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Research Article

IMPACT OF DAIRY COOPERATIVES IN SMALLHOLDER DAIRY PRODUCTION SYSTEMS: THE CASE OF THE BAYBAY DAIRY COOPERATIVE

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The dairy sector has been identified as a source of livelihood for some farming households, particularly those involved in milk production. However, the potential of this sector has not been fully realized due to challenges such as low productivity and the lack of market access. Farmer organizations such as Cooperatives have been identified to tackle these issues, enhancing the skills of the dairy farmer. As such, this study seeks to investigate the Baybay Dairy Cooperative's impact on carabao farmers' production systems. This study employed the Mann-Whitney U test and correlation analysis to investigate the impact of dairy cooperative membership on household income, access to credit (financial stability), milk consumption (nutrition), employment, and technology improvement. The study revealed a positive impact on the mentioned variables except employment. The evidence of increased employment remains inconclusive. Recommendations include promoting cooperative participation, targeted interventions for employment, continuous monitoring, and knowledge dissemination. The study's findings contribute to understanding cooperative impacts on rural economies, emphasizing the need for nuanced strategies for comprehensive development.

***Keywords*:** Cooperative membership, Dairy farmers, Household income, Nutrition, Rural development

***JEL Classification codes*:** Q13, Q12, O13

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1. INTRODUCTION

Milk production supports approximately 150 million households globally, serving as a crucial source of income, food security, and nutrition, particularly for small-scale farmers in developing countries (FAO, 2024). In 2023, global milk production reached 965.7 million tonnes, with Asia contributing 30% of the world's output, highlighting the region's growing role in dairy production (Burke *et al*., 2018).

Despite these increases, many developing countries, including the Philippines, struggle to meet domestic demand, relying heavily on dairy imports. In 2019, dairy products were the country's third-largest agricultural import, with New Zealand, the United States, and Australia serving as the primary suppliers (Hernandez *et al*., 2022). This dependence on imports has exposed the domestic dairy industry to economic disruptions, such as those experienced during the COVID-19 pandemic, emphasizing the need to strengthen local production (Oliveros, 2019).

Smallholder dairy farmers, who typically own 1 to 5 animals, dominate the local dairy sector and often rely on locally sourced feed crops. However, these farmers face numerous challenges that threaten their profitability and sustainability. One of the most pressing issues is the high cost of feed, which constitutes a significant portion of production expenses (Hernandez *et al*., 2022). Many smallholder farmers struggle with feed price fluctuations, limited access to high-quality feed, and supply chain inefficiencies, making it difficult to maintain productivity. In addition to rising input costs, smallholders encounter barriers to formal market access, including inadequate infrastructure, financial constraints, and inconsistent product quality. Consequently, an estimated 90% of their milk is sold through informal channels, limiting their ability to maximize profits and expand their operations (Cheng *et al*., 2025; Kawambwa *et al*., 2014).

These challenges do not only restrict smallholders' profitability but also impede their transition toward commercialized dairy farming. While commercialization is essential for improving smallholder agriculture, several barriers must be addressed to enable this shift. These include weak farmer coordination, often resulting in lower prices, low production volumes, and limited competitiveness (Poulton *et al*., 2010; Boka 2017). Furthermore, small-scale farmers frequently lack access to technology, capital, and mechanization, all of which are critical for scaling up production and achieving long-term sustainability (Pingali *et al*., 2019). The combination of low productivity, minimal investment, and

persistent financial constraints has trapped many smallholder farmers in a cycle of poverty and economic stagnation (Barrett *et al*., 2016). Addressing these systemic challenges is crucial for fostering a more resilient and sustainable smallholder dairy sector.

One potential solution lies in dairy cooperatives, which have been recognized for their role in enhancing smallholder farmers' access to markets, technology, and financial resources, thereby improving productivity and overall welfare (Chagwiza *et al*., 2016). A growing body of research highlights the benefits of cooperative membership in overcoming market barriers, as cooperatives empower rural farmers by enhancing collective bargaining power, facilitating access to inputs, and providing technical training and financial support (Manda *et al*., 2020). By reducing transaction costs, mitigating financial risks, and improving knowledge-sharing networks, dairy cooperatives enable smallholders to transition from subsistence to commercial farming, thereby contributing to poverty alleviation, employment generation, and food security (Cheng *et al*., 2025; Ng'ombe *et al*, 2024; Bernard & Taffesse, 2012).

