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Factors influencing the decision of dairy farmers in selecting milk market in the Central Java Province

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Abstract

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Dairy farming is a livestock business that contributes to the local economy. Indonesian dairy farmers have many options for selling their fresh milk. Consequently, dairy farmers decide the most suitable market for selling fresh milk. According to utility theory, milk sold through certain outlets offers more advantages than milk sold through other outlets. This study aimed to analyze the factors influencing farmers' choices when selecting a milk market to sell their fresh milk. The study was conducted by collecting data through questionnaires from 238 dairy farmers in Central Java Province. The sample size computation was conducted using a multistage random sampling method, whereas the sampling was performed using purposive sampling. The analysis employed was a multinomial logistic regression analysis. The multinomial logistic regression analysis findings revealed that farmers' decisions about the milk market were influenced by age, price, volumes of milk sales, and participation in livestock groups.

Keywords: dairy farmer; milk selling channels; multinomial logistic

Introduction

Dairy farming is a livestock business that contributes to the local economy. Dairy farming is a vital component of the livestock sector in Indonesia, with significant potential for growth and development. Between 2018 and 2022, the largest concentration of dairy cattle in Indonesia was found in East Java Province, with approximately 299.33 thousand heads, accounting for 51.79% of the national dairy cattle population. Central Java ranked as the second-largest dairy cattle center, with around 144.42 thousand heads (24.99%), followed by West Java with 120.09 thousand heads (20.78%) of the total national population. Nevertheless, most domestic milk supply, specifically 66.16%, is sourced from imported milk. It is because local cow's milk can only account for 33.84% of the total milk availability (Center for Agricultural Data and Information Systems, 2022).

Dairy farming is intricately linked to dairy cooperatives. The cooperative is a facilitator in the milk purchasing process for dairy farmers. Aside from cooperatives, farmers also employ other channels to market their milk. One of these individuals is a milk collector, who serves as a mediator in the exchange of goods between farmers and end-users. Milk collectors frequently have an extensive network and can cover regions not encompassed by dairy cooperatives. Furthermore, milk can be purchased directly from farmers by collectors, retailers, and consumers (Cheelo and Merwe, 2021; Mengistu and Meressa, 2023). Farmers have a wider

range of choices for promoting their dairy products, thanks to various channels for selling milk.

Dairy farmers in Semarang Regency, Central Java Province, sell milk to cooperatives, consumers, collectors, and retailers (Nugroho et al., 2023). According to Anindyasari et al. (2016), 46% of dairy farmers in Getasan Subdistrict, Semarang Regency, sell their fresh milk to the milk collectors, while 57% of dairy farmers in Cepogo Subdistrict, Boyolali Regency, sell their milk through a milk collector, and 43% through a cooperative due to distance. Furthermore, farmers in the Boyolali Regency, particularly those in the Mojosongo Subdistrict, prefer to sell milk directly to consumers or through intermediate milk collectors rather than selling it directly to cooperatives (Sari et al., 2017). The fact that not all farmers sell milk to cooperatives suggests that there are plenty of alternatives to selling fresh milk. Farmers decide where to market their milk based on the availability of multiple options. Several factors influence dairy farmers' decisions to sell fresh milk, including age, education, farming experience, family size, number of livestock, and number of milk sales (Moturi et al., 2015; Dessie et al., 2018; Ishaq et al., 2017; Mengistu and Meressa, 2023; Jara, 2023; Kurgat et al., 2023). Price, service quality, and participation in livestock groups are also factors that influence farmers' decisions on where to sell milk (Jitmun and Kuwornu, 2019; Kuma et al., 2013; Habiyareme et al., 2023). Farmers make decisions on where to sell fresh milk based on the theory of utility. According to this theory, each person will choose the option they believe will benefit them the most. Farmers choose a specific location if the expected utility from selling there is greater than in other places.

