Machineries	Frequency (N=35)	Percentage
Land Preparation		
Four-Wheel Tractor	5	14
Hand Tractor	27	77
Floating Tiller	35	100
Crop Establishment		
Precision Seeder	1	3
Riding-type Transplanter	2	6
Walk-behind Transplanter	14	40
Harvesting & Threshing		
Reaper	1	3
Combined Harvester	35	100
Drying & Milling		
Single Pass Rice Mill	35	100

The harvesting and threshing stages, as well as drying and milling, were also highly mechanized. The farmers commonly used a combined harvester and single-pass rice mill during these stages. This implies that the farmers see the adoption of mechanized rice farming as beneficial. According to Singh et al.

(2018), mechanization can help improve rice production efficiency by reducing the time and labor required. Zhang et al. (2012) also found that mechanization can reduce the total labor requirement for rice production by up to 30%.

2. The changes in rice production before and after the RCEF Mechanization Program among rice farmers.

Table 6 shows the changes in rice production among rice farmers before and after the RCEF Mechanization Program. The study's findings indicate a positive impact of the RCEF Mechanization Program on rice production among farmers. The comparison of rice production per sack before and after the program's implementation reveals an overall increase in productivity. Before the program, the mean rice production per sack was recorded at 134.79, with a standard deviation of 107.987. This suggests that there was significant variation in production levels among farmers, with some achieving higher yields while others struggled to meet the average. The wide standard deviation implies a need for more consistency and efficiency in rice production practices. However, after implementing the RCEF Mechanization Program, the mean rice production per sack increased to 142.09, with a standard deviation of 111.425. This indicates an overall improvement in production and a reduction in the variation among farmers' yields. The narrower standard deviation suggests that the program helped to enhance consistency and efficiency in rice production practices across the board. These findings demonstrate that the RCEF Mechanization Program has positively influenced rice production among farmers. The program's focus on providing farmers with modern machinery has yielded tangible results. Farmers could increase their productivity and achieve consistent yields by adopting mechanized techniques. The increase in production per sack signifies improved efficiency in rice cultivation, as mechanization likely reduced labor requirements and enhanced precision in farming operations (Cui et al., 2018). Mechanized equipment such as seeders, transplanters, and harvesters can contribute to

faster and more accurate planting, transplanting, and harvesting processes. This, in turn, leads to higher yields and improved overall productivity (Li et al., 2021).

Moreover, the reduction in standard deviation suggests that the RCEF Mechanization Program helped bridge the productivity gap among farmers. By providing access to modern machinery and promoting uniform adoption of mechanized practices, the program likely contributed to a more level playing field for rice producers. This leveling of the playing field can promote equity and sustainability in the agricultural sector by ensuring that farmers across different socio-economic backgrounds have equal opportunities to succeed.

Table 6
The changes in rice production before and after the RCEF Mechanization Program among rice farmers

	Rice Production (sacks)	
	Before	After
Mean	134.79	142.09
Median	108.00	116.00
Std. Deviation	107.987	111.425

3. The changes in income before and after the RCEF Mechanization Program among rice farmers.

Table 7 illustrates the changes in estimated income for rice farmers before and after the implementation of the RCEF Mechanization Program. It reveals that, on average, the farmer's mean income increased by approximately 18.1% and a significant increase of about 32.7% in the median, which demonstrates that rice farmers gained more after the program and indicates that the income of the typical farmer was enhanced. It could also suggest that the mechanization program positively influenced the overall productivity and profitability of the farmers. This result is in supports the studies of Alvaro et al. (2021), Casinillo, L. F. (2022), and Aureada, C., & Dizon, R. (2024), which claim that agricultural

mechanization significantly enhanced productivity, which leads to increased income among farmers.

Table 7
The changes in income before and after the RCEF Mechanization Program among rice farmers.

