

Analysis on the Resource Use Efficiency of Block Farm and Cooperative Schemes in Sugarcane Production

Cleo Jane A. Alcasid*, Harih G. Lopez

Institute of Graduate and Professional Education, Davao del Sur State College,
Matti, Digos City, 8002, Davao del Sur, Philippines

*Corresponding Author Email: prettycleo7@gmail.com

Date received: May 15, 2025

Date revised: June 4, 2025

Date accepted: July 1, 2025

Originality: 92%

Grammarly Score: 99%

Similarity: 8%

Recommended citation:

Alcasid, C. J., Lopez, H. (2025). Analysis on the resource use efficiency of block farm and cooperative schemes in sugarcane production. *Journal of Interdisciplinary Perspectives*, 3(7), 936-947.

<https://doi.org/10.69569/jip.2025.409>

Abstract. The primary aim of the study was to determine if there is a significant difference in the resource-use efficiency of sugarcane production between block farm members and cooperative members, using data from 216 farmers in Kiblawan and Hagonoy. A descriptive-comparative research design was utilized from December 2024 to February 2025. Data was analyzed using Frequency Distribution, Mean, Net Profit Margin, Cobb-Douglas production function, Marginal Value Productivity, and Resource Use Efficiency. The majority of respondents were between 52 and 67 years old, male, and almost all were married, having attained tertiary education. They dedicate their entire landholding to sugarcane farming. All the farmers have been in sugarcane production for 5 years or more, while 68.50% are members of the sugarcane farmer cooperative, and all of them have undergone training related to sugarcane production. Farmers who are members of sugarcane cooperatives spend more on labor costs per hectare than their counterparts from block farms. Even with a higher cost of production, cooperative members still reported a slightly higher net income, with a Net Profit Margin of 0.18. Consequently, the benefit-cost ratio is also higher for farmers who are members of the cooperative, at 0.23. All the variables associated with sugarcane production for cooperative member farms are overutilized, and output can be increased by reducing the units of inputs. On the other hand, for farmers under the block farm system, there is a mix of underutilization and overutilization of variables. Labor, land preparation, and transportation costs were underutilized, while the other expenses associated with sugarcane production were overutilized. To increase the efficiency of sugarcane production under block farms, it is necessary to optimize the use of inputs for labor, land preparation, and transportation costs, thereby maximizing productivity while minimizing the overutilization of resources such as machinery and equipment, fertilizers, and pesticides.

Keywords: Benefit: cost ratio; Profitability; Resource use efficiency; Sugarcane farming.

1.0 Introduction

Sugarcane farming plays a significant role in the Philippines, contributing to the country's economy, employment, and agricultural sector (Mandegari et al., 2019). It also provides employment opportunities for many Filipinos in rural and urban areas (De Leon, 2019). In addition to providing sugar, sugarcane is an essential feedstock for producing bioenergy, which supports renewable energy sources (Raza et al., 2019). Millions of people in the sugarcane value chain, including farmers, labourers, and agribusinesses, depend on efficient sugarcane farming to sustain food security and consistent production levels (Martiniello & Azambuja, 2019). One of the commodities that the Philippines exports is sugar, and the United States of America is its leading importer (Abrahám et al., 2021). Sugarcane output ranks fifth among all crops produced in the Philippines (Tongson, 2019). Consequently, one of the main crops grown in the Philippines is sugarcane. Furthermore, 24.3% of all jobs in the nation are in the

This work is licensed under a Creative Commons Attribution-Noncommercial 4.0 International License (CC BY-NC 4.0).

agriculture sector (Fernandez et al., 2022). According to research by Reyes et al. (2020), the average ideal land size for sugarcane cultivation is approximately 41 hectares. This finding aligns with the 1997 report of the Sugar Industry Presidential Task Force, which recommended a maximum size of 50 hectares. However, Oñal et al. (2021) indicated that small farmers appear to have been unable to increase the yield of their land and continued to farm for subsistence due to small land area cultivation.

According to the Philippine Statistics Authority's 2018 report, there were 11.3 million workers in agriculture, 74.25% of whom were men. Most agricultural workers (61.5%) fall within the ideal age range for employment. Regarding education, the majority of the least educated sectors were in agriculture (28% having only completed tertiary undergraduate and graduate degrees), compared to 60% in industry and 74% in services. Thus, about 78,276 farmers work in the Philippines' sugarcane industry; 81.46% of them own less than 5 hectares of land, making smallholder farmers the majority of sugarcane farmers (Luzaran et al., 2022). Given the significance of the sugarcane sector, the Sugarcane Sector Roadmap was introduced by SRA in 2010 with the following objectives: to significantly expand the use of technology to enhance sugarcane farm productivity and yield; and to promote the production of bioethanol from molasses and sugarcane (Gonzaga et al., 2021).

While sugarcane farming brings significant economic benefits, it is also essential to address challenges such as pest and disease management, market fluctuations, and sustainability issues to ensure the long-term viability of the industry and the well-being of those dependent on it (El Chami et al., 2020). Thus, Pandey et al. (2020) mentioned that utilizing resources such as land, water, labor, fertilizers, and machinery directly affects the profitability of sugarcane farming operations. By maximizing the productivity of these resources, farmers can reduce production costs, increase yields, and ultimately enhance their profitability (Yang et al., 2022).

In the international context, the cost of resource use was observed to have a positive influence on sugarcane production, but no significant difference was found between tenant and owner farmers. The resources used by tenant farms were found to be underutilized, with seeds, human labor, fertilizer, and machines, whereas owner farms were found to use a greater number of seeds (Bey et al., 2021). This means that tenant farms may not have the resources or motivation to optimize inputs, which could result in poorer profitability and productivity compared to owner farms. Meanwhile, resource use efficiency was found to be better among owner farmers than among tenant farmers in sugarcane cultivation (Mitra et al., 2022). This may imply that owner farmers are financially invested in both the long-term viability of their farms and the land. On the other hand, tenant farmers may be more concerned with making quick money due to their erratic or transitory land tenure, which could result in less efficient resource use (Murken & Gornott, 2022).

In neighboring country India, agricultural subsidies are provided in various sectors, including input subsidies (for fertilizers, power, irrigation, and credit), price support subsidies, income subsidies, export subsidies, and crop insurance (Pandey et al., 2019). Despite this, the status of sugarcane production remains very low, with a higher production cost (Thibane et al., 2023). Although an adequate amount of inputs is recommended for sugarcane production, there are insufficient socio-economic studies on the capacity of farmers to allocate the cost of inputs for maximizing revenue (Ambetsa, 2020).

