

## THE RELATIONSHIP OF COOPERATIVE ROLE TO MILK PRODUCTION AND INCOME OF CORPORATE FARMS IN SEMARANG DISTRICT

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### ABSTRACT

Dairy cooperatives play an important role in improving the welfare of member farmers. Working together increases dairy farming and farmer income. However, farmers' income is low despite rising production due to individual sales. The cooperative is expected to increase income through its role with group strength and efficiency. Cooperatives are utilized to increase income through joint milk production. This study analyzes the role of cooperatives in milk production and income generation of farmers in Semarang. The research was carried out by survey method with questionnaires as a research tool. This research was conducted in 3 cooperatives active in Semarang Regency, Andini Luhur KUD, Nusantara KSU and Mekar KUD. Sampling was carried out through the proportional quota sampling method, with 120 breeders as respondents. Data processing was carried out using path analysis as the analysis method. The average ownership of lactating dairy cows was 2,825 heads/farmer, while milk production per head per day increased to 9.92 liters. Dairy income increased from the previous year and was above minimum wage both in 2022 and 2023, which was Rp 2,804,300.53 per month. The results of the path analysis show that the role of cooperatives as marketing guarantors has a major role in increasing income through milk production. Thus, to increase the income of dairy farmers, it is necessary to improve the quality of milk production and the development of cooperatives as marketing guarantors. The implementation is expected to increase the income of dairy farmers so that it has implications for the economy of the national dairy farming sector.

**Keywords:** *influence, role of institutions, cooperatives, milk production, income of dairy farmers, path analysis*

### BACKGROUND

Livestock plays an important role in the agricultural sector that contributes to the country's economy. This sub-sector has a vital role in meeting people's consumption needs, especially in terms of animal protein intake. Domestic demand for milk continues to increase, while local milk production is not sufficient for domestic needs (Budiraharjo et al., 2021). National cow's milk only contributes 22.7% of the total demand, which is 4.3 million tons per year, while the remaining 77.3% of domestic milk supply comes from imports, therefore dairy farming business has the potential to be developed with the aim of increasing domestic milk production so that consumer demand can be met (Pusat Data dan Sistem Informasi Pertanian, 2020). The increase in whole milk consumption in 2018 reached 106.71%, with an average growth in whole milk consumption from 2009 to 2018 of 0.17 liters per capita per year. Semarang Regency is one of the largest milk production centers after

Boyolali Regency, this area is the location for the development of dairy farms and has potential as an agricultural development area. Boyolali Regency accounts for 49.68% of fresh milk production, Semarang Regency contributes 27.87%, while the rest comes from several other regions in Central Java (BPS Semarang Regency, 2021).

The maintenance of dairy cows requires considerable investments, especially in terms of feed costs. According to research conducted by Fatonah et al. (2020) feed costs, especially concentrate feed, are the largest production costs in raising dairy cows, with total costs reaching 60-80% of total production costs. Dairy cattle businesses often face several problems, including low milk productivity, limitations in fast marketing, and perishable characteristics of milk that needs to be marketed immediately, as well as high production/feed costs (Santoso & Mukson, 2022). Cooperatives have a strategic role in coaching and counseling, where the role of cooperatives as supporting institutions for community livestock businesses is very important in supporting the economy of farmers and increasing livestock productivity (Hadiani et al., 2022). Factors of the institutional role of cooperatives can include distribution and marketing chain, efficiency in marketing, business cooperation models, business coaching models, frequency of coaching, and cooperation principles. This collaboration aims to reduce production costs with support from cooperatives in terms of maintenance and guarantee the sale of livestock production, especially milk (Ziętek-Kwaśniewska et al., 2022).

Milk cooperatives have an important role in various aspects, as can be seen through several factors, including as a provider of production facilities (Fikadu et al., 2019). These factors include the provision of concentrate feed, business lending, extension activities, distribution, and marketing of milk. The purpose of this role is to provide more affordable access, ensure a guaranteed and sustainable milk supply, and provide quality inputs for dairy farmers who have limitations in terms of capital and marketing (Sukariani et al., 2019). Dairy cooperatives also have an important role in the development and improvement of dairy cows' milk production. This can be achieved through improving the quality of animal feed, procuring superior breeds of cattle, and good health services. Procurement of superior breeds of cows can be carried out by government agencies and dairy cooperatives. The purpose and novelty of this study is to quantitatively identify the key factors that most influence the increase in income of dairy farmers and to provide policy input to empower dairy farmers (Onyango et al., 2023).

Therefore, dairy cooperatives have a very important role in supporting dairy farming businesses through the provision of production facilities, production development, marketing, extension, and financing. This role is not only beneficial for breeders, but also contributes to the improvement of the welfare of society as a whole. Based on previous research conducted by Ervina et al. (2019) with the title "Analysis of Factors Affecting the Business Income of Dairy Cattle of KTT Lumintu in Sumurrejo Village, Gunungpati District, Semarang, it was found that the business income of dairy cattle of Tani Ternak Rejeki reached Rp 872,772,364 per year. The variables of selling prices of dairy product, labor wages, additional feed prices, and the number of lactation cows that have been corrected with the amount of milk production have a significant influence on the income of dairy cattle business at KTT Lumintu, while the variable price of milk does not have a significant effect on dairy cattle business income. Based on the description above, this study was conducted to analyze the role of dairy cooperatives in increasing milk production and dairy income. This research needs to be conducted in depth on the role of dairy cooperatives in increasing farmers' production and income, in order to obtain a more comprehensive picture. It is important to evaluate the contribution of

cooperatives to improving farmers' livelihoods, as well as identify key factors that need to be followed up to optimize their role in the future. This research has implications for dairy farmer empowerment policies at the local and national levels.