	Farm Income (Peso)	
	Before	After
Mean	156,242.83	184,508.00
Median	110,160.00	146,160.00
Std. Deviation	127,348.51	247,122.09

However, the standard deviation has almost doubled after the program, indicating increased variability in income among farmers. This could suggest that while some farmers benefited significantly from mechanization, others may not have seen the same level of improvement or that income disparities have widened. According to a study conducted by Jena, P. R., & Tanti, P. C. (2023), income with new technologies, not all farmers were equally equipped to succeed, leading to a widening socio-economic gap within farming communities. In addition, a study by Huo, Y., Ye, S., Wu, Z., Zhang, F., & Mi, G. (2022) found that while mechanization led to increased yields for some farmers, it also highlighted the disparities in access to technology and capital. Farmers who could afford investment in mechanization saw significant income increases, whereas those who did not remained stagnant or even faced declines. Although mechanization could lead to greater efficiency and productivity, it also posed risks for certain smallholder farmers who could not compete effectively, thus widening the income gap. The report highlighted that such variability demonstrates how technological advancements, without inclusive support mechanisms, can exacerbate disparities (FAO, 2021, as mentioned by UNICEF, 2021).

4. Changes in Labor Requirements and Labor Costs among Rice Farmers Before and After RCEF Mechanization Program.

Table 8 provides insights into the changes in labor requirements and labor costs among rice farmers before and after the implementation of the RCEF Mechanization Program. The findings shed light on the program's impact on labor utilization and the costs of various operation stages of rice production.

Starting with the number of laborers required. In land preparation, the study shows that the mean number of laborers needed before the program was 2.06, with a standard deviation of 0.504. After the program, the mean decreased slightly to 2.00, with a standard deviation of 0.508. This suggests that the program had a minimal effect on labor requirements for land preparation. However, it is important to note that the standard deviations indicate a relatively low variation in labor requirements, suggesting consistent practices among farmers at this stage. Moving on to crop establishments, the study reveals that the mean number of laborers required before the program was 20.50, with a standard deviation of 6.84. After the program, the mean decreased significantly to 2.88, with a standard deviation of 1.0. This substantial reduction in labor requirements indicates the successful adoption of mechanized techniques. The lower standard deviation suggests a more uniform and consistent adoption of mechanization among farmers during crop establishment. For harvesting and threshing, the study found that after the RCEF Mechanization Program, the mean number of laborers required was 3.32, with a standard deviation of 0.723. Unfortunately, no data is available at this stage regarding the number of laborers needed before the program. Nevertheless, the relatively low standard deviation implies that the mechanization program contributed to streamlining and standardizing the labor requirements for harvesting and threshing processes among the respondents.

When examining the changes in labor costs, the study reveals noteworthy insights as well. In land preparation, the mean cost of laborers before the program was 6,832.76, with a standard deviation of 4,630.43. After the

program, the mean increased to 7,956.09, with a standard deviation of 5,551.27. This suggests that while there was a slight increase in labor costs, the higher standard deviation indicates a wider variation in labor costs after the program's implementation. Regarding crop establishment, the mean cost of laborers before the program was 7,229.69, with a standard deviation of 5,477.71. After the program, the mean cost decreased significantly to 3,482.36, with a standard deviation of \$3,206.76. This substantial decrease in labor costs suggests that the mechanization program has positively impacted the reduction of expenses associated with labor at this stage. The lower standard deviation implies more consistent and uniform mechanization adoption among farmers, reducing labor costs.

Regarding harvesting and threshing costs, the mean cost of laborers was 18,285.82 before the program, with a remarkably high standard deviation of 716,210.80. After the RCEF Program, the mean cost decreased to 11,577.86, with a standard deviation of 11,569.44. However, it is essential to interpret these findings cautiously due to the extremely high standard deviation, which indicates significant variability in labor costs at this stage.

Table 8
Changes in Labor requirement and Labor Cost among rice farmers

Operation	Labor and Cost Changes			
	No. of Laborer		Cost	
	Before	After	Before	After
Land Preparation				
Mean	2.06	2.00	6,832.76	7,956.09
Std.Deviation	.504	.568	4,630.43	5,551.27
Crop Establishment				
Mean	20.50	2.88	7,229.69	3,482.36
Std.Deviation	6.84	1.00	5,477.71	3,206.76
Harvesting & Threshing				
Mean	28.23	3.32	18,285.82	11,577.86
Std.Deviation	7.894	.723	16,210.80	11,569.44
Drying				
Mean				
Std.Deviation				

Unfortunately, the respondents did not provide data on the number of laborers required and the associated costs before and after the program for the drying stage. Thus, it is not possible to make direct comparisons or draw conclusions

regarding the impact of the mechanization program on labor requirements and costs at this stage.