This implies that variations in the use and combination of various factors of production affect sugarcane yield. The Sugarcane Block Farming program has been implemented in sugarcane farms since 2012. However, since the program began, there has been little to no research on its impact on farm income and productivity (Rokhani et al., 2020). As presented by Ghamkhar et al. (2023) in their book, Block farming, as opposed to standard row farming, is the process of growing sugar cane in clusters or blocks. This technique has several potential advantages, including improved land usage, higher yields, and more economical use of resources such as fertilizer and water (Zulfiqar et al., 2019). Sugarcane growers may be able to boost yields and maximize resource utilization by implementing block farming techniques, thereby increasing cultivation efficiency and profitability (Bhatt, 2020). However, when implementing any farming ideas, local conditions – such as climate, soil type, and available resources – should always be considered.

Reviving farmer organizations has emerged as the primary paradigm for agricultural growth. Increasing farmer involvement in associations, cooperatives, and farmer groups in Indonesia is a key plan for revitalizing farmer associations (Gany et al., 2019). Thus, Nurfatriani et al. (2023) indicated that smallholder agriculture is the cornerstone of agricultural and rural economic development in developing nations, and farmer organizations play

a critical role in empowering farmers and accomplishing this objective. NNjuki et al. (2019) suggested that farmer organizations can facilitate farmers' participation in the development process. This indicates that farmers involved in cooperatives or organizations tend to enhance their farming practices as they receive various grants or initiatives from the organization itself.

Akanmu et al. (2023) argue that agricultural cooperatives serving South African small-scale farmers have not contributed to improving agricultural development and the financial security of these farmers. That contrasts with Belete and Nigatu's (2023) research, which found that joining a cooperative increases technical efficiency. This implies that consideration should also be given to the quality and capacity of cooperatives to address market imperfections. Cooperatives may carefully explore ways to improve their service to members, considering that cooperative member farmers were not significantly more technically efficient than non-members (Manikas et al., 2019).

In other countries, such as Japan, Taiwan, and South Korea, land consolidation occurred after land was distributed to the recipients of land reform (Kim & Lee, 2021). Plans for land consolidation included the actual reassignment of plots, joint farming via sales and exchanges of land, the acquisition of temporary quasi-land, and land renovation (Li, 2022). Land consolidation was not carried out as a national initiative in the Philippines. However, the DAR continued to push for the implementation of the SBF and the land consolidation-based agriculture venture agreements (AVAs) (Montefrio, 2019). This program is designed to enhance farm productivity and increase income.

Correspondingly, with the small sugarcane farm productivity hardly improving, the program was launched in 2011 by the Department of Agrarian Reform (DAR) in collaboration with the Department of Agriculture (DA) through the Sugar Regulatory Administration (SRA) to enhance the technical and agribusiness entrepreneurial skills of CARP beneficiaries and their organizations (Lala et al., 2023). Furthermore, to boost agricultural output and sugarcane yield, the Sugarcane Regulatory Administration (SRA) started using Sugarcane Block Farming (SBF) in 2012 (Matsuura, 2020). SBF is the operation consolidation using multipurpose cooperatives (Nithinyurwa & de Vries, 2021). Through the adoption and diffusion of technology, block farming has contributed to increased profit efficiency among farmers. Program members receive various forms of training, technical advice, and production support (Bastos Lima, 2021). This means that farmers who have been members of the block farming program offered by the SRA receive benefits such as training in improving their farming practices and others.

The block farm program's endowment of SRA interventions has improved the performance and increased the profitability of farmer members (Fernandez et al., 2022). Block farming, which primarily aims to help small sugarcane farmers adapt and disseminate new technology, experience, knowledge, and skills, has contributed to a rise in farmers' profit efficiency (Loison, 2019). Eleazar et al. (2024) indicated that to achieve economies of scale in sugarcane cultivation, the SRA organized small farmers into block farms, allowing them to become larger under the SBF program. The farm-based income of CARP beneficiaries will increase if the planting, harvesting, and transporting are done. Moreover, marketing of sugarcane is organized and consolidated, given the crop's need for mechanization (Munson, 2021). Additionally, lower costs for agricultural inputs – particularly fertilizer – acquired through bulk purchases and labor contracts will boost farm profit (Chen & Chen, 2021).

Meanwhile, Block farming is one of the many agricultural initiatives that both past and current governments in Ghana have implemented (Lambert, 2019). These initiatives often emphasize a quantitative increase in production to achieve food security and a significant impact on reducing poverty (Rantšo & Seboka, 2019). Since the country relies heavily on the agricultural sector, increasing the potential benefits and initiatives for farmers may lead to positive outcomes, such as improved crop production. Regarding generating profits, 98% of farmers employing block farming reported significant benefits in their lives and businesses, while 2% reported no changes (Al Mamun et al., 2022). Since over 90% of farmers report significant improvements in their lives and businesses, their focus on profit is expected to change the way families spend their money, encourage them to adopt new technologies early, reduce food insecurity and farmer poverty, and expand the market for mass production (Dominici et al., 2019). Thus, the block farming plan has significantly improved the businesses and living standards of beneficiary farmers, as well as their outputs and returns. Most people enroll in block farming programs to make a living and have simple access to loans and markets (Demedeme et al., 2022).

Efficient use of resources will enable small-scale farmers to allocate their inputs effectively and reduce wastage, whether it is excess materials, time, or energy. Ullah et al. (2019) also noted that the efficiency of resource use in sugarcane production has a positive impact on yield and production. Meanwhile, Silva et al. (2021) also indicated that by comparing the before-and-after outputs in using Sugar block farming, it can be shown that farmers' yields have increased. Increased farmers' incomes also mean that they have enough food to sustain their families, leading to self-sufficiency. This means that some farmers indicate that sugar block farming is efficacious in improving their farm performance. Suwandari et al. (2020) reported a significant improvement in sugarcane production among smallholder farmers.