Aligned with global development goals, particularly the 2030 Agenda for Sustainable Development, strengthening cooperatives presents an opportunity to enhance rural incomes, reduce poverty, and improve national food security (FAO, 2017). This study investigates the impact of cooperative membership on smallholder dairy farmers, focusing on the Baybay Dairy Cooperative (BDC) in the Philippines. Specifically, it examines whether cooperative membership improves farmers' income, access to technology, financial stability, household nutrition, and employment opportunities. By assessing the role of cooperatives in addressing key constraints within the smallholder dairy sector, this research aims to provide empirical insights into how collective action can enhance sustainability and economic resilience among smallholder dairy farmers.

2. REVIEW OF RELATED LITERATURE

Smallholder dairy farmers face numerous challenges in production and marketing, often stemming from limited access to resources and fragmented value chains. Dairy cooperatives are critical in addressing these barriers by pooling individual farmer resources for collective use, linking producers to buyers, reducing price risks, and enhancing bargaining power (Bayan, 2018; Chagwiza *et al*., 2016). They also equip farmers with training, technical knowledge, and support

to adopt innovative practices, enabling them to adapt to dynamic market conditions (Habiyaremyen *et al*., 2023; Bizikova *et al*., 2020).

Commercializing smallholder farm output has improved productivity, income, and food security while fostering allocative efficiency (Dureti *et al*., 2023; Bernard *et al*., 2008). However, smallholder farmers remain constrained by imperfect markets, high transaction costs, and information imbalances, limiting their ability to benefit from commercialization fully. These challenges often expose them to fraud and opportunistic behavior within the value chain (Shiferaw *et al*., 2011; Poulton *et al*., 2010).

Farmer organizations, including cooperatives, have been widely recognized for their role in alleviating rural poverty and enhancing food security. These organizations provide vital services, such as access to input and output markets, improved pricing, and support for increasing production and income (Cuevas & Minah, 2022; Verhofstadt & Maertens, 2015). In the Philippines, cooperatives facilitate resource pooling to strengthen input supply, production, marketing, and access to credit, making them essential to smallholder development (Araullo, 2006).

Collective action has emerged as a pathway to improving farmers' socio-economic outcomes by enabling them to access larger markets and achieve better prices (Paje, 2021). Evidence suggests that cooperative membership positively impacts farmers' productivity and income (Ojiagu & Onugu, 2015; Majo *et al*., 2017; Verhofstadt & Maertens, 2015).

The Baybay Dairy Cooperative (BDC)

The dairy industry in the Philippines, primarily centered on carabaos or the domesticated buffalos (*Bubalus bubalis*), has emerged as a sustainable sector with significant potential to enhance food security and generate income for small-scale farmers (Padre, 2015). Carabaos are a vital asset for many economically disadvantaged farmers, who typically have limited landholdings and restricted access to alternative livelihoods (PCC, n.d.). Despite its potential, local milk production currently meets only 1% of national demand.

To address this gap, the Philippine Carabao Center (PCC) has introduced carabao development programs to improve productivity for both meat and milk, aiming to enhance nutrition and agricultural incomes. Cooperative development is a key component of this strategy, fostering collective action among smallholder farmers to address production and market challenges. Under Republic Act 6938,

the Cooperative Code of the Philippines (1990), cooperatives receive special privileges, such as priority access to government training and resources (Paje, 2021).

The Baybay Dairy Cooperative was established as part of this initiative to promote dairy farming and empower farmers in the city of Baybay. Its objectives include addressing low milk productivity, limited market access, and the absence of organized support systems. The cooperative provides comprehensive training, technical assistance, and market linkages to improve farmer livelihoods and their overall well-being while contributing to the local dairy industry's sustainable growth.

Through collective action, the cooperative facilitates resource sharing, market negotiation, and training in modern dairy farming practices, animal health management, and milk quality control. Members also receive support in accessing credit and financial services for investments in shared infrastructure and equipment. Additionally, the program enhances milk collection, processing, and packaging facilities, adding value to dairy products and ensuring efficient distribution.