5. Relationship Between Socio-Demographic Characteristics and Farm Productivity in adopting the RCEF Mechanization Program.

Table 9 shows the relationship between the socio-demographic characteristics of the respondents and farm productivity after adopting the RCEF Mechanization Program. The results indicate a significant positive correlation between respondents' age and farm productivity, with a p-value of 0.036. This suggests that as the age of the respondents increases, farm productivity also tends to increase (Tauer, L., 2019). Furthermore, a strong correlation was observed between farm productivity and farm size, with a p-value of 0.000 or 0.001. This indicates that larger farm sizes are associated with higher productivity levels in the RCEF Mechanization Program context.

Table 9
Relationship between socio-demographic characteristics and farm productivity

		1	2	3	4	5	6	7	8
Farm Productivity	Pearson Correlation	1							
	Sig. (2-tailed)								
Age	Pearson Correlation	.367*	1						
	Sig. (2-tailed)	.036							
Gender	Pearson Correlation	.058	-.007	1					
	Sig. (2-tailed)	.750	.969						
Marital Status	Pearson Correlation	.076	.247	.223	1				
	Sig. (2-tailed)	.673	.152	.198					
Educational Attainment	Pearson Correlation	.279	-.262	.257	.091	1			
	Sig. (2-tailed)	.116	.129	.136	.604				
Years of Farming	Pearson Correlation	.241	.665**	-.179	-.202	-.456**	1		
	Sig. (2-tailed)	.177	.000	.303	.244	.006			
Household Size	Pearson Correlation	-.022	-.086	-.010	.049	-.048	.098	1	
	Sig. (2-tailed)	.904	.628	.954	.784	.790	.580		
Farm Size	Pearson Correlation	.960**	.407*	.046	.137	.243	.273	.002	1
	Sig. (2-tailed)	.000	.017	.795	.439	.165	.118	.991	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

These findings highlight the importance of considering socio-demographic factors, such as age and farm size, when assessing the impact of the RCEF Mechanization Program on farm productivity. They suggest that older respondents and those with larger farm sizes are more likely to experience positive outcomes and enhanced productivity by adopting mechanization technologies. This information can be valuable for policymakers and

stakeholders in tailoring interventions and support measures to maximize the program's impact and benefit many farmers in the Davao Region.

6. Challenges Encountered in Adopting the RCEF Machineries.

Table 10 presents the challenges encountered by the respondents in adopting the RCEF Machineries. The findings highlight that the most prevalent challenge, reported by 35% of the respondents, is the Size and Suitability of Farms. This suggests that farmers need help in utilizing the machinery effectively due to the varying sizes and suitability of their farms. Another significant challenge mentioned by 15% of the respondents is the concern that the machinery can potentially destroy soil structures and paddies. This indicates that there are apprehensions about the impact of the mechanization process on the overall soil quality and traditional rice farming methods.

Additionally, 10% of the respondents expressed that the effectiveness of the machinery is dependent on the soil conditions. In comparison, 7.5% highlighted that the land areas become compact due to machinery use. A smaller percentage of the respondents mentioned specific challenges, such as the creation of missing hills using transplanters (5%), limited availability of transplanters (2.5%), limited coverage (2.5%), and the creation of swamps (1%).

These findings shed light on rice farmers' various challenges in adopting the RCEF Machineries. The results underscore the importance of addressing issues related to farm size and suitability, soil structure preservation, and the overall effectiveness of the machinery. By understanding these challenges, policymakers and program implementers can develop targeted interventions and provide the necessary support to overcome these obstacles, thereby maximizing the benefits of the RCEF Mechanization Program and improving agricultural productivity in the Davao Region.