## RESEARCH METHODS

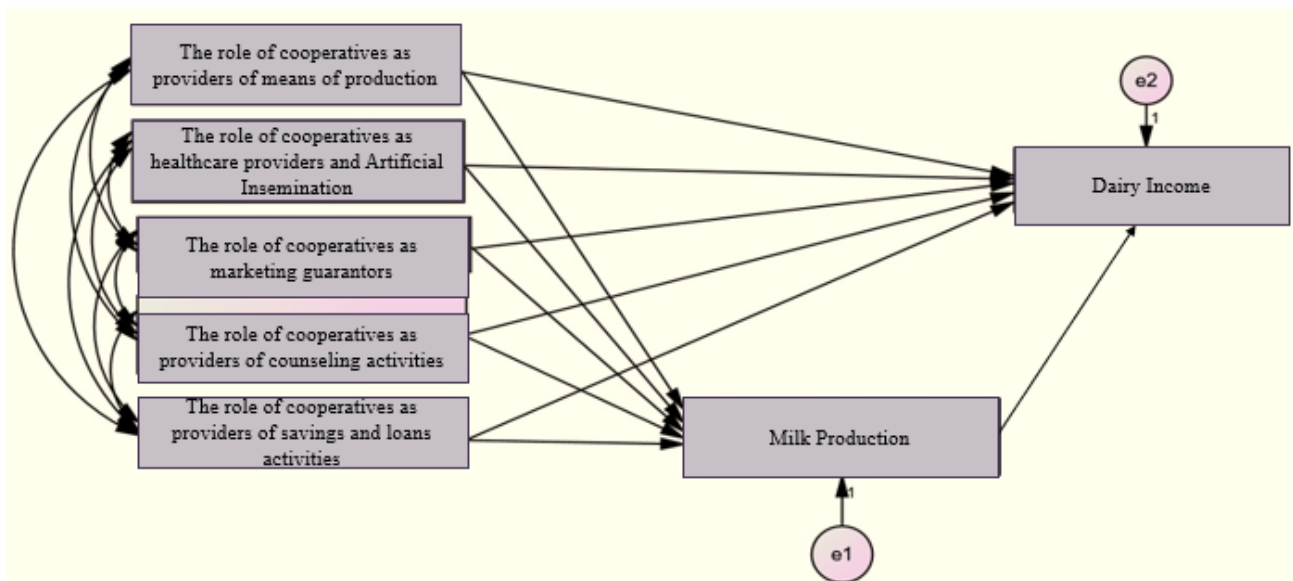
The location chosen for the study was a cooperative that has a dairy farming business unit in Semarang Regency. The research locations were purposively selected with the criteria that respondents were active and members of village unit cooperatives and then conducted direct interviews with respondents using questionnaires. This study focuses on the role of dairy cooperatives in increasing the productivity of dairy cows reflected through milk production and farmers' income in Semarang Regency. The total population used in this study amounted to 600 farmers who are still active as milk depositors in dairy cooperatives and have lactating cows in Semarang Regency. Sampling was conducted using proportional quota sampling method calculation with an error rate of 10%. The sample was then calculated based on the proportion of regions and cooperative institutions. The analysis included descriptive analysis to describe the characteristics of respondents, path analysis to model the prediction of factor variables and income analysis, resulting in the following equation:

$$Y = \rho_{yx1}X1 + \rho_{yx2}X2 + \rho_{yx3}X3 + \rho_{yx4}X4 + \rho_{yx5}X5$$
$$Z = \rho_{zx1}X1 + \rho_{zx2}X2 + \rho_{zx3}X3 + \rho_{zx4}X4 + \rho_{zx5}X5$$

Information:

- X1 : The role of cooperatives as providers of means of production
- X2 : The role of cooperatives as providers of health care and artificial insemination
- X3 : The role of cooperatives as marketing guarantors
- X4 : The role of cooperatives as providers of extension activities
- X5 : The role of cooperatives as providers of savings and loans activities
- Y : Milk Production
- Z : Farmer Income
- $\rho_{yx1}$  : Path Coefficient

Based on the concept in the study Cendan & Susilo (2022) the path analysis model of the effect of various roles of cooperative institutions on milk production and income of dairy farmers in Semarang Regency with milk production as an intervening variable is as follows in figure 1.



**Figure 1.** Research Flowchart Model

**RESULT AND DISCUSSION**

**Research Location**

Semarang Regency is the second milk production center after Boyolali in Central Java Province. The dairy population in Central Java until 2021 reached 142,124 cows, while the dairy cattle population in Semarang Regency reached 25,989 cows spread across all districts in Semarang Regency (15 sub-districts) or 18.29% of the population in Central Java (BPS Kabupaten Semarang, 2022).