Collaboration with local businesses, retailers, and institutional buyers secures regular sales of milk and dairy products, providing farmers with stable incomes. The Baybay Dairy Cooperative plays a significant role in developing a sustainable dairy industry, improving food security, nutrition, employment opportunities, and income growth within the community (Amante & Mardo, 2022).

3. THEORETICAL FRAMEWORK

Theory of Collective Action

The Baybay Dairy Cooperative was established to address challenges such as low milk productivity, limited market access, and the absence of organized support systems. By fostering cooperation and collaboration among small-scale dairy farmers, the cooperative creates a robust structure that enables collective action, resource sharing, and improved market negotiations.

Collective action occurs when individuals voluntarily collaborate to pursue shared goals, driven by interconnectedness and mutual motivation (Devaux et al., 2009; McCarthy, 2004). Social learning facilitates these interactions by enabling members to jointly define problems, develop solutions, and

implement practices (Koelen & Das, 2002). According to Ostrom (2010), collective action can outperform self-interested individual efforts by achieving higher collective outcomes. As a product of collective action, cooperatives are economic organizations designed to serve members' needs rather than generate profits for investors (Kustepeli et al., 2019).

The decision to cooperate is influenced by factors such as local circumstances, group size, diversity, trust, reputation, and the availability of public benefits (DeMarrais & Earle, 2017). A study in Ethiopia by Nugusse et al. (2012) identified statistically significant determinants of cooperative membership, including access to information, credit, and training; household head education; market proximity; and farmland ownership. These findings reveal the importance of creating an enabling environment to encourage participation in cooperatives.

Collective action has been compared to achieving a socially optimal Nash equilibrium, where cooperation yields better outcomes than self-interested strategies (Mgomezulu et al., 2024; Reisman, 1990). In the context of small farms, uniting through collective action can lead to greater efficiency, higher incomes, and improved market access. Sjaow-Koen-Fa et al. (2016) found that collective action allows farmers to enter more lucrative markets, add value to their production, and strengthen their marketing and processing capacities. For the Baybay Dairy Cooperative, value addition is a primary objective, enabling members to sell milk to the cooperative and earn additional income from processed dairy products.

However, collective action is not without challenges. Issues such as mismanagement of funds and the potential for resource overuse—referred to by Hardin (1986) as the "Tragedy of the Commons"—can arise. Proper organizational rules and regulatory measures are essential to mitigate these risks and sustain the benefits of collective action (Mgomezulu et al., 2024).

Sustainable Livelihood Framework

Cooperatives play a significant role in promoting sustainable livelihoods, as understood through the Sustainable Livelihood Framework (SLF) developed by UK Department for International Development (DFID) (1999). The SLF identifies five key components: the vulnerability context (shocks, trends, seasonality), livelihood assets or capitals (human, natural, financial, social, and physical), transforming structures and processes, livelihood strategies, and livelihood outcomes. Cooperatives enhance their members' access to livelihood assets,

mitigate vulnerabilities, and create supportive systems (transforming structures and processes) that strengthen resilience and promote sustainable livelihood strategies (Ferguson, 2012).

A particularly strong relationship exists between cooperatives and social capital asset. Social capital refers to the networks, relationships, and norms that facilitate cooperation within a group or community. According to Kustepeli et al. (2019), cooperatives create and benefit from social capital, forming a mutually reinforcing relationship. By consolidating individual voices into a powerful collective, cooperatives enable members to advocate for services, influence legislation, and shape power structures in ways that individuals cannot achieve alone (Ferguson, 2012). The World Bank similarly notes that "social capital shapes social interactions in society through institutions, relationships, and norms" (Kustepeli et al., 2019, p. 6).

The SLF describes social capital as the social resources people draw upon to pursue their livelihood goals. These include networks that build trust and expand institutional access, membership in formal groups with shared norms and rules, and relationships based on reciprocity and cooperation (DFID, 1999). The Organization for Economic Cooperation and Development (OECD) expands this view, defining social capital as "networks together with shared norms, values, and understandings that facilitate cooperation within or among groups" (Kustepeli et al., 2019, p. 6). Cooperatives leverage this social capital to compensate for members' lack of other capital. For example, a cooperative might provide veterinary services to farmers who lack financial capital for livestock health maintenance.