Correspondingly, agricultural development can be facilitated by farmer-level institutions such as cooperatives, farmer associations, and farmer groups. Farmers can obtain a wide range of high-quality, reasonably priced agricultural inputs by banding together as an organization (Msosa, 2022). Furthermore, farmer organizations serve as a conduit for the most recent agricultural technologies and information (Raj et al., 2021). This implies that access to recent agricultural information and technology is crucial to adopting good farming practices. As a result, joining farmer organizations will increase farmers' access to high-quality inputs, the most recent agricultural technology and knowledge, and negotiating power, all of which boost farm profitability and production (Nikam et al., 2019).

Empirically, several studies have shown that farmer organizations improve farm output. For instance, Mangeni (2019) describes how organic vegetable farmer clubs strengthen social networks among farmers in Thailand. This is also supported by the findings in Ncube's (2020) study, which shows that participation in farmer organizations promotes the adoption of cutting-edge technologies, enabling small-scale farmers to innovate and adopt various farming techniques. The fact that farmers participated in cooperatives and farmer associations further demonstrated the beneficial effects (Raghunathan et al., 2019). Thus, farmers who form a cooperative can bargain for higher prices for their produce or more affordable inputs (such as machinery, seeds, and fertilizer) (Fabregas et al., 2019). Their ability to bargain collectively gives them a competitive advantage in the market.

In both rich and developing nations, agricultural cooperatives play a significant role in the global economy. According to the World Cooperative Monitor (2021), 34.7% of the top 300 cooperatives are involved in agriculture. Globally, agricultural cooperatives have the potential to secure sustainable economies and communities by controlling the environment (Kalogiannidis, 2020). By granting their members access to the economy, maintaining production continuity, and promoting sustainable agriculture, cooperatives contribute to reducing poverty and inequality. Nurdiana et al. (2023) also found that providing cooperative members and staff with access to high-quality education and training opportunities significantly enhances their work and quality of life.

Furthermore, Davey et al. (2019) found that cooperatives support sustainable production and consumption by providing and adopting sustainable technologies, such as improved seeds, organic fertilizers, and innovative farming practices. Additionally, cooperatives support environmental sustainability through activities that reduce pollution and protect natural resources. Candemir et al. (2021) also indicate that individual farmers' produce is frequently combined by cooperatives, giving them access to bigger markets that they might not otherwise be able to access. Due to economies of scale and collective bargaining strength, this may lead to higher prices and increased sales for their products (Teng et al., 2022). On the other hand, cooperatives have the potential to provide farmers with access to pooled resources and services, such as bulk purchases of equipment, fertilizer, and seeds (Bhattarai & Pandit, 2023). Members can typically obtain lower prices and lower transaction expenses by purchasing in bulk, which increases their profitability.

Similarly, Gezie (2019) noted that farmers can mitigate the effects of erratic elements, such as weather variations or market price volatility, by utilizing risk management services provided by cooperatives, including price hedging or crop insurance. Through the cooperative's networks and combined resources, members may have easier access to financing and credit possibilities (Yu et al., 2023). This might help farmers during tough times to smooth out cash flow, buy inputs, or invest in their enterprises. Thus, numerous cooperatives offer their members extension services, training, and technical support to help them adopt sustainable farming practices, increase productivity, and improve agricultural practices. Higher yields, better-quality produce, and more financial success for farmers are all possible outcomes of this support (Shamsuddoha et al., 2023).

Resource-use efficiency, on the other hand, measures a farm's ability to use inputs in optimal proportions, given their respective prices and the production technology. It is the ability to combine inputs and outputs in optimal

proportions, considering prices (Verma & Solanki, 2020). Additionally, efficient resource management can result in cost savings for sugarcane farmers (Kaab et al., 2019). This implies that by minimizing wastage and using inputs more judiciously, farmers can reduce production costs, improving overall profitability. Thus, identifying and addressing inefficient resource use can lead to increased crop yields (Gilbertson et al., 2020). This is essential for sugarcane farmers who rely on high yields to maximize their income. Ma et al. (2022) also agreed that improved resource efficiency often correlates with higher productivity.

Furthermore, along with low productivity, the cost of production is also higher, which has ultimately increased the cost of sugar in the factory (Pokharel et al., 2019). This means that sugarcane farmers should be able to manage the cost of production to gain a higher return on income. The inputs for resource use were not being utilized efficiently (Taru et al., 2018). Thus, there is a need for training sugarcane farmers on the optimum utilization of farm inputs by the extension agents. Understanding resource utilization efficiency helps farmers and cooperative members allocate resources more effectively.

Indeed, ownership status and tenure arrangements have a significant influence on resource utilization patterns in agriculture, with potential implications for productivity, profitability, and sustainability (Benjamin, 2020). However, there has been no empirical evidence on the efficiency of resource use by block farmers and cooperative members. Therefore, the study aims to assess the trends in resource use efficiency for both block farmers and cooperative members in Davao del Sur. Through this study, researchers can make informed decisions that will improve productivity and sustainability in the sugar industry.

2.0 Methodology

2.1 Research Design

The study employed a descriptive-comparative research design. As defined by Gopalan et al. (2020), descriptive survey design aims to accurately and systematically describe a population, situation, or phenomenon. Meanwhile, the researcher used and adopted questionnaires to collect numerical data from the data gathering procedure. As defined by Mehrad and Zangeneh (2019), quantitative research design emphasizes objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating pre-existing statistical data using computational techniques. The research design used was suitable for measuring the study's objectives.

2.2 Research Instrument

On the other hand, the researcher utilized a survey questionnaire that was tailored to the research objectives. It has two parts that assess the resource-use efficiency of block farm members and cooperative members in Davao del Sur. The first part deals with the socio-economic characteristics of the sugarcane farmers in Davao del Sur, which was adopted from the study of Mushi (2015) entitled "Profitability of Smallholder Sugarcane Farming Systems in Tanzania: A Comparative Analysis between Block Farming and Traditional Farming Systems in Morogoro". Meanwhile, the second part examines the resource-use efficiency of block farm members and cooperative members, which was adopted from the study by Pokharel et al. (2019), entitled "Dynamics and Economic Analysis of Sugarcane Production in Eastern Plains of Nepal". Experts in this field thoroughly reviewed the set of questions to ensure that all items were suitable for the study's objectives.