Material and Methods

This study used primary data through a direct survey. A sample of 238 dairy farmers was interviewed using a valid and reliable questionnaire. Sample respondents were selected through a multistage random sampling process in Boyolali, Klaten, Semarang, and Salatiga Regencies. The research sites were chosen based on the largest number of dairy farming households in Central Java Province and the province's largest dairy cattle population. Respondents were selected using a purposive sampling technique with the criteria that respondents were dairy farmers who had reached the working age of at least fifteen. Furthermore, respondents met the condition that they were dairy farmers with productive lactating dairy cows at the time of the study, were not in dry periods, and did milking and sold milk. The minimum number of respondents was determined using the Yamane formula (1967):

$$n = \frac{N}{1 + Ne^2}$$

Description:
n = number of samples
N = total population
e = desired significance level (0,1)

The total population of dairy farmer households in Boyolali, Semarang, Klaten, and Salatiga districts was 39,324. Based on the total population, the total sample size (n) can be determined using the formula (Yamane, 1967):

$$n = \frac{39.324}{1 + 39.324 \times 0{,}1^2}$$

n = 39.324 /394,24
n = 99,75
n = 100

Based on the calculation results, the minimum number of respondents used in this study was 100. Furthermore, the number of sample respondents in each district was calculated. This calculation was carried out proportionally according to the total population in each district. The results of the calculation of the number of respondents for each district are presented in Table 1.

$$n_i = \frac{N_i \times n}{N}$$

Description :
n_i = number of samples in a sampling area
N_i = total population in a sampling area
n = total number of samples obtained by Yamane (1967)
N = total population

This study involved 238 dairy farmers as respondents, consisting of 92 from Boyolali, 58 from Semarang, 38 from Salatiga, and 50 from Klaten. The number of respondents used in each district meets the minimum number required.

Table 1. Number of respondents per district

District	N	n_i	n_i (real)
Boyolali	27.697	70,25	92
Semarang	8.751	22,20	58
Salatiga	1.472	3,73	38
Klaten	1404	3,56	50
Total	40.375	100	238

Source: Authors' own elaboration

The analytical method used to answer the research objectives regarding the factors that influence farmers' decisions in determining where to sell fresh milk is multinomial logistic regression analysis. This analysis is used when the dependent variable in the study is more than two. The general form of the multinomial logit odds model with m factors is formulated in the following equation (Hosmer et al., 2000):

$$\pi j\,(x) = P\,(Y = j\ x) = \frac{e^{gj(x)}}{\sum_{k}^{2}=0^{gk(x)}}$$

Description:

$\pi j\,(x)$ = probability of occurrence of the j^{th} event

for j = 0, 1, 2 any 2(p+1) parameter vector function $\beta^{T} = \beta^{T}1, \beta^{T}2$

Vector $\beta 0 = 0$ and $g0\,(x)=0$

So the logit function is formulated as follows:

$$g\,j\,(x) = \ln\left[\frac{p(Y=jx)}{p(Y=m\,x)}\right]$$

$$g\,j\,(x) = \beta_{j0} + \beta_{j1}x_1 + \beta_{j2}x_2 + \ldots + \beta_{jp}x_p$$

$$g\,j\,(x) = x^{T}\beta_{j}$$

With j being the category and m being the reference category

This multinomial analysis consists of dependent variables (Y) with more than two categories; in this study, the dependent variable used is a three-choice option for where to sell fresh milk, including cooperatives, milk collectors, and consumers. An explanation of the variable definitions used in this study is provided in full in Table 2.

Result and Discussion

Multinomial analysis was employed to identify the factors influencing dairy farmers' decisions regarding the selection of a market for selling fresh milk. Multinomial analysis is utilized when there are more than two dependent variables. In this study, three dependent variables were examined: the decision of where to sell fresh milk, which included options such as cooperatives, milk collectors, and direct sales to consumers.

The feasibility of the regression model was evaluated using Hosmer et al. (2000) goodness-of-fit test, which was measured by the chi-square value. The Goodness of Fit Test yielded a chi-square value of 252.484 at a significance level of 1,000. The test results showed that the probability value (Sig.) was≥ 0.05 (a significant value), namely 1.000 ≥ 0.05. It suggested that there was no significant difference between the model and the data, implying that the regression model used in this study was feasible and could predict the value of the observations. In conclusion, the logistic regression model can accurately match the data (Gio and Rosmaini, 2016).