**Overview of Cooperatives in Research Location**

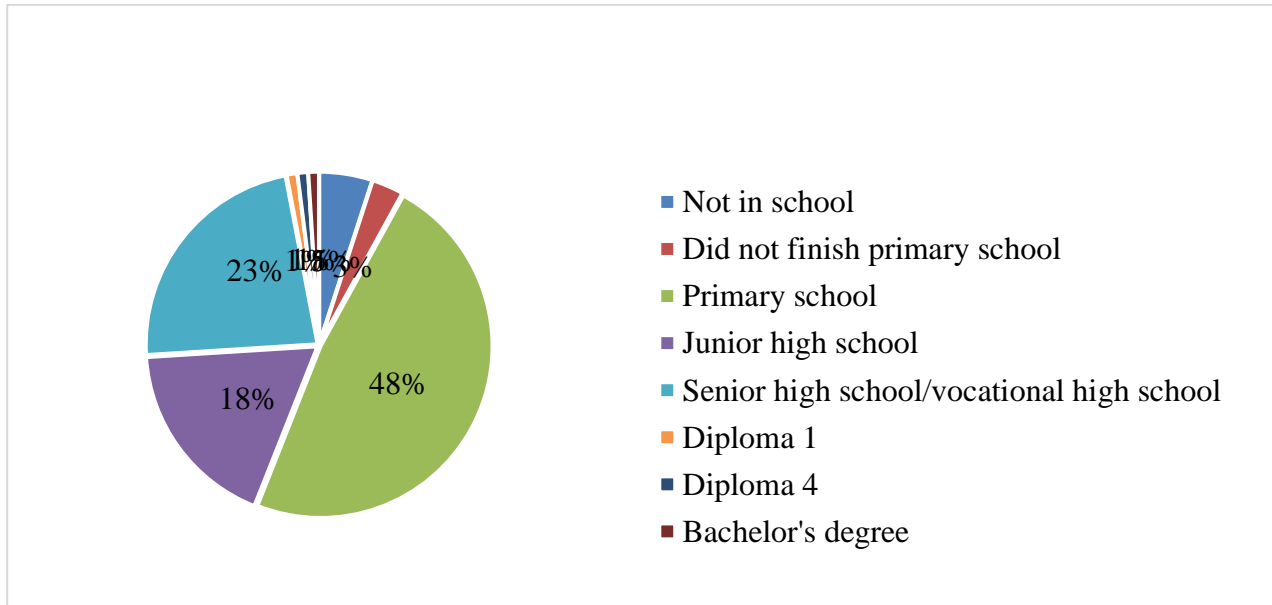
The cooperatives taken are cooperatives that have dairy units in Semarang Regency, namely Andini Luhur KUD, Nusantara KSU and Mekar KUD. The respondent area taken at Andini Luhur KUD is in Getasan District. The respondents taken through KSU Nusantara were in Tengaran and Getasan sub-districts, while Mekar KUD took areas in West Ungaran and East Ungaran sub-districts. The number of respondents in this study amounted to 120 farmers consisting of 82% or 98 farmer respondents from Getasan sub-district, 8% or 10 farmer respondents came from East Ungaran and 8% or 10 farmer respondents came from West Ungaran while the remaining 2% of farmer respondents came from Tengaran sub-district. The collection of respondents' areas was carried out based on the route of milk lines owned by each cooperative.

**Respondents's Characteristic**

This analysis of respondent characteristics aims to understand the composition and representativeness of samples used in research and provides useful information in understanding patterns and interpretations of research results. This includes information about the respondent's education, age, number of family members and length of farming experience.

**Education**

Education is an effort to change one's behavior based on knowledge and experience that is recognized and accepted by society. The level of education affects the understanding of the material studied. The level of formal education of farmer farmers who are respondents in Semarang Regency can be seen in figure 2.

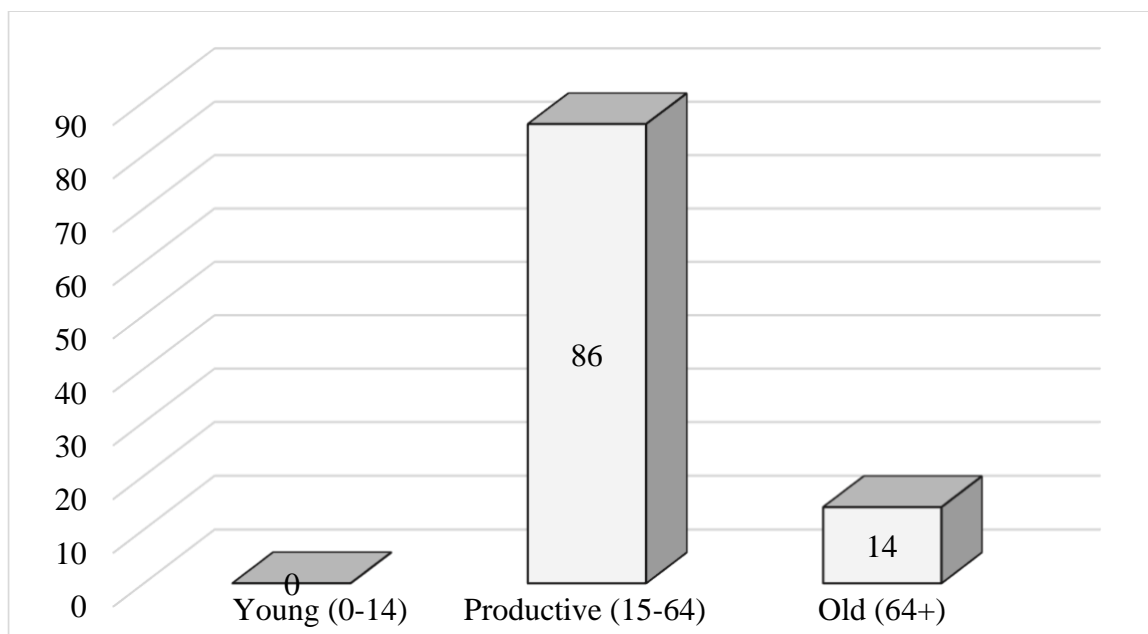


**Figure 2.** Respondents' Education Level

Based on figure 2. It was obtained that 48% or 59 respondents attended elementary school, 23% or 27 respondents attended Senior High School/Vocational School, 18% or 22 respondents attended Junior High School, and the remaining 14% took other education. The majority of respondents have taken formal education even though their level of education is still relatively low. The low level of education greatly affects the pattern of livestock rearing, besides that it affects the level of absorption of extension materials, for that intensive counseling and training are needed. In accordance with Mandaka and Hutagaol (2006) which states that the high and low level of education will affect the ability of farmers to adopt existing livestock science and techniques. Mukson *et al.* (2009) also mentioned that a low level of education can affect the development of the dairy cattle business, so there needs to be additional education such as counseling and technical guidance to support the development of the dairy cattle business.