In addition to substituting for missing resources, cooperatives actively build other livelihood capitals. Training and learning activities enhance human capital (Birchall, 2004; Ferguson, 2012), while savings, credit, and insurance services strengthen financial capital (Ferguson, 2012). Although cooperatives cannot create natural resources such as land or water, they establish policies and activities to ensure these resources are managed equitably and sustainably.

Cooperatives serve as powerful mechanisms for achieving sustainable livelihoods and reducing poverty by fostering collaboration, building social capital, and compensating for resource gaps.

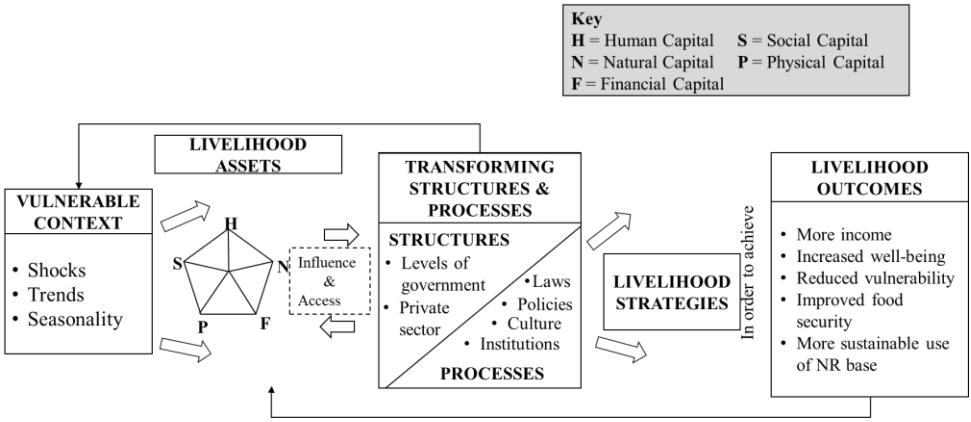

Figure 1. Sustainable Livelihood Framework (*Source: DFID, 1999)*

4. CONCEPTUAL FRAMEWORK

The Baybay Dairy Cooperative strengthens the livelihoods of its members by providing shared facilities (e.g., freezer, pasteurizing facility), training and technical assistance, and facilitating market linkages, addressing key vulnerabilities such as market fluctuations and resource limitations. These interventions enhance human, financial, physical, natural, and social capital, enabling farmers to improve productivity and income. The cooperative helps mitigate the impacts of resource scarcity and market volatility by offering access to shared infrastructure, technology, and collective bargaining power. The cooperative ensures equitable benefits and fosters collaboration among members through its governance and management structures. The resulting outcomes include increased household income, improved nutrition, job creation, and heightened economic resilience. The cooperative contributes to sustainable livelihoods and community development, fostering long-term growth for smallholder carabao farmers.

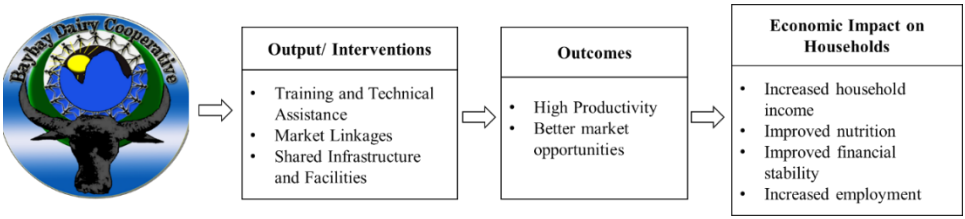

Figure 2. Conceptual Framework of the study (*Source: Author's own construct*)

5. METHODOLOGY

Study Area

This study was conducted in the City of Baybay, Province of Leyte, Philippines. Baybay, a coastal component city, encompasses a land area spanning 459.34 square kilometres or 177.35 square miles, constituting 7.25% of Leyte's total landmass (PSA, 2017). The predominant occupation among Baybay's residents revolves around agricultural production. Historically, Baybay has garnered recognition for its livestock and poultry farming prowess. Regarding livestock husbandry, 6,692 agricultural establishments have reported raising 14,801 livestock animals, including carabao, cattle, goats, sheep, horses, and swine (Baybay LGU, n.d.). Notably, swine and carabao represent the predominant livestock categories among farmers, comprising 79% and 16% of the livestock population, respectively.