2.3 Participants and Sampling Technique

Block farm members and cooperative members were considered as the respondents of the study. The inclusion criteria for selecting respondents in the study are that they must be registered members of a cooperative involved in sugarcane production or a block farm member. They must also have farming experience, considering they are willing to participate in the study. However, the researcher excluded farmers who were not members of any cooperative or block farm, those without experience in cultivating the main crop through multiple ratoon cycles, and those outside the research locale. Notably, the number of members in cooperatives and block farms is not equal, as the study only involved those who met the inclusion criteria.

Correspondingly, universal sampling was used as the study's sampling technique. A universal sampling technique was employed, where all members of the two groups were included as respondents (Avron et al., 2019). The researcher preferred to use this sampling technique to select respondents from the cooperatives and block farms since they can provide helpful information to test the hypothesis of this research. Table 1 shows the number of respondents surveyed during the study.

Table 1. *Sample Size of the Farmers in the Study*

Cooperatives	Population
Cooperatives	148
Block Farms	68
Total	216

2.4 Research Instrument

The researcher used a survey questionnaire tailored to the research objectives. It has two parts that assess the resource-use efficiency of block farm members and cooperative members in Davao del Sur. The first part examines the socio-economic characteristics of sugarcane farmers in Davao del Sur, drawing on the study by Mushi (2015), titled "Profitability of Smallholder Sugarcane Farming Systems in Tanzania: A Comparative Analysis between Block Farming and Traditional Farming Systems in Morogoro." Meanwhile, the second part examines the resource-use efficiency of block farm members and cooperative members, which was adopted from the study by Pokharel et al. (2019), entitled "Dynamics and Economic Analysis of Sugarcane Production in Eastern Plains of Nepal." Experts in this field thoroughly checked the set of questions to ensure that all the items were suitable for the study's objectives.

2.5 Data Gathering Procedure

During the research, the researcher employed data gathering procedures to ensure that the process was grounded in the ethical principles of research. The researcher took the following steps: (a) The researcher formally requested permission from the dean of the Institute of Graduate Studies and Professional Education to conduct the research, taking into account the established timelines, (b) The researcher secured the survey questionnaire in preparation for the data gathering. Three experts were asked to review the instrument to ensure that all items were aligned with the study's objectives, (c) After checking the instrument, the researcher gathered relevant data from the cooperatives and block farm associations that pertained to the necessary information for the study. The data being gathered was collected and encoded into the spreadsheet, (d) The researcher then collated all the data and submitted it to the research statisticians for analysis. Then, based on the data gathered from the analysis, the researcher interpreted the results and discussed their implications.

2.6 Data Analysis Procedure

Frequency distributions were used to summarize categorical variables, including age groups, sex, marital status, educational attainment, household size, landholdings (in hectares), size of sugarcane farm (in hectares), years of involvement in sugarcane farming, membership in a cooperative or block farm, and training on sugarcane farming. The mean was used to determine the value of costs associated with sugarcane production, serving as a basis for calculating the total cost per hectare. The Net Profit Margin was calculated by deducting all expenses per hectare from the total revenue per hectare, expressed as a percentage. The Cobb-Douglas production function was used to describe the relationship between inputs and outputs in a production process.

3.0 Results and Discussion

3.1 Socio-Economic Characteristics of Sugarcane Farmers

Table 2 presents the socio-economic characteristics of sugarcane farmers in Davao del Sur. Data were gathered from a total of 216 respondents, comprising cooperative and block farm members. It was found that the majority of respondents were between 52 and 67 years old, while some were within the 35-51 years old age bracket (47.70%). On the other hand, the majority of farmers are male (54.60%), and almost all of them are married (96.80%), with a high proportion having reached tertiary education (88.00%). Furthermore, in terms of household size, it is notable that the majority of sugarcane farmers have a household size of 4-6 members (50.90%), followed closely by those with 1-3 household members (46.80%). It was also found that sugarcane farmers dedicate their entire landholding to sugarcane farming, as evidenced by the same percentage of farmers who have 1-2 hectares of landholding and a farm area dedicated to sugarcane farming (76.40%). The rest of the respondents also dedicate their entire landholding to sugarcane farming, with 19.90% possessing a farm area of 3-5 hectares, and 3.70% with a landholding of 6 hectares or more. Almost all farmers had been involved in sugarcane production for five years or more, while 68.50% of the respondents were members of a sugarcane farmer cooperative, and all of them had undergone training related to sugarcane production.

Table 2. Socio-Economic Characteristics of Sugarcane Farmers

Socio-Economic Characteristics	Frequency	Percentage
Age		
20-35	1	0.50
36-51	103	47.70
52-67	111	51.40
68 and above	1	0.50
Sex		
Male	118	54.60
Female	98	45.40
Marital Status		
Single	4	1.19
Married	209	96.80
Widowed	3	1.40
Educational Attainment		
Elementary	4	1.90
High School	20	9.30
Tertiary	190	88.00
Vocational Level	2	0.90
Household Size		
1-3	101	46.80
4-6	110	50.90
7-9	4	1.90
10 and above	1	0.50
Landholdings (ha)		
1-2	165	76.40
3-5	43	19.90
6 and above	7	3.70
Size of Sugarcane Farm (ha)		
1-2	165	76.40
3-5	43	19.90
6 and above	7	3.70
Years Involved in Sugarcane Farming		
1-2	21	9.70
3-5	21	9.70
5 and above	174	80.60
Membership		
Cooperative	148	68.50
Block Farm	68	31.50
Training about Sugarcane		
Yes	216	100.00
No	0	0

3.2 Cost of Production and Benefit: Cost Ratio of Sugarcane Production

Table 3 presents the cost of producing sugarcane on a per-hectare basis in Davao del Sur, both for cooperative and block farm setups. This data was computed based on the average of costs reported by farmers per variable. Expenses incurred by farmer-members of cooperatives were tabulated separately from those under block farms, on a per-hectare basis, to ensure uniformity and accuracy of data. The average was computed per group and was used as the basis for computation and comparison.

It was found that farmers who are members of sugarcane cooperatives spend more than their counterparts from block farms, as the labor cost for cooperative members reached as high as P50,785.23 per hectare, which is slightly higher than those under block farms at P48,134.33 per hectare. On the other hand, other costs associated with sugarcane production are higher in sugarcane farms operated by farmer-members of a cooperative, unlike those under a block farm set up, such as land preparation costs, machinery costs, fertilizer costs, costs associated with fertilizers, herbicides, and pesticides, as well as transportation costs. It is also notable that farms under block farms did not report water cost or cost associated with irrigating sugarcane farms, compared with respondents who are cooperative members who reported that they have expenditures for irrigating their sugarcane farms, which is presented in Table 3 per hectare basis.