**Age**

Age can be used as an indicator of a person's physical ability, in business in the field of animal husbandry, the age of farmers can affect work productivity, because age affects the mindset of farmers in determining the management system applied. The age description of respondents is categorized into young, productive, and old. The age category of respondents can be seen in figure 3.



**Figure 3.** Respondents's Age Category

It shows that as many as 103 respondents or about 86% of the total respondents are in the productive age range (15-64 years), while the remaining 17 respondents or around 14% are in the old age range. The more livestock business activities are managed by productive age farmers, the more dairy farming business in Semarang Regency can be managed effectively. This is in accordance with Hasan et al. (2022) which states that the age of 15 years to 64 years is a productive workforce or is still in an active working stage, this means that there is a continuous regeneration of farmers which reflects that livestock businesses still have the potential to be developed.

**Breeding Experience**

Breeding experience is the time that farmers have passed in running a business in the field of animal husbandry, the longer the experience they have, the wiser they will be in making decisions. The length of experience of raising respondents in the study can be seen in table 1.

**Table 1.** Experience of Breeding

Experience of Breeding (year)	Number of Breeder (people)	Percentage (%)
1 – 5	17	14.2
6 – 10	28	23.3
11 – 15	14	11.7
16 – 20	31	25.8
> 21	30	25
	120	100

Source: Primary Data (2022)

Table 1. shows that breeders with 1-5 years of experience are 17 people or 14.2%, 6-10 years of breeding experience are 28 breeders or 23.3%, 11-15 years of 14 breeders or 11.7%, 16-20 years of 31 breeders or 25.8% of breeders and the number of breeders with more than 21 years of breeding experience is 30 breeders or 25% of the total. The average length of experience of raising respondents

was 16.8 years. This average shows that almost all farmers already have sufficient livestock experience as capital in running their business. The length of breeding experience is expected to help farmers in making more appropriate policies. This is in accordance with Nurdiyansah et al. (2020) which states that livestock experience is obtained by a person based on the length of time experiencing in a livestock business where livestock experience is an important factor that farmers must have to decide all policies to be applied in their business.

### ***Number of Family Member***

The number of family member is the number of family members owned, where the activeness of family members owned can have a positive impact on livestock rearing business. This activeness can be seen based on the contribution of energy and thought. The number of family dependents in the study can be seen in table 2.

**Table 2.** Number of Family Member

<b>Number of Family Member (people)</b>	<b>Number of Breeder (people)</b>	<b>Percentage (%)</b>
1 - 2	21	17.5
3 - 4	55	45.8
5 - 6	39	32.5
7 - 8	4	3.3
9 - 10	1	0.8
	120	100

Source: Primary Data (2022)

Table 2. shows that the number of dependents of families 1 – 2 people is 17.5%, 3 – 4 people is 45.8%, 5 – 6 people is 32.5%, 7 – 8 people are 3.3% and the number of dependents of families 9 – 10 people is 0.8%. The average number of family dependents in the study area was 4 people. The number of family dependents can affect the farmer in managing the business. The activeness of family members in business activities can help farmers, both in the form of energy and thinking. Conversely, the large number of family dependents does not provide a positive impetus to the increase in farmer income. In accordance with Nurdiansyah et al. (2020), that the more the number of family dependents, the more financial burden will be borne, so that the farmer's income is very important to increase.

### **Dairy Business Performance**

Dairy farming business in Semarang Regency has high potential to be developed. The average ownership of lactation cows is 2.5 cows per farmer, with an average milk yield of 9.92 liters per head per day. The price of fresh milk deposited by farmers is given based on the quality of milk produced by farmers, with a range of Rp 3000,- to Rp 6100,- In addition to the quality of milk produced, milk prices are also formed based on the policies of each cooperative. Milk deposits are made in the morning and evening, either through pick-up to the farmer's area or direct deposit to the dairy cooperative unit.

### ***Milk Production***

Milk production is one of the factors that determine the productivity of dairy farms and is directly related to the level of business income of dairy cows. High milk production can be used as

an indicator of income generated, the higher the milk production produced, the greater the business income generated. Milk production produced by research respondents on cooperative members located in Semarang Regency can be seen in table 3.