Data Collection Procedure

This study relied on primary data collected using a structured questionnaire. The questionnaire was designed to capture carabao farmers' socioeconomic characteristics and production outputs. Convenience sampling was employed to gather data from the carabao farmers, who were the target population. This sampling technique was adopted due to its practicality and efficiency, given the constraint of time and resources. A total of 99 carabao farmers were interviewed, 39 of whom were members of BDC and 60 were non-members. BDC has 60-70 active members during the data collection for this study in 2023.

Method of Data Analysis

This study employed a descriptive analysis, correlation, and Mann-Whitney Rank sum test to analyze the collected data. Descriptive statistics were used to summarize the socioeconomic and production characteristics of the farmers. Meanwhile, correlation analysis was used to test whether there was a relationship between cooperative membership and income, access to technology (number of Artificially Inseminated or AI carabao), employment (number of people working on carabao farms), average per capita consumption of milk (nutrition), and access to credit (financial stability).

While many studies employ Propensity Score Matching (PSM) to address selection bias and endogeneity, this study opted for the Mann-Whitney U test and correlation analysis for several reasons. First, PSM typically requires a larger sample size to create balanced matched groups, which was not feasible given the study's sample of 39 cooperative members and 60 non-members. Second, PSM relies on the assumption of confoundedness, which cannot be fully verified in this context due to potential unobserved confounding variables. Third, the Mann-Whitney U test provides a straightforward and robust method for comparing two independent groups without the need for complex matching procedures, making it more suitable for the study's objectives and data constraints.

This approach contributes to the literature by providing insights into the specific case of the Baybay Dairy Cooperative and its role in improving the livelihoods of smallholder farmers. By focusing on a direct comparison of outcomes between members and non-members, the study offers practical evidence of the cooperative's impact while addressing the limitations of the available data.

Table 1. Description of variable used in the study

Variable	Unit of Measurement	Type of Variable	Description
Performance indicators (Outcome variable)			
Access to technology	Number of Carabao	Continuous	Number of owned artificially inseminated (AI) carabao
Total income	Pesos	Continuous	Annual income from carabao farming
Employment	Person days	Continuous	Total labor used on farm

Per Capita milk consumption (Nutrition)	Gram	Continuous	Per capita daily consumption of self-produced milk
Explanatory variables			
Age	Years	Continuous	Age of carabao farmer
Education	Years	Continuous	Years of schooling of carabao farmer
Household size	Number	Continuous	Total number of people in household
Herd size	Number	Continuous	Total number of carabao in the farm
Crossbred carabao	1 if yes; 0 if otherwise	Dummy	Ownership of crossbred carabao
Market distance	kilometer	Continuous	Distance to the nearest market
Access to credit	1 if yes; 0 if otherwise	Dummy	Ability of farmers to easily access credit when needed
Experience in dairy farming	Years	Continuous	Number of years spent in dairy farming

Table 2. Summary of hypotheses of the study

Outcome variable	Null Hypothesis (H_0)	Alternative Hypothesis (H_1)
Household Income	Cooperative membership has no effect on farmers' household income.	Cooperative membership improves farmers' household income.
Financial Stability	Cooperative membership does not enhance farmers' access to credit or financial services.	Cooperative membership improves farmers' access to credit or financial services.
Nutrition	Cooperative membership does not increase household milk consumption.	Cooperative membership increases household milk consumption.
Access to Technology	Cooperative membership has no impact on farmers' access to technology.	Cooperative membership improves farmers' access to technology.

Employment	Cooperative membership does not lead to increased employment.	Cooperative membership increases employment opportunities.

6. RESULTS AND DISCUSSION

Socioeconomic characteristics of respondents

Tables 3 and 4 offer an overview of the socioeconomic characteristics of carabao farmers in Baybay City. The results reveal a predominance of males (69.7%) within the sample, with the majority falling within the working age or economically active age group (82.8%), and the average age is 53. Educational attainment varies with a notable presence at the high school level (44.4%), while marital status predominantly comprises married individuals (90.9%). Household dynamics reveal a high percentage of farmers as household heads (67.7%), and the majority of households have a size of 5 and below (72.8%), with the average household size being 4. Additionally, 52.5% of respondents have access to credit, while 30.3% are members of the Baybay Dairy Cooperative. Regarding livestock, ownership of AI Carabao is substantial (67.7%). Additionally, the average milk production among dairy farmers is 2.60 liters, with a per capita milk consumption in households being 291.16 grams.