Table 3. Cost of Production and Benefit: Cost Ratio per Hectare Basis of Sugarcane Production in Davao Del Sur

	Cooperative	Block Farm
Labor Cost (Php/ha)	50,785.23	48,134.33
Land Preparation Cost (Php/ha)	71,375.84	65,671.64
Water Cost (Php/ha)	826.91	0.00
Machinery and Equipment (Php/ha)	14,322.15	13,671.64
Fertilizer Cost (Php/ha)	11,701.34	10,343.28
Pesticides/Herbicides (Php/ha)	3,502.68	2,935.82
Transportation Cost (Php/ha)	79,644.30	73,955.22
Total	232,158.50	214,711.90
Average Revenue (Php/ha)	285,616.78	259,786.60
Net Income (Php/ha)	53,458.32	45,074.63
Net Profit Margin	18.00%	17.00%
Benefit and Cost	0.23	0.21

Despite the higher expenditures incurred by farmers who are members of cooperatives, it was found that they have a higher average revenue of P285,616.73 per hectare of sugarcane farm operated, compared with block farms at P259,786.60. Even with a higher cost of production, cooperative members still reported slightly higher net income per hectare. Net Profit Margin of 18.00%, compared with Net Profit Margin of 17.00% for those under block farm set up, and with this, the Benefit: Cost Ratio is also higher for farmers who are members of cooperative at 0.23, which implied that farmers who are members of sugarcane cooperatives earn more than their counterparts and that for every peso invested in sugarcane production, cooperative members earn 23 centavos, which is slightly higher than those experienced by block farm farmers.

3.3 Resource Use Efficiency of Sugarcane Production

The regression coefficients of costs associated with sugarcane production, both in cooperative and block farms, are presented in Table 4.

Table 4. Regression Coefficients of Sugarcane Production in Davao del Sur

	Cooperative	Block Farm
Constant/intercepts	0.886	2.914
Labor Cost	0.254	0.275
Land Preparation Cost	0.252	0.207
Water Cost	0.002	**
Machinery and Equipment	0.103	0.153
Fertilizer Cost	0.066	-0.040**
Pesticides/Herbicides	0.191	-0.004**
Transportation Cost	0.261	0.290
R2	0.67	0.92

These are computed to determine the significant variables. From Table 4, it is noted that the coefficient for Multiple Determination (R^2) differed between the two production schemes among sugarcane farmers, with the coefficient for Multiple Determination for those under the cooperative scheme being lower than that for those under block farms, at 0.67 and 0.92, respectively. This implied that 67% of output for farms under cooperative scheme would be explained by the seven variables such as Labor Cost (X1), Land preparation cost (X2), water Cost (X3), machinery and equipment (X4), fertilizer cost (X5), pesticides/herbicides (X6) and transportation cost (X7), unlike that of under the block farm scheme which is 92% which on the other hand implies that 92% of variation in output is more affected by the above mentioned variables.

Moreover, it is also observed from Table 4 that the Labor Cost regression coefficient in Block Farms is significantly higher compared with the cost associated with farms under the cooperative scheme. On the other hand, no significant differences were observed in land preparation costs, machinery costs, and transportation costs despite the differences incurred between the two production schemes. Moreover, significant differences were observed in the costs of fertilizer and pesticides/herbicides. The negative regression coefficient for fertilizer and pesticides/herbicides in block farms implied a negative effect on the revenue, net profit margin, and benefit-cost ratio of sugarcane production under block farms. On the other hand, the regression of water cost for cooperative, signifies that sugarcane production can be increased with the use of additional irrigation (water cost) by 5%,

production of sugarcane would increase the production of sugarcane, while the reduction of fertilizer cost and pesticides and herbicides would increase the production of sugarcane for block farms. This indicates that there is a need to reassess the expenses incurred by farmers to maximize the profitability of sugarcane production.

Table 5 presents the resource use efficiency of sugarcane production among farmers in the cooperative and block farming systems. Based on the data presented, all the variables associated with sugarcane production for cooperative member farms are overutilized, indicating an overutilization of these variables. This means that farmers were spending too much on these variables, and that production can be increased by reducing the units of inputs.

Table 5. *Marginal Value Productivity and Resource Use Efficiency of Sugarcane Production in Davao del Sur*

Variables	MVP	MIC	MVP/MIC	Resource Use Efficiency	Difference
Cooperatives					
Labor Cost	0.842	1	0.842	Overutilization	0.158
Land Preparation Cost	0.085	1	0.085	Overutilization	0.915
Water Cost	0.001	1	0.001	Overutilization	0.991
Machinery and Equipment Cost	0.001	1	0.001	Overutilization	0.991
Fertilizer Cost	0.014	1	0.014	Overutilization	0.986
Pesticides/Herbicides	0.125	1	0.125	Overutilization	0.875
Transportation Cost	0.107	1	0.107	Overutilization	0.893
Block Farms					
Labor Cost	1.607	1	1.607	Underutilization	-0.607
Land Preparation Cost	1.460	1	1.460	Underutilization	-0.467
Water Cost	-	1	-		
Machinery and Equipment Cost	0.303	1	0.303	Overutilization	0.697
Fertilizer Cost	0.229	1	0.229	Overutilization	0.771
Pesticides/Herbicides	0.651	1	0.651	Overutilization	0.349
Transportation Cost	1.641	1	1.641	Underutilization	-0.641

On the other hand, for farmers under the block farm system, there is a mix of underutilization and overutilization of variables. Data revealed that labor, land preparation, and transportation costs were underutilized, while the remaining costs associated with sugarcane production were overutilized. Results implied that to increase the efficiency of sugarcane production under block farms, there is a need to increase the unit of inputs for labor, land preparation, and transportation costs to maximize productivity. In contrast, inputs such as machinery and equipment, fertilizers, and pesticides are overutilized, and there is a need to reduce units of these inputs to increase resource use efficiency. The differences presented in Table 5 indicate that the greater the difference between Marginal Value of Production (MVP) and Marginal Input Cost (MIC), the greater the inefficient use of resources, and vice versa (Gouraj et al., 2022).