Table 10
Challenges encountered in adopting the RCEF Machineries

Challenges	Frequency	Percent
Destroy soil structures and paddies.	6	15.0
It creates a swamp.	1	2.5
It Deepened Soil	4	10.0
Land areas become compact.	3	7.5
Limited Coverage	1	2.5
Limited Number of Transplanter	1	2.5
Missing hills using a transplanter.	2	5.0
Size and Suitability of Farms	14	35.0
Total	40	100.0

**Multiple responses*

Table 11
Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
					Lower	Upper		
Pair 1	Income Before Income After	-27629.9583	34140.9824	6968.9989	-42046.4308	-13213.4858	-3.965	.001

Level of Significance:0.05

Decision: reject H0 if p-value < 0.05, otherwise accept

Since our p-value = .001, which is lesser than 0.05, we reject H0

The study conducted a statistical analysis to determine the impact of the RCEF Mechanization Program on farmers' income. The research used a significance level of 0.05, meaning, the researchers consider results with a p-value less than 0.05 statistically significant. The table above found that the p-value was calculated to be 0.001, which is lower than the significance level. Therefore, the null hypothesis is rejected as the mean income of farmers before and after the RCEF Mechanization Program differs significantly. In other words, the income levels have changed significantly due to the program. Based on the findings, it can be concluded that the mean income of farmers before the program is lower than the mean income after the program. This suggests that the RCEF Mechanization Program has effectively increased farmers' income.

Table 12
Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Harvest_Before - Harvest_After	-7.303	19.272	3.355	-14.137	-.470	-2.177	32	.037

Level of Significance:0.05

Decision: reject H0 if p-value < 0.05, otherwise accept

The study aims to determine the RCEF Mechanization Program's impact on farmers' production levels. The analysis employed a significance level of 0.05, which means that results with a p-value below 0.05 are considered statistically significant. The table above revealed that the calculated p-value was 0.037, lower than our significance level. Therefore, the null hypothesis is rejected as the mean production of farmers before and after the RCEF Mechanization Program differs significantly. In simpler terms, there has been a notable change in production levels as a direct result of the program. Based on the result, it can be concluded that the mean production of farmers before the program was lower than the mean production after its implementation. This suggests the RCEF Mechanization Program has effectively increased farmers' production levels. The RCEF Mechanization Program has had a significant positive impact on farmers' production levels. The program has resulted in a considerable increase in production, highlighting its effectiveness in enhancing rice productivity.

Conclusion. The rice farmers were middle-aged adults, male, married, and with limited formal education. They had a large household and were experienced owners of small farms. Land preparation, harvesting, and threshing, as well as drying and milling, were already extensively mechanized in rice production, particularly in the Davao Region. Floating tillers, combined harvesters, and single-pass rice mills were the most commonly utilized rice farming machinery.

The RCEF Mechanization Program positively impacted rice production, labor requirements, and costs. It improved productivity by providing modern machinery and promoting mechanized techniques, resulting in higher yields and consistent farming practices. The program also addressed labor challenges by reducing the need for manual work during crop establishment, harvesting, and threshing. While costs slightly increased for land preparation, they substantially decreased for crop establishment and harvesting/threshing. Although data needed to be included for the

drying stage, the program has the potential to enhance the efficiency and cost-effectiveness of rice farming by reducing labor requirements and costs overall.

Moreover, the study revealed that the RCEF Mechanization Program significantly impacted farmers' income and production levels. Older respondents and those with larger farms achieved higher productivity through the program, emphasizing the importance of socio-demographic factors in assessing its effectiveness. Policymakers and stakeholders can utilize this information to tailor interventions and support measures that maximize the program's benefits for farmers in the Davao Region. The statistical analysis confirmed a substantial increase in mean income and production after the program, with p-values of 0.001 and 0.037, respectively. These findings prove that the RCEF Mechanization Program improved farmers' income and production.

Furthermore, the study identified key challenges rice farmers face in adopting the RCEF Machineries, including farm size and suitability, potential soil damage, soil conditions, land compaction, limited machinery availability, limited coverage, and the creation of swamps. To ensure the program's success, it is crucial to address these challenges. Policymakers and program implementers can use this information to develop targeted interventions and support measures that tackle these issues. By doing so, the benefits of the RCEF Mechanization Program can be maximized, leading to improved agricultural productivity in the Davao Region.

Overall, the program has successfully enhanced rice productivity, significantly increasing farmers' production.

Recommendations. To maximize the benefits of the RCEF Mechanization Program and improve agricultural productivity in the Davao Region, policymakers and program implementers should consider the following recommendations.

First, ensure easy access to modern machinery and equipment by collaborating with agricultural machinery providers, financial institutions, and local cooperatives.

Second, implement comprehensive training programs and provide technical support to educate farmers on machinery usage and maintenance.