Table 3. Socioeconomic characteristics of respondents

Variable	Frequency	Percentage (%)
Sex		
Male	69	69.7
Female	30	30.3
Age		
15-64 years (working age)	82	82.8
65 years and above (old dependents)	17	17.2
Educational Attainments		
Elementary level	40	40.4
High School level	44	44.4
Vocational level	11	11.1
College level	3	3.0
Postgraduate level	1	1.0

Marital Status		
Single	4	4.0
Married	90	90.9
Others	5	5.1
Position in Household		
Household head	67	67.7
Spouse of the head	27	27.3
Child of the head	3	3.0
Others	2	2.0
Household size		
5 and below	72	72.8
6 and above	27	27.2
Number of dependent household members	12	12.1
None (0)	73	73.7
1 to 4	14	14.2
5 and above		
Members of Dairy cooperative		
Yes	39	30.3
No	60	69.7
Carabao for milk production		
Yes	36	36.4
No	63	63.6
Access to Credit		
Yes	52	52.5
No	47	47.5
Access to insurance for Carabao		
Dairy carabao		
Yes	8	22.2
No	28	77.8
Nondairy carabao		
Yes	3	3.0
No	96	97
Ownership of AI Carabao		
Yes	67	67.7
No	32	32.3

Table 4. Descriptive statistics of variables

Variables	Minimum	Maximum	Mean	Std. Deviation
Age	28	84	53.21	11.521
Household size	1	10	4.48	1.950
Number of dependent household members	0	8	2.49	1.826
Number of Carabao	1	11	2.11	2.109
Number of AI carabao	0	10	1.52	1.95
Number of labourers	0	7	1.53	1.380
Cost of feed	0	1350	199.43	367.525
Milk produced	0	18	2.60	3.873
Per capita consumption of milk	0	2610	291.16	420.486

Test for Normality

One of the basic assumptions of the Mann-Whitney U test is that the data has no specific distribution. And so, to test for normality, we use the Shapiro-Wilk test and test the following hypothesis:

Null hypothesis (H_o): The sample data are not significantly different from the normal population
Alternative hypothesis (H_A): The sample data are significantly different from the normal population

By the rule of thumb, if tests showed that the p-value is less than 0.05, we reject the null hypothesis that data is normally distributed. However, if the p-value exceeds 0.05, we claim that the normality assumption was met. From the results of Table 5, data is not normally distributed since p-values are less than 0.05, which leads to the rejection of the null hypothesis of normality. The violation of the normality assumption leads to using the non-parametric test, the Mann-Whitney U-test.

Table 5. Test for Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Household income	.226	99	.000	.830	99	.000
Number of Artificially Inseminated Carabao	.241	99	.000	.689	99	.000
Per capita consumption of milk	.311	99	.000	.700	99	.000
Number of people working on Carabao farm	.254	99	.000	.797	99	.000

a. Lilliefors Significance Correction

Impact of Dairy Cooperative Membership

Household Income

From the ranks table, dairy cooperative members have a higher sum of ranks than non-members. This means that members of the dairy cooperative have higher incomes than non-members. From the test statistics, reading from a one-tailed asymp sig., $0.000 < \alpha = 0.05$., we reject the null hypothesis that dairy cooperative membership has not improved the household income of its members. It can, therefore, be concluded that there is enough statistical evidence to support the claim that there is a significant improvement in the household income of members of the dairy cooperative.

An enterprise's economic soundness and viability are reflected in the magnitude of income generation. Additionally, income is the ultimate indicator for assessing the impact of dairy cooperatives (Meena *et al*., 2009). According to Amante and Mardo (2022), focus group discussions and key informant interviews with dairy cooperative members revealed increased income for farmers. Farmers stated that their income from milk production has increased since the carabao they owned is hybrid (through the coop's hybridization support) which produces more

milk as compared to other breeds in the locality. The coop buys the milk of the farmer-members, regardless of the volume as long as it is of good quality. This means that all the milk produced by farmers, except for what is consumed, generates income. Additionally, they are also given a proportion of income from the sales made by the cooperative from selling dairy products and annual dividends from their share capital to the cooperative.