Improving the resource-use efficiency of arable crops is crucial to meet the growing demands for food from a rapidly expanding population (Khan et al., 2020). In Assam, India, tenant farms had lower profits compared to the owner farms in sugarcane production, as the rent paid for the leased land and the cost of resource use were observed to have a positive influence on sugarcane production. However, it showed no significant difference between them, and resource use efficiency was found to be better in the owner farmers (Kolambkar & Geddar, 2023). On the other hand, according to Ranjan et al. (2020), the average total cost of cultivation in the Ghazipur district of Uttar Pradesh was found to be Rs. 93290.98 per hectare (approximately Php19,841.72). The cost of cultivation was highest on medium sample farms and lowest on marginal farms, due to higher expenditure on human labor and seed charges by medium farms compared to other categories of farms. According to Khan et al. (2020), Results suggest that productivity and resource use efficiency of ponda sugarcane can be achieved through integrated approaches at farmers' fields. Higher biomass, cane yield, and resource use efficiencies, such as RUE, WUE, and NUE, of ponda sugarcane can be achieved by optimizing planting time, irrigation regimes, and nitrogen levels under irrigated arid environmental conditions.

3.4 Differences in Cost of Production and Benefit: Cost Ratio of Sugarcane Production

Table 6 presents the results of the analysis of differences in the cost of production and the benefit-to-cost ratio between sugarcane production in cooperative and lock farm schemes. It was found that the expenses incurred in sugarcane production under two different schemes resulted in significant differences in the total cost, thereby affecting the Net income, which is also significantly different between the two schemes. This implies that the net

income of sugarcane farmers who are members of cooperatives is significantly higher than that of farmers under block farms. However, despite the significant differences, the net profit margin and the benefit: cost ratio are not significantly different at all, which signifies that even with the significantly higher income of farmers who are cooperative members, higher level of analysis factoring more than just the net income, the benefit of sugarcane production does not significantly vary between two schemes (cooperative and block farms). This could be attributed to the average income between the two schemes, considering that these farms are not closely located to each other, and that some other factors may have influenced the outcome. The results implied that the membership of farmers, whether in cooperatives or block farms, does not significantly affect their membership in either of the two production schemes; other underlying factors, besides the production schemes to which they belonged, need to be considered.

Table 6. Differences in Cost of Production and Benefit: Cost Ratio per Hectare of Sugarcane Production

	P Value	Interpretation
Labor Cost	0.000	Significant
Land Preparation Cost	0.685	Not Significant
Machinery and Equipment	0.193	Not Significant
Fertilizer Cost	0.000	Significant
Pesticides/Herbicides	0.000	Significant
Transportation Cost	0.539	Not Significant
Total Cost (Php)	0.006	Significant
Average Revenue (Php)	0.417	Not Significant
Net Income (Php)	0.002	Significant
Net Profit Margin	0.158	Not Significant
Benefit and Cost	0.099	Not Significant

4.0 Conclusion

The majority of respondents were between 52 and 67 years old, male (54.60%), and almost all of them were married (96.80%), having attained tertiary education (88.00%). The majority of sugarcane farmers have a household size of 4-6 members (50.90%), dedicating their entire landholding to sugarcane farming, as evidenced by the same percentage of farmers who have 1-2 hectares of landholding and a farm area for sugarcane farming (76.40%). Almost all farmers had been in sugarcane production for 5 years or more. Additionally, 68.50% of the respondents were members of a sugarcane farmer cooperative, and all of them had attended training related to sugarcane production.

It was found that farmers who are members of sugarcane cooperatives spend more than their counterparts from block farms, other costs associated with sugarcane production is higher in sugarcane farms operated by farmer-members of cooperative, unlike for those under block farm set up such as land preparation costs, machinery cost, fertilizer cost, costs associated with fertilizers, herbicides and pesticides, as well as transportation costs. Even with higher cost of production, cooperative members still reported slightly higher net income, and Net Profit Margin of 0.18, and the Benefit: Cost Ratio of 0.23, which implied that farmers who are members of sugarcane cooperatives earn more than their counterparts and that for every peso invested in sugarcane production, cooperative members earn 23 centavos.

Additionally, all the variables associated with sugarcane production for cooperative member farms are overutilized, and production can be increased by reducing the units of inputs. To increase the efficiency of sugarcane production under block farms, there is a need to increase the unit of inputs for labor, land preparation, and transportation costs to maximize productivity. In contrast, inputs such as machinery and equipment, fertilizers, and pesticides are overutilized, and there is a need to reduce the units of these inputs to increase resource use efficiency.

5.0 Contributions of Authors

This research is an output of a collaborative effort between the authors. Ms. Alcasid, as the primary author, was responsible for data gathering, writing, data encoding, and interpretation. At the same time, Dr. Lopez served as the research adviser, supervising the study's conduct, as well as proofreading and editing the results.

6.0 Funding

Partly funded by the Sugar Regulatory Administration (SRA).

7.0 Conflict of Interests

None declared.

8.0 Acknowledgment

The researcher extends heartfelt gratitude to the Almighty for divine guidance, wisdom, and strength throughout this academic journey. The blessings and favor received have been instrumental in overcoming challenges and achieving this milestone.

To SSPMPC, Block Farm, USPD, and Free Planters MPC, for granting access to collect the data needed for the study. Their cooperation and support have been instrumental in the completion of this research, and we appreciate the time, willingness, and valuable insights provided by the respondents. Your contributions have been crucial to the success of this study.

To the Sugar Regulatory Administration (SRA) for providing the opportunity to pursue this academic endeavor through their generous scholarship grant. The researcher expresses sincere gratitude to SRA for its investment in support.

To Ocean Moon Social Enterprise for providing a supportive work environment that fosters growth and development. Special acknowledgement to Dr. Chee Keong Choo and Sir Kai Jian Lim for their exceptional understanding. Their approval of work schedule adjustments for academic commitments, as well as their encouragement, have been invaluable. The researcher's appreciation goes beyond words for their trust and support. This support has boosted the researcher's motivation.

To Davao del Sur State College for providing resources, facilities, and opportunities that facilitated this research. The institution's rich academic environment and support have not only enhanced the researcher's knowledge but also fostered a culture of innovation and critical thinking.

The researcher acknowledges that this accomplishment is not solely the result of individual effort but rather a culmination of support from numerous individuals and institutions. Your contributions, whether big or small, have been invaluable.