**Table 3.** Total Milk Production of Research Respondents

No	Institution	Ownership of Lactation cows (tails)	Daily Milk Production (litre)	Monthly Milk Production (litre)
1	KUD Mekar	50	197	5,898
2	KSU Nusantara	102	411	12,323
3	KUD Andini Luhur	149	584	17,509
Total		301	1,191	35,729
Average		2.5	9.92	

Source: Primary Data (2022)

Lactation cattle ownership at the study site was 301 cows, with an average ownership of 2.5 cows per farmer. The average milk production from farmers in Koperasi Mekar is 5,898 liters per month, while in KSU Nusantara it reaches 12,323 liters per month, and in Koperasi Andini Luhur it reaches 17,509 liters. The total amount of production at the study site was 1,191 liters per day with the average milk production per cow per day was 9.92 liters. This production figure has increased compared to the results of research conducted by Mukson, et al. (2012) and Prasetyo et al., (2016) which stated that milk production in the region is 9.2 liters and 9.05 liters. Increased milk yield can be influenced by internal and external factors in livestock business. Internal factors include the number of lactation cows, feed quality and maintenance management. The age factor of farmers, the majority of whom are in productive age, also has an important influence on business improvement, although the majority of farmers have low education levels, the extension activities carried out have succeeded in overcoming it. Farmers are still able to absorb the information and innovation needed in the livestock business, so that production and business income tend to increase.

### ***Farmers's Income***

Income refers to the amount of money or economic value earned by an individual, business, or other entity through specific activities or sources of income. Dairy income can come from various sources, depending on the type of livestock raised and the purpose of raising the livestock. Dairy business income can be seen from several sources, namely milk production as the main source, male livestock sales and thought sales. The main dairy income depends on the amount of milk produced and the quality of milk produced. The price of milk also plays an important role in dairy income, because each grade of milk has a different price in each institution. The results of respondents' income analysis can be seen in table 4.



**Table 4.** Farmers’s Income

No	Institution	Sales (Rupiahs)	Income (Rupiahs)
1	KUD Andini Luhur	397,312,000.00	170,607,900.23
2	KSU Nusantara	259,887,083.33	113,276,175.71
3	KUD Mekar	112,366,333.33	52,631,150.58
Total		769,565,416.67	336,515,226.52
Average		6,413,045.14	2,804,293.55

Source: Primary Data (2022)

Table 4 shows that the average income of farmers in the study area was Rp 6,413,045.14, while the average income of farmers per month was Rp 2,804,293.55. The income obtained from the dairy livestock business is already above the UMR of Semarang Regency, namely Rp 2,311,254 (in 2022) and Rp 2,480,988 (in 2023). Farmer revenue is the cost of production plus the income generated by the farmer. The results show that the production cost is 56.27%. This figure is smaller than the research of Anindiyasari et al. (2019), which states that production costs can reach 60-80% of the total production costs.

**Model Assumption Test**

The assumption test is a prerequisite and an indispensable part of the analysis that precedes the analysis of research data. The normality test is used to evaluate the distribution of data from a group of data or to find out if the variables are normally distributed. Here are the normality test results in table 5.

**Table 5.** Normality Test Results

Variabel	Min	Max	Skew	c.r.	Kurtosis	c.r.
The role of cooperatives as providers of means of production	6,000	25,000	.155	.691	-1.137	-2.531
The cooperative's role as a Health and IB service provider	6,000	17,000	.859	3.827	.931	2.072
The role of cooperatives as marketing guarantors	15,000	30,000	.012	.054	1.169	2.603
The role of cooperatives as providers of counseling activities	9,000	43,000	-.208	-.925	-1.423	-3.168
The role of cooperatives as providers of savings and loans activities	8,000	20,000	-.219	-.976	.952	2.121
Milk Production	6,000	20,000	.673	2.997	.251	.559
Dairy Income	4,000	20,000	.371	1.650	-1.217	-2.709
Multivariate					1.504	.731

Source: Primary Data (2022)

Normality is expressed if the value of the variable critical ratio is in the range of -2.58 to 2.58 for multivariate normality. Table 5 shows that variable values have a critical ratio between -2.58 and 2.58, which is 1.504 and 0.731, meaning that all variables have a normal distribution. this indicates that the data is suitable for use and fulfills the assumption of normality (Demir, 2022). After the data is normally distributed, the next step is to perform a path analysis to determine the effect of the independent variable on the dependent variable. Output model analysis of the role path of dairy

cooperative institutions on farmer production and income can be seen in table 6. After the normality test is fulfilled, then test multicollinearity with the aim of knowing whether in a regression model there is a correlation between independent variables. The following are the results of the multicollinearity test in table 6.

**Table 6.** Multicollinearity Test Results

<b>Results of Analysis of the Role of Dairy Cooperatives</b>	<b>Estimate</b>
The role of cooperatives as providers of extension activities ↔ The role of cooperatives as savings and loan activities	.277
The role of cooperatives as providers of extension activities ↔ The role of cooperatives as marketing guarantors	.456
The role of cooperatives as providers of Health and IB services ↔ The role of cooperatives as marketing guarantors	.243
The role of cooperatives as providers of Health and IB services ↔ The role of cooperatives as providers of production facilities	.278
Cooperative role as marketing guarantor ↔ Cooperative role as savings and loan activity	.210
The cooperative's role as a Health and IB service provider ↔ The cooperative's role as a savings and loan activity	-.012
The cooperative's role as a provider of production facilities ↔ The cooperative's role as a savings and loan activity	.412
The role of cooperatives as providers of extension activities ↔ The role of cooperatives as providers of Health and IB services	.231
The cooperative's role as a provider of extension activities ↔ The cooperative's role as a provider of production facilities	.528
Cooperative role as a provider of production facilities ↔ Cooperative role as marketing guarantor	.231

Source: Primary Data (2022)

There is no multicollinearity relationship in each independent variable if the correlation value between each exogenous construct is  $<0.85$ . Based on the table above, it can be seen that all correlation values have a value of  $<0.85$ , so it can be concluded that there are no symptoms of multicollinearity (Kyriazos & Poga, 2023).