The result of this study is similar to that of Bayan (2018). Using the propensity score matching technique, the author analyzed the impacts of dairy cooperatives in smallholder dairy production systems. The study revealed that membership of dairy cooperatives contributes to improving household income. Similar results were also identified by Ghosh and Maharjan in 2001. They revealed that cooperative member households tend to have higher income levels than non-cooperative households, much higher than the national figures.

Comparing two dairy cooperatives, Ofori et al. (2019) found a positive coefficient for the natural logarithm of farm revenue, farm revenue per earner, and total household revenue. However, these coefficients were generally not statistically significant. The exception is the coefficient on the log of household income, which was marginally significant at 0.10. When a household has carabao for dairy purposes, the probability of milk marketing increases, which in turn increases the household income level. This indicates that dairy cooperative membership results in an improvement in farmers' household income.

Financial Stability

From the ranks table, dairy cooperative members have a higher sum of ranks than non-members. This means dairy cooperative members have more access to credit or financial services than non-members. From the test statistics, reading from a one-tailed Asymp Sig., $0.000 < \alpha = 0.05$., we reject the null hypothesis that dairy cooperative membership has not improved carabao farmers' access to credit or financial services. Therefore, it can be concluded that dairy cooperative members have better access to credit or financial services, supported by sufficient statistical evidence.

Amante and Mardo (2022), from their qualitative study on the impact evaluation of the Baybay Dairy Cooperative, revealed that members' credit is made available to farmers through the cooperative. Providing financial assistance to the carabao farmers improves their financial stability, especially in terms of resilience. This study is coherent with that of Ofori et al. (2019), who revealed that

member households were more likely to have access to credit than their counterparts.

Nutrition

From the ranks table, dairy cooperative members have a higher sum of ranks than non-members. This means dairy cooperative members and their households consume more milk than their counterparts. From the test statistics, reading from a one-tailed Asymp Sig., $0.001 < \alpha = 0.05$., we reject the null hypothesis that dairy cooperative membership has not increased milk consumption among cooperative members and their households. Therefore, there is sufficient statistical evidence to support the assertion that dairy cooperative members have increased milk consumption among carabao farmers and their households.

The increase in consumers' income is projected to lead to higher demand for milk and milk products (Chagwiza *et al*., 2016). Milk consumption is higher among member households than non-member households. This could be attributed to higher income levels that they can use in buying commercial milk or higher access to milk and milk products since they produce their own.

Improved access to nutrition products is essential in achieving increased well-being, which is one of the desired end goals of sustainable livelihood as shown in DFID's Framework (1999) along with more income, reduced vulnerability, improved food security, and more sustainable use of natural resources.

Access to technology (Number of AI carabao)

From the ranks table, dairy cooperative members have a higher sum of ranks than non-members. This means dairy cooperative members have more access to technology than non-members. From the test statistics, reading from a one-tailed Asymp Sig., $0.000 < \alpha = 0.05$., we reject the null hypothesis that dairy cooperative membership has not improved access to technology among carabao farmers. Therefore, it can be concluded that there is enough statistical evidence to support the claim that dairy cooperative membership has improved access to technology among cooperative members. Being in a cooperative, the consolidated individual voices of farmers enable them to access government services (Kustepeli et al., 2019) like from the Philippine Carabao Center (PCC) which provides them with technical services on the hybridization of the carabao and maintaining animal health.

The findings support the results of Chagwiza *et al*. (2016), who discovered that being a member of cooperatives significantly and positively influences the chosen indicator for technological innovation. They explained this as a shift towards enhancing dairy production by cooperative members.

Employment

From the ranks table, non-cooperative members have a higher sum of ranks than their counterparts. From the test statistics, reading from a one-tailed Asymp Sig., 0.08 > α = 0.05., we fail to reject the null hypothesis that dairy cooperative membership has not improved access to technology among carabao farmers. Therefore, it can be concluded that there is not enough statistical evidence to support the claim that dairy cooperative membership has improved access to technology among cooperative members. However, the null hypothesis can be rejected if α = 0.10.