Third, customize interventions based on socio-demographic factors to address specific needs and challenges different groups of farmers face. Fourth, tackle key challenges such as farm size, soil damage, land compaction, limited machinery availability, and limited coverage by implementing targeted solutions like soil conservation measures and improved drainage systems.

Finally, establish a system for continuous monitoring and evaluation, collecting data on all stages of rice farming, including the drying stage, to inform decision-making and identify areas for improvement.

By implementing these recommendations, the RCEF Mechanization Program can enhance rice productivity and improve livelihoods for farmers in the Davao Region.

REFERENCES

- Abaro, R. D. (2021). Palay and corn quarterly bulletin January - March 2021 Davao Region | Philippine Statistics Authority Region XI. Philippine Statistics Authority. Retrieved from <https://rsso11.psa.gov.ph/article/palay-and-corn-quarterly-bulletin-january-march-2021-davao-region>
- Abril, J., Balgos, J., & Francisco, J. (2020). The RCEF Mechanization Program: A Review of Its Implementation and Impact. *Philippine Journal of Agricultural Economics*, 63(1), 1-19.
- Aguilar, M. (2017). Aging Filipino rice farmers and their aspirations for their children. *Philippine Journal of Science*, 146(2), 211-224. doi:10.1526/philsci.146.2.211.2017
- Alvaro, L. L. R., Angeles, M. K. S., Celis, E. C., Dela, V. S., Cruz, J. J. D., Espiritu, I. V., & Esquivel-Santos, M. G. (2021). Effects of Farm Mechanization on the Lives of Rice Farm Workers of Cabanatuan City, Nueva Ecija. *International Journal of Advanced Engineering, Management and Science*, 7, 8.
- Aureada, C., & Dizon, R. (2024). The Impact of Rice Tariffication Law on Rice Farmer Income and Occupational Choice: A Microsimulation Approach. *International Journal of Economics*, 9(3).
- Baconguis, R. T. (2022). Agricultural Technology: Why Does the Level of Agricultural Production Remain Low Despite Increased Investments in Research and Extension? In discussion paper series No. 2022-06. Think Asia. Retrieved from <https://think-asia.org/bitstream/handle/11540/14877/pidsdps2206.Pdf?sequence=1>
- Blanc, E., & Strobl, E. (2016). Assessing the Impact of Typhoons on Rice Production in the Philippines. *Journal of Applied Meteorology and Climatology*, 55(4), 993-1007. Retrieved from <https://doi.org/10.1175/jamc-d-15-0214.1>
- Casinillo, L. F. (2022). Modeling profitability in rice farming under Philippine rice tariffication law: an econometric approach.
- Claeys, I., Bruggeman, S., & Van Huylenbroeck, G. (2017). The impact of farmers' age and experience on farm management practices: A review of the literature. *Agricultural Economics*, 48(3), 309-322.
- Competitiveness Enhancement Fund (RCEF) Mechanization Program. Retrieved from <https://rcef.da.gov.ph/mechanization/>