**Table 7.** Path Analysis Results

Path Analysis of Variables	Estimate	S.E.	C.R.	P
Milk Production ← The role of cooperatives as providers of means of production	-.225	.053	-4.277	***
Milk Production ← The cooperative's role as a Health and IB service provider	-.156	.097	-1.608	.108
Milk Production ← The role of cooperatives as marketing guarantors	.408	.083	4.922	***
Milk Production ← The role of cooperatives as providers of counseling activities	.164	.025	6.427	***
Milk Production ← The role of cooperatives as savings and loans activities	.010	.096	.099	.921
Dairy Income ← The role of cooperatives as providers of means of production	.101	.069	1.469	.142
Dairy Income ← The cooperative's role as a Health and IB service provider	.294	.120	2.456	.014
Dairy Income ← The role of cooperatives as marketing guarantors	-.186	.111	-1.676	.094
Dairy Income ← The role of cooperatives as providers of counseling activities	-.219	.036	-6.057	***
Dairy Income ← The role of cooperatives as savings and loans activities	-.014	.117	-.119	.905
Dairy Income ← Milk Production	1.830	.112	16.295	***

Source: Primary Data (2022)

Based on Table 7, variables that have a significant influence on variables Y and Z can be seen from the p-value. Variable cooperative role as a provider of production facilities, there is a significant negative influence (-0.225) on Milk Production. This can be interpreted that the involvement of cooperatives in providing production facilities has a significant negative impact on Milk Production seeing the p-value <0.05. The cooperative's role as a Health and IB service provider, there is a negative influence (-0.156) on Milk Production. However, this estimate was not statistically significant with a p-value (0.108) higher than 0.05. This indicates that cooperative involvement in health and AI services has no significant influence on Milk Production. Cooperative role as marketing guarantor shows a significant positive (0.408) influence on Milk Production. This estimate indicates that cooperative involvement as a marketing guarantor contributes positively and significantly to Milk Production judging from the p-value smaller than 0.05. In addition, the cooperative's role as a provider of extension activities has a significant positive influence (0.164) on Milk Production. These estimates indicate that cooperative involvement in extension activities contributes positively and significantly to Milk Production judging from a p-value of less than 0.05. The role of cooperatives as savings and loan activities did not show a significant effect (0.010) on Milk Production. This estimate has a p-value (0.921) greater than 0.05, indicating insignificance in the influence of cooperatives as providers of savings and loan activities on Milk Production. This result is in accordance with Okello et al. (2020) that overall the variables that have a significant effect on milk production are the role of cooperatives as providers of production facilities, marketing guarantors, and providers of extension activities.

The role of cooperatives as production input providers on Farm Income has an estimated effect of 0.101. Although this estimate is positive, it is not statistically significant with a high p value Relationship of Cooperative Role to Milk Production and Income (Fifin et al., 2024)

(0.142). This indicates that the role of cooperatives as providers of production facilities does not have a significant effect on Farm Income. The cooperative's role as a Health and IB service provider, there is a significant positive effect of 0.294 on Farm Income. This estimate shows that cooperative involvement in health and IB services contributes positively and significantly to Farm Income. This is indicated by the low p-value (0.014). Furthermore, the cooperative's role as marketing guarantor shows an insignificant negative effect (-0.186) on Farm Income. Although this estimate shows a negative effect, it is not statistically significant with a high p-value (0.094). This indicates that the cooperative's role as marketing guarantor does not have a significant effect on Farm Income. The role of cooperatives as providers of extension activities shows a significant negative effect of -0.219 on Farm Income. This estimate indicates that cooperative involvement in extension activities has a significant negative impact on Farm Income. This is indicated by the very low p-value (0.000) indicating strong significance. Cooperatives' role as providers of savings and loan activities has a negative effect (-0.014) on Farm Income. This estimate has a high p-value (0.905), indicating insignificance in the influence of cooperatives as providers of savings and loan activities on Farm Income. Furthermore, the variable considers the relationship between Milk Production and Farm Income, there is a highly significant positive effect of (1.830) of Milk Production on Farm Income. This estimate shows that Milk Production contributes significantly and positively to Farm Income. This is indicated by the very low p-value (0.000). The results of the effect analysis can be seen in table 8.

**Table 8.** Effect Analysis Result

Independent Variable	Direct Effect		Indirect Effect	Total Effect	
	Milk Production	Farmers's Income	Farmers's Income	Milk Production	Farmers's Income
The role of cooperatives as providers of means of production	-.365	.095	-.387	-.365	-.292
The role of cooperatives as healthcare provider and AI	-.115	.126	-.122	-.115	-.004
The role of cooperatives as marketing guarantors	.376	-.099	.399	.376	.299
The role of cooperatives as providers of counseling activities	.551	-.426	.584	.551	.158
The role of cooperatives as savings and loans activities	.007	-.006	.008	.007	.002
Milk Production	.000	1.060	.000	.000	1.060

Source: Primary Data (2022)