Results from key informant interviews and focus group discussions revealed an increase in economic activity in the study area which leads to an increase in employment, however reading from a confidence level of 95%, we cannot accept this from the respondents. This study contradicts the findings of Bayan (2018), who revealed that cooperative membership leads to higher employment. In another perspective, the farmers can be considered to be engaged in self-employment since they generate income through the production of milk. Additionally, carabao-rearing requires a high level of attention from the farmers which makes it difficult for them to be engaged in other full-time jobs.

Table 6. Results of the Mann-Whitney U test

	Ranks			
	Membership in Baybay Dairy Cooperative	N	Mean Rank	Sum of Ranks
Household income	0	60	35.64	2138.50
	1	39	72.09	2811.50
	Total	99		
Access to credit or financial services	0	60	40.50	2430.00
	1	39	64.62	2520.00
	Total	99		

Per capita daily consumption of milk in your household		0	60	43.63	2617.50
		1	39	59.81	2332.50
	Total		99		
Number of people working on farm		0	60	46.97	2818.00
		1	39	54.67	2132.00
	Total		99		
Number of AI carabao		0	60	36.18	2170.50
		1	39	71.27	2779.50
	Total		99		

Test Statistics[a]

	Household income	Access to credit	Average per capita daily consumption of milk in household	Number of people working on farm	Number of AI carabaos
Mann-Whitney U	308.500	600.000	787.500	988.000	340.500
Wilcoxon W	2138.500	2430.000	2617.500	2818.000	2170.500
Z	1-6.214	-4.719	-3.030	-1.374	-6.164
Asymp. Sig. (2-tailed)	.000	.000	.002	.169	.000

a. Grouping Variable: Membership in Baybay Dairy Cooperative

Testing for Economic Relationships

Table 7 presents the results of the correlation analysis. This was used to test the economic relationship between dairy cooperative membership and access to credit, technology, employment, nutrition, and household income. Results reveal a strong association and a significant relationship between dairy cooperative membership and the number of AI carabao (a proxy for technology

improvement) as well as dairy cooperative membership and household income. However, there is a moderate but significant association between dairy cooperative membership and average per capita milk consumption in households and access to credit or financial services. A weak relationship existed between dairy cooperative membership and the number of people working on farms. This relationship was also not significant.

Based on the p-values, there is sufficient evidence supports the claim that there is a relationship between dairy cooperative membership and access to credit, household income, per capita consumption of milk and improvement in technology. However, no statistical evidence supports the claim that there is a relationship between dairy cooperative membership and an increase in employment as measured by number of people working on the carabao farm.

Table 7. Results of the Spearman's rho correlation analysis

	Variables	Correlation coefficient	Sig. (2-tailed)
Membership in BDC	Number of AI carabao	0.623	0.000**
	Number of hired labor	0.139	0.171
	Household income	0.628	0.000**
	Average per capita daily consumption of milk	0.308	0.002**
	Access to credit	0.477	0.000**

N = 99

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

7. CONCLUSION AND RECOMMENDATION

This study assesses the impact of the Baybay Dairy Cooperative on carabao production systems in the Baybay Municipality. The findings provide compelling evidence that cooperative membership is positively associated with improved household income, financial stability, access to technology, nutrition, and employment outcomes. However, while the relationship between cooperative membership and household income, financial stability, technology access, and

nutrition is statistically significant, the relationship with local employment is weak and non-significant. This weak association suggests that while cooperative membership enhances other aspects of livelihoods, it does not significantly influence local employment. Overall, the study demonstrates that the Baybay Dairy Cooperative positively impacts multiple livelihood outcomes, but its effect on employment generation is limited.

Based on the study's findings, the following are recommended: 1) Promote cooperative membership. To maximize the benefits of cooperative membership, awareness of the cooperative should be made available. People should be made aware of the benefits of the cooperative's services. This could also be done by members sharing their success stories with non-members, as this would foster trust and encourage them to join the cooperative. 2) Continuous Monitoring and Evaluation: to ensure that the benefits are sustained in the long run and ensure accountability, there should be regular monitoring and evaluation of the cooperative to ensure proper management and sustainability. Lastly, 3) Explore the possibility of prioritizing the members for employment opportunities in the cooperative to diversify the livelihood activities of the members: The cooperative could create policies to promote internal hiring practices and initiatives to encourage more job creation within the cooperative.

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