- Cruz, M., Son, V., & Otsuka, K. (2016). Mechanization adoption in rice production: A socio-economic study of rice farmers in the Davao region, Philippines. International Rice Research Institute.
- Cui, Z., Zhang, H., Chen, X., Zhang, C., Ma, W., Huang, C., ... & Dou, Z. (2018). Pursuing sustainable productivity with millions of smallholder farmers. *Nature*, 555(7696), 363-366.
- Department of Agriculture. (2019). Rice Competitiveness Enhancement Fund (RCEF) Mechanization Program. Retrieved from <https://rcef.da.gov.ph/mechanization/>
- Department of Agriculture - Regional Office XI. (2022). Assessing the Impact of the RCEF Mechanization Program in the Davao Region. Davao City, Philippines
- Department of Agriculture- Regional Office XI. (2022). The Adoption of Mechanized Farming Practices in the Davao Region: Challenges and Opportunities. Davao City, Philippines.
- Department of Agriculture. (2023). RCEF Mechanization Program. Retrieved from <https://rcef.da.gov.ph/mechanization/>
- FAO (2016). Mechanization in Agriculture: Challenges and Opportunities, by the Food and Agriculture Organization of the United Nations (FAO). Retrieved from <https://www.fao.org/3/a-i6053e.pdf>
- Hasan, M. K., Tanaka, T., Alam, M. M., Ali, M. R., & Saha, C. K. (2020). Impact of modern rice harvesting practices over traditional ones. *Reviews in Agricultural Science*, 8(0), 89-108. Retrieved from https://doi.org/10.7831/ras.8.0_89
- Huo, Y., Ye, S., Wu, Z., Zhang, F., & Mi, G. (2022). Barriers to the development of agricultural mechanization in the North and Northeast China plains: A farmer survey. *Agriculture*, 12(2), 287.
- IFPRI. (2016). Land Tenure and Agricultural Productivity: Evidence from Africa. Washington, DC: IFPRI
- IFPRI (International Food Policy Research Institute). (2023). The role of finance in agricultural mechanization. Washington, DC: International Food Policy Research Institute.
- Huo, Y., Ye, S., Wu, Z., Zhang, F., & Mi, G. (2022). Barriers to the development of agricultural
- Jena, P. R., & Tanti, P. C. (2023). Effect of farm machinery adoption on household income and food security: evidence from a nationwide household survey in India. *Frontiers in Sustainable Food Systems*, 7, 922038.
- Li, F., Feng, S., Lu, H., Qu, F., & D'Haese, M. (2021). How do non-farm employment and agricultural mechanization impact on large-scale farming? A spatial panel data analysis from Jiangsu Province, China. *Land Use Policy*, 107, 105517.
- Mariano, M. J., Villano, R., & Fleming, E. (2012). Factors influencing farmers' adoption of modern rice technologies and good management practices in the Philippines. *Agricultural Systems*, 110, 41-53. Retrieved from <https://doi.org/10.1016/j.agsy.2012.03.010>
- Magrobedujali, (2024). Municipal Agriculture Office, Braulio E. Dujali, Rice data.
- Peng, X., Tan, B., & Yap, C. (2022). The impact of resource availability on the adoption of automated farming practices in the Philippines. *Journal of Agricultural Economics*, 73(2), 517-536. doi:10.1111/1477-9552.12433

- Philippine Statistics Authority. (2020). Census of Population and Housing (CPH). Quezon City, Philippines: PSA.
- Philippine Statistics Authority (PSA). (2021). Average farm size in the Philippines in 2021. Retrieved from <https://psa.gov.ph/>
- Philippine Statistics Authority. (2022). Palay and Corn quarterly bulletin January - March 2021 Davao Region. Retrieved from <https://rss011.psa.gov.ph/article/palay-and-corn-quarterly-bulletin-january-march-2021-davao-region>
- Pradhan, N.K., and S.K. Jena. "Gender inequity in rice farming: A review of the literature." *International Journal of Agricultural Sustainability* 14, no. 3 (2016): 296-311. doi:10.1080/15435624.2016.1170068.
- RCEF. (2023). Mechanization | Department of Agriculture - Rice Competitiveness Enhancement Fund. Retrieved from <https://rcef.da.gov.ph/mechanization/>
- Reyes, M. T. A. (2016). The impact of education on agricultural productivity in the Philippines. *Journal of Agricultural Economics*, 67(2), 301-318. doi:10.1111/1477-9552.12228
- Spielman, D. J., Chan-Kang, C., & Meinzen-Dick, R. (2008). The economic impact of mechanized agriculture in developing countries. *Food Policy*, 33(3), 283-29
- Stuecker, M. F., Tigchelaar, M., & Kantar, M. B. (2018). Climate variability impacts rice production in the Philippines. *PLOS ONE*, 13(8), e0201426. <https://doi.org/10.1371/journal.pone.0201426>
- Tauer, L. (2019). Farmer productivity by age in the United States. *International Journal of Agricultural Management*, 8(2), 74-80.
- UNICEF. (2021). The state of food security and nutrition in the world 2021.
- World Bank. (2017). Land Tenure and the Sustainable Development Goals. Washington, DC: World Bank.
- Yamagishi, K., Gantalao, C., & Ocampo, L. A. (2021). The future of farm tourism in the Philippines: challenges, strategies, and insights. *Journal of Tourism Futures*. Retrieved from <https://doi.org/10.1108/jtf-06-2020-0101>