Based on Table 8, the role of cooperatives as providers of production facilities has a direct negative effect on milk production of -36.5% and a direct positive effect on farmer income of 9.5%. The negative effect on milk production is due to the cooperative's limitations in providing concentrate feed, forage, maintenance tools, dairy cow breeding stock, as well as vitamins and veterinary drugs, which have an impact on reducing milk production (Gebreselassie, 2019). In contrast, the positive effect on farmers' income indicates the cooperative's assistance in improving production efficiency

or providing access to resources that increase income (Wassie et al., 2019). There is also a negative indirect effect of cooperatives on farmers' income mediated by milk production with a coefficient of -0.387. This occurs because of the cooperative's limitations in providing feed, tools, and livestock medicine so that it has a negative impact on milk production and farmer income decreases by 0.387 times the decrease in milk production (Nsengiyumva et al., 2022). The role of cooperatives as health and artificial insemination service providers has a negative direct effect on milk production of -11.5% and a positive direct effect on farmer income of 12.6%. The negative effect on milk production is due to the cooperative's limitations in livestock health services and artificial insemination, thus reducing milk production. Inadequate health facilities and access to artificial insemination can reduce the productivity of dairy cows (Rosyad et al., 2019). However, cooperatives can play a positive role by establishing health insurance programs or shared health facilities so that farmers' income increases due to the accuracy of diagnosis and treatment (Kipaya et al., 2020). In addition, there is an indirect effect in the form of a negative effect on farmers' income through milk production -12.2. The cooperative's limitations in meeting farmers' needs may hinder the achievement of high and stable milk production, thus negatively affecting income. It is important for cooperatives to provide livestock health services and artificial insemination to support farmers' overall income improvement (Baluka, 2020). The role of cooperatives as marketing guarantors has a positive direct effect on milk production of 37.6% and a negative direct effect on farmer income of -9.9%. The greater the role of cooperatives in ensuring the marketing of dairy products, the greater the milk production that can be achieved. This illustrates that cooperative support in promoting and marketing dairy products can encourage increased production (Koutsou & Sergaki, 2020). On the other hand, fees or deductions from income charged by cooperatives for marketing services can reduce farmers' income (Yu & Huang, 2020). There is also an indirect effect in the form of a negative effect on farmer income through milk production with an effect of 39.9%. Through their role in facilitating marketing and supporting increased milk production, cooperatives can contribute positively to farmers' income (Habiyaemye et al., 2023).

The role of cooperatives as providers of extension activities has a positive direct effect on milk production of 55.1% and a negative direct effect on farmer income of -42.6%. Effective cooperative assistance can improve farmers' knowledge, skills and motivation, which contributes to increased milk production through improved livestock productivity (Vyas et al., 2020). However, cooperatives as providers of extension activities can negatively affect farmers' income if not well implemented by farmers (Baiyegunhi et al., 2019). Therefore, it is important for cooperatives to not only provide quality extension activities. In addition, there is an indirect effect in the form of a positive effect on farmer income through milk production with an effect of 58.4%. Good extension activities can have a positive impact on farmers' income through increased milk production and overall farm business efficiency (Oenema & Oenema, 2021). The role of cooperatives in savings and loan activities has a positive direct effect on milk production of 0.7% and a negative direct effect on farmer income of -0.6%. Although the value is small, savings and loan activities can provide financial support to farmers which has implications for milk production (Maina et al., 2020). On the other hand, the cost or loan interest that dairy farmers have to pay to the cooperative has a negative impact on income (Maina et al., 2020). In addition, there is an indirect effect in the form of a positive effect on income. Farmers through milk production with an effect of 0.8%. Saving and loan activities carried out by cooperatives can provide access to capital or credit for farmers to increase milk production so that their income increases (Uddin et al., 2022). Milk production has a real direct positive effect on

farmer income with a coefficient of 1.060. Milk production is an important factor that determines farmer income. Increased milk production has implications for increasing income through increased sales volume of dairy products (Nosov et al., 2020). The greater the volume of milk production produced, the greater the income received by farmers from the sale of dairy products. Thus, milk production plays a central role in sustaining farmers' income levels.

The previous analysis has shown the various direct and indirect effects of the role of cooperatives on milk production and farmers' income. However, to fully understand the contribution of cooperatives to farmers, it is necessary to analyze the total effect. The total effect is a combination of the direct and indirect real effects of an independent variable on the dependent variable. By analyzing the total effect, the overall contribution of the cooperative to farmers' income will be seen. This is important to identify which aspects need to be strengthened so that the role of cooperatives can optimally meet the needs of farmers and increase their income. The results of the total effect are presented in the income model equation as follows:

$$Y = -0.292 X1 - 0.004 X2 + 0.299 X3 + 0.158 X4 + 0.002 X5 + 1.06 Z$$

Information:

- X1 : The role of cooperatives as providers of means of production
- X2 : The role of cooperatives as healthcare providers and Artificial Insemination (AI)
- X3 : The role of cooperatives as marketing guarantors
- X4 : The role of cooperatives as providers of counseling activities
- X5 : The role of cooperatives as providers of savings and loans activities
- Z : Milk Production
- Y : Dairy Income

From the income model equation, the total effect of the cooperative's role as a provider of production facilities on farmers' income through the effect of milk production is -29.2%. This estimate indicates that the involvement of cooperatives in providing production facilities contributes negatively to farmers' income. One of the factors that could potentially cause a negative effect on farmers' income is the cost of obtaining inputs from cooperatives of less than optimal quality. Although the cooperative provides concentrate feed, husbandry tools, vitamins and veterinary medicines, the costs borne by farmers to obtain these facilities can have a negative impact on income (Twumasi et al., 2021). If production costs increase without a comparable increase in income, it will negatively affect farmers' income. In addition, external factors such as milk price levels and milk sales volume also have the potential to influence. If the price of milk is low and the quality of production facilities is low, which reduces the volume of milk production and sales, farmers' income will be negatively affected even though the cooperative has provided production facilities.