9.0 References

- Abrahám, J., Vošta, M., Čajka, P., & Rubáček, F. (2021). The specifics of selected agricultural commodities in international trade. *Agricultural and Resource Economics: International Scientific E-Journal*, 7(2), 5-19. <http://dx.doi.org/10.22004/ag.econ.313626>
- Akanmu, A. O., Akol, A. M., Ndolo, D. O., Kutu, F. R., & Babalola, O. O. (2023). Agroecological techniques: Adoption of safe and sustainable agricultural practices among the smallholder farmers in Africa. *Frontiers in Sustainable Food Systems*, 7. <https://doi.org/10.3389/fsufs.2023.1143061>
- Al Mamun, M. A., Dargusch, P., Wadley, D., Zulkarnain, N. A., & Aziz, A. A. (2022). A review of research on agrivoltaic systems. *Renewable and Sustainable Energy Reviews*, 161, 112351. <https://doi.org/10.1016/j.rser.2022.112351>
- Belete, A. A., & Nigatu, A. G. (2023). Determinants of market participation among smallholder teff farmers, empirical evidence from Central Ethiopia. *Environmental Development*, 48, 100929. <https://doi.org/10.1016/j.envdev.2023.100929>
- Bhatt, R. O. (2020). Resource management for sustainable sugarcane production. *Resources use efficiency in agriculture*, 647-693. https://doi.org/10.1007/978-981-15-6953-1_18
- Benjamin, E. (2020). Smallholder agricultural investment and productivity under contract farming and customary tenure system: A Malawian perspective. *Land*, 9(8), 277. <https://doi.org/10.3390/land9080277>
- Bey, B. S., Hazarika, J. P., & Deka, N. (2021). Is there any difference in resource use in rice cultivation under tenant and owner farmers in Karbi Anglong District of Assam, India? *International Journal of Current Microbiology and Applied Sciences*, 10, 508-515. <https://tinyurl.com/y23637zf>
- Candemir, A., Duvaleix, S., & Latruffe, L. (2021). Agricultural cooperatives and farm sustainability—A literature review. *Journal of Economic Surveys*, 35(4), 1118-1144. <https://doi.org/10.1111/joes.12417>
- Chen, J., & Chen, Y. (2021). The impact of contract farming on agricultural product supply in developing economies. *Production and Operations Management*, 30(8), 2395-2419. <https://doi.org/10.1111/poms.13382>
- Davey, B., Elliott, K., & Bora, M. (2019). Negotiating pedagogical challenges in the shift from face-to-face to fully online learning: A case study of collaborative design solutions by learning designers and subject matter experts. *Journal of University Teaching & Learning Practice*, 16(1), 3. <https://doi.org/10.53761/1.16.1.3>
- Dominici, A., Boncinelli, F., & Marone, E. (2019). Lifestyle entrepreneurs in winemaking: An exploratory qualitative analysis on the non-pecuniary benefits. *International Journal of Wine Business Research*, 31(3), 385-405. <https://doi.org/10.1108/IJWB-06-2018-0024>
- Fabregas, R., Kremer, M., & Schilbach, F. (2019). Realizing the potential of digital development: The case of agricultural advice. *Science*, 366(6471), eaay3038. <https://doi.org/10.1126/science.aay3038>
- Fernandez, M. D., Ronario, J., Estanislao, E., & Aguila, L. M. D. (2022). Profitability and profit efficiency of sugarcane block farming in Balayan, Batangas, the Philippines: An empirical study. *Economics*, 7(5) 243-253. <https://doi.org/10.11648/j.jiae.20220705.16>
- Gany, A. H. A., Sharma, P., & Singh, S. (2019). Global review of institutional reforms in the irrigation sector for sustainable agricultural water management, including water users' associations. *Irrigation and Drainage*, 68(1), 84-97. <https://doi.org/10.1002/ird.2305>
- Ghamkhar, K., Williams, W. M., & Brown, A. H. D. (2022). *Plant genetic resources for the 21st century: The omics era* (1st ed.). Apple Academic Press. <https://doi.org/10.1201/9781003302957>
- Gezie, M. (2019). Farmer's response to climate change and variability in Ethiopia: A review. *Cogent Food & Agriculture*, 5(1), 1613770. <https://doi.org/10.1080/23311932.2019.1613770>
- Gonzaga, J. A., Cruz, E. D., & Lopez, N. S. (2021). Identification of key sugarcane harvester features using the Analytic Hierarchy Process. In *IOP Conference Series: Materials Science and Engineering*, 1109, 012010 <https://doi.org/10.1088/1757-899X/1109/1/012010>
- Kalogiannidis, S. (2020). Economic cooperative models: Agricultural cooperatives in Greece and the need to modernize their operation for the sustainable development of local societies. *International Journal of Academic Research in Business and Social Sciences*, 10(11), 452-468. <http://dx.doi.org/10.6007/IJARBS/v10-i11/8035>
- Kim, C. S., & Lee, S. (2021). Factors leading to success or failure of land reform: The cases of South Korea and Chile. *Asian Journal of Latin American Studies*, 34(2), 171-207. <https://doi.org/10.22945/ajlas.2021.34.2.171>
- Lala, M., Sallu, S. M., Lyimo, F., Moore, E., Shirima, D. D., Nnyiti, P., & Pfeifer, M. (2023). Revealing diversity among narratives of agricultural transformation: Insights from smallholder farmers in the Northern Kilombero Valley, Tanzania. *Frontiers in Sustainable Food Systems*, 7, 1148928. <https://doi.org/10.3389/fsufs.2023.1148928>
- Li, J. (2022). Farmland deregulation and third-stage land reform in Taiwan. *NYU Law Review*, 97(1), 357. <https://tinyurl.com/2etr27ed>
- Loison, S. A. (2019). Household livelihood diversification and gender: Panel evidence from rural Kenya. *Journal of Rural Studies*, 69, 156-172. <https://doi.org/10.1016/j.jrurstud.2019.03.001>
- Luzaran, R. T., Engle, L. M., Villariez, H. P., & Oquias, G. B. (2022). Sugarcane breeding and germplasm development in the Philippines. *Sugar Tech*, 24(1), 210-221. <https://doi.org/10.1007/s12355-021-00979-3>
- Mandegari, M., Petersen, A. M., Benjamin, Y., & Görgens, J. F. (2019). Sugarcane biofuel production in South Africa, Guatemala, the Philippines, Argentina, Vietnam, Cuba, and Sri Lanka. *Sugarcane Biofuels: Status, Potential, and Prospects of the Sweet Crop to Fuel the World*, 319-346. https://doi.org/10.1007/978-3-030-18597-8_15
- Manikas, L., Malindretos, G., & Moschuris, S. (2019). A community-based Agro-Food Hub model for sustainable farming. *Sustainability*, 11(4), 1017. <https://doi.org/10.3390/su11041017>
- Mitra, S., Khan, M. A., Nielsen, R., & Rahman, M. T. (2022). Improving aquaculture productivity, efficiency, and profitability in Bangladesh: Does land ownership matter? *Aquaculture Economics & Management*, 26(2), 215-231. <https://doi.org/10.1080/13657305.2021.1983069>
- Munson, R. (2021). Tech to table: 25 innovators reimagining food. Island Press.
- Msosa, S. K. (2022). Challenges facing women cooperatives in accessing markets for agricultural products: A systematic literature review. *International Review of Management and Marketing*, 12(6), 37-43. <https://doi.org/10.32479/irmm.13420>
- Murken, L., & Gornott, C. (2022). The importance of different land tenure systems for farmers' response to climate change: A systematic review. *Climate Risk Management*, 35, 100419. <https://doi.org/10.1016/j.crm.2022.100419>
- Nikam, V., Singh, P., Ashok, A., & Kumar, S. (2019). Farmer producer organisations: Innovative institutions for upliftment of small farmers. *The Indian Journal of Agricultural Sciences*, 89(9), 1383-1392. <https://doi.org/10.56093/ijas.v89i9.93451>
- Ntuhinyurwa, P. D., & de Vries, W. T. (2021). Farmland fragmentation, farmland consolidation and food security: Relationships, research lapses and future perspectives. *Land*, 10(2), 129. <https://doi.org/10.3390/land10020129>
- Nurfatriani, F., Tarigan, H., & Perkasa, H. W. (2023). The role of the social forestry programs in increasing farmers' income and conserving forests in the Upstream Citarum Watershed, West Java, Indonesia. *International Forestry Review*, 25(2), 211-222. <https://doi.org/10.1505/146554823837244455>
- Oñal, P. A., Panes, N. P., Jr., & Neri, V. A. (2021). Level of productivity of sugarcane farmers and farm profile in the Visayas, Philippines. *European Journal of Agricultural and Rural Education*, 2(12), 16-24. <https://tinyurl.com/mwtcc5y2>
- Pandey, A., Bista, D. R., Bhandari, T., Panta, H. K., & Devkota, S. (2020). Profitability and resource-use efficiency of sugarcane production in Nawalparasi West District, Nepal. *Cogent Food & Agriculture*, 6(1), 1857592. <https://doi.org/10.1080/23311932.2020.1857592>
- Pokharel, D., Uprety, R., Mehata, S., Shrestha, H. K., & Panday, D. (2019). Dynamics and economic analysis of sugarcane production in the Eastern Plains of Nepal. *Current Agriculture Research Journal*, 7(2). <http://dx.doi.org/10.12944/CARI.7.2.08>
- Raj, M., Gupta, S., Chamola, V., Elhence, A., Garg, T., Atiquzzaman, M., & Niyato, D. (2021). A survey on the role of Internet of Things for adopting and promoting Agriculture 4.0. *Journal of Network and Computer Applications*, 187, 103107. <https://doi.org/10.1016/j.jnca.2021.103107>
- Raza, G., Ali, K., Hassan, M. A., Ashraf, M., Khan, M. T., & Khan, I. A. (2019). Sugarcane as a bioenergy source. *Sugarcane Biofuels: Status, Potential, and Prospects of the Sweet Crop to Fuel the World*, 3-19. https://doi.org/10.1007/978-3-030-18597-8_1