The total effect of the cooperative's role as a health and artificial insemination (AI) service provider on farmers' income through the effect of milk production is -0.4%. This estimate indicates that the involvement of cooperatives in providing health and AI services contributes negatively to farmers' income. One of the factors causing this negative effect is the cost that farmers have to incur to obtain health and AI services from cooperatives and the lack of maximization of these facilities in increasing milk productivity. Although cooperatives provide services such as livestock health checks, livestock medical personnel facilitators, measures against non-communicable diseases, information

on dangerous diseases, vaccination services, and artificial insemination, the costs associated with these services can negatively affect farmers' income (Belay, 2020). In addition, other factors such as the effect of high costs result in low milk production and hence lower milk quality and selling price. This results in farmers' income being negatively affected even though the cooperative provides good health and artificial insemination services.

The total effect of the cooperative's role as marketing guarantor on farmers' income through the effect of milk production is 29.9%. This estimate indicates that the involvement of cooperatives in ensuring marketing contributes positively to farmers' income (Molla et al., 2024). One of the factors causing the positive effect is the ability of the cooperative to carry out the function of milk tempering, scheduling deposits according to milking, depositing or selling milk to institutions, and even picking up milk directly or through a loper. With the existence of a marketing guarantor cooperative, farmers can improve the marketing of milk sales. In addition, milk production factors such as the number of lactating cows, lactation period, and milk production also influence. With marketing guarantee by the cooperative, farmers have the opportunity to sell their entire milk production, which contributes to an increase in farmers' income.

The total effect of the cooperative's role as a provider of extension activities on farmer income, through the effect of milk production is 15.8%. This estimate shows that the involvement of cooperatives in providing extension activities makes a significant positive contribution to farmers' income (Girma & Kuma, 2022). One of the factors causing this positive effect is the extension activities provided by cooperatives to farmers. Cooperatives have an adequate number of extension workers and high extension intensity. Through these extension activities, farmers can gain the knowledge and skills needed to increase milk production. Milk production factors such as number of lactating cows, lactation period, milk yield, and milk quality can be improved through increased knowledge and implementation of appropriate practices. The positive influence of these extension activities contributes directly to the increased income of farmers.

The total effect of the cooperative's role in savings and loan activities on farmers' income through the effect of milk production is 0.2%. This estimate indicates that the involvement of cooperatives in providing savings and loan activities contributes positively although relatively small to farmers' income (Koricho & Ahmed, 2022). One of the factors causing the positive effect is the easy access to business capital provided by the cooperative to farmers. Cooperatives provide support in the form of capital to purchase breeding stock and production facilities. The existence of savings and loan activities provides an opportunity to increase milk production. Milk production factors such as the number of lactating cows and milk production are shown through the use of capital obtained from savings and loans to buy quality cow seeds or obtain good feed. In the long term, increased milk production contributes to increased farmer income.

The effect of milk production on farmers' income from the overall role of the cooperative is 106%. This estimate shows that milk production makes a very real and positive contribution to farmers' income derived from the overall role of the cooperative. Milk production has a strong effect on farmers' income because it is one of the main sources of income for dairy farming (Tissie et al., 2019). Some indicators of milk production include the number of lactating cows, lactation period, milk production, and milk quality. The number of lactating cows owned by farmers is an important factor to increase milk production. The more lactating cows owned, the greater the potential for milk production. Cooperatives can play a role in providing access to quality cattle breeding and developing optimal milk production to increase dairy farmers' income .

To evaluate the extent to which the influence of the independent variable collectively on the dependent variable requires an analysis of the coefficient of determination. The coefficient of determination provides information about how much variation the dependent variable can explain by the variation of the independent variable as a whole. Here are the results of the values of the coefficient of determination in table 9.

**Table 9.** Coefficient Determination Estimation Result

No	Variable	Estimate
1	Milk Production	.479
2	Dairy Income	.740

Source: Primary Data (2022)

The coefficient of determination (R-squared) is used to measure the extent to which the independent variable in a regression model can account for variation in the dependent variable. In the milk production variable, the R-squared value is 0.479 or 47.9%, which means that the variables X1, X2, X3, X4, and X5 collectively exert an influence of 47.9%. The remaining 52.1% was explained by other factors not included in the model. Meanwhile, in the dairy income variable, the R-squared value is 0.740 or 74%, indicating that the variables X1, X2, X3, X4, X5, and Z collectively exert an influence of 74%. The remaining 26% is explained by other factors not included in the model. Overall, milk production and play a very large role in increasing the income of dairy farmers. To increase the income of dairy farmers, it is necessary to improve the quality of milk production through education and technical support, develop cooperatives as marketing guarantors, expand marketing access, organize training and mentoring programs, and improve access to finance. With these implementations, it is expected that the income of dairy farmers can increase so that it has implications for the national dairy sector economy.

## CONCLUSION AND SUGGESTION

The study was taken from 3 cooperatives located in Semarang Regency, where the respondent collection was taken based on cooperatives that are still actively operating and have dairy units. The average ownership of lactating dairy cattle is 2.8 cows/farmer, while the milk production per day per head increases to 9.92 liters. Dairy income increased from the previous year and was above the UMR both in 2022 and 2023, which was Rp 2,804,300.53 per month. Factors that influence milk production are the role of cooperatives as providers of production facilities, marketing guarantors, and providers of extension activities. Factors that have a real impact on the income of dairy farmers are milk production, the role of cooperatives as providers of livestock health services and artificial insemination, and providers of extension activities. milk production is the biggest factor in increasing income. To increase the income of dairy farmers, it is necessary to implement measures such as improving the quality of milk production through education and technical support, developing cooperatives as marketing guarantors, expanding marketing access, organizing training and mentoring programs, and increasing access to business capital. Implementation of these measures is expected to increase the income of dairy farmers and thus have positive implications for the national dairy sector economy.



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