- Reyes, J. A. O., Carpennero, A. S., Santos, P. J. A., & Delfin, E. F. (2020). Effects of water regime, genotype, and formative stages on the agro-physiological response of sugarcane (*Saccharum officinarum* L.) to drought. *Plants*, 9(5), 661. <https://doi.org/10.3390/plants9050661>
- Rokhani, R., Rondhi, M., Kuntadi, E. B., Aji, J. M. M., Suwandari, A., Supriono, A., & Hapsari, T. D. (2020). Assessing determinants of farmers' participation in sugarcane contract farming in Indonesia. *AGRARIS: Journal of Agribusiness and Rural Development Research*, 6(1), 12-23. <https://doi.org/10.18196/agr.6187>
- Shamsuddoha, M., Nasir, T., & Hossain, N. U. I. (2023). A sustainable supply chain framework for dairy farming operations: A system dynamics approach. *Sustainability*, 15(10), 8417. <https://doi.org/10.3390/su15108417>
- Teng, Y., Pang, B., Wei, J., Ma, L., Yang, H., & Tian, Z. (2022). Behavioral decision-making of the government, farmer-specialized cooperatives, and farmers regarding the quality and safety of agricultural products. *Frontiers in Public Health*, 10, 920936. <https://doi.org/10.3389/fpubh.2022.920936>
- Tongson, E. E. (2019). Simulating impacts of ENSO and climate change on sugar cane production in Negros Occidental province, Philippines. *Climate, Disaster and Development Journal*, 4(1), 11-19. <https://doi.org/10.18783/cddj.v004.i01.a02>
- Ullah, A., Silalertruksa, T., Pongpat, P., & Gheewala, S. H. (2019). Efficiency analysis of sugarcane production systems in Thailand using data envelopment analysis. *Journal of Cleaner Production*, 238, 117877. <https://doi.org/10.1016/j.jclepro.2019.117877>
- Yan, L., Zhou, Y., Meng, B., Li, H., Zhan, J., Xiong, H., & Zhang, F. (2022). Reconciling productivity, profitability, and sustainability of smallholder sugarcane farms: A combined life cycle and data envelopment analysis. *Agricultural Systems*, 199, 103392. <https://doi.org/10.1016/j.agsy.2022.103392>
- Zulfiqar, F., Navarro, M., Ashraf, M., Akram, N. A., & Munné-Bosch, S. (2019). Nanofertilizer use for sustainable agriculture: Advantages and limitations. *Plant Science*, 289, 110270. <https://doi.org/10.1016/j.plantsci.2019.110270>