R-Square value or coefficient of determination for Cox and Snell, Nagelkerke, and McFadden is 0.365, 0.450, and 0.273, respectively. The highest of the three values was chosen: the Nagelkerke value of 0.450, or 45%. The Nagelkerke coefficient of 45% indicated that the independent variables in this study influenced the decision in selecting a market to sell fresh milk, whereas 55% was influenced by other variables not included in the research model.

The parameter significance test determines the extent to which the independent variables collectively affect the response variable. A score of less than 5% alpha or 0.05 indicated that one independent variable had a statistically significant effect on the response variable. Because the si-

Table 2. Variable definition

	Variables	Definition
1	Dependent variable where to sell milk	The place where fresh milk is sold by farmers consisting of 3 options, Cooperative, Milk collectors, and Consumer
2	Independent Variabel	
	X1 (Age)	Age of respondent interviewed in years
	X2 (Education)	Formal education on that has been taken in years
	X3 (Experience)	Experience of the farmer in livestock business in years
	X4 (Family size)	Number of people borne by the head of the household, in units of people
	X5 (Number of dairy cattle)	Number of dairy cattle owned by respondent in TLUs
	X6 (Price)	The amount received by the farmer on each sale of one liter of fresh milk, in rupiah
	X7 (Volume of milk sales)	The volume of milk sold by the farmer every day in liters
	X8 (Service quality)	The value of the quality of service provide by dairy farmers to place that sell fresh milk, in the category
	X9 (Livestock groups)	The level of activity of dairy farmers in livestock groups, in categories.

Source: Authors' own elaboration

multaneous test indicated significance, we continued to the partial test.

The partial test, also known as the likelihood ratio test, determines the extent to which independent variables influence the response. This test is also known as the t-test. The significance level was 5%. The t-test results are presented in Table 3.

Table 3. Partial test (Likelihood Ratio)

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	301.967	13.785	2	0.001
Age	297.052	8.870	2	0.012
Education	293.097	4.915	2	0.086
Experience	290.195	2.013	2	0.366
Family size	292.366	4.184	2	0.123
Number of dairy cattle	294.764	6.582	2	0.037
Price	353.068	64.886	2	0.000
Volume of milk sales	306.433	18.251	2	0.000
Service quality	290.885	2.703	2	0.259
Livestock group	299.176	10.995	2	0.004

Source: Primary data processed (2024)

According to the results of the likelihood ratio test in Table 3, the significance value of the variables age, number of livestock, price, number of milk sales, and participation in livestock groups is less than 0.05, implying that these variables influenced farmers' decisions about where to sell their fresh milk. The variables farming experience, family size, and service quality all have a significant value higher than 0.05, indicating that they did not influence where farmers sell fresh milk.

The multinomial model in this study used "cooperative" as the baseline for the dependent variable (Y). The baseline served as a reference during the data interpretation process. The results of the multinomial test are presented in the table below.

Dairy farmers' preferred markets to sell fresh milk are divided into cooperatives, milk collectors, and consumers. The results of the multinomial analysis in the table above demonstrate that the variables of the number of milk sales and participation in livestock groups significantly influenced milk collectors preference for selling milk compared to co-

Table 4. Results of parameter estimation on the choice of the milk market

Milk Market		B	Wald	Sig	Exp (B)
Milk collector	Intercept	3.573	3.054	0.081	
	Age	-0.002	0.009	0.924	0.998
	Education	-0.053	1.213	0.271	0.948
	Experience	0.011	0.565	0.452	1.011
	Family size	0.014	0.014	0.907	1.014
	Number of dairy cattle	0.156	2.203	0.138	1.168
	Price	0.000	0.004	0.950	1.000
	Volume of milk sales	-0.034	7.673	0.006***	0.966
	Service quality	-0.554	2.190	0.139	0.575
	Livestock group	-0.501	9.851	0.002***	0.606
Consumer	Intercept	-39.687	2.474	0.116	
	Age	-0.325	3.248	0.072*	0.723
	Education	-0.744	2.642	0.104	0.475
	Experience	0.214	0.737	0.391	1.239
	Family size	-2.011	2.201	0.138	0.134
	Number of dairy cattle	2.029	2.453	0.117	7.604
	Price	0.009	4.489	0.034**	1.009
	Volume of milk sales	-0.452	3.384	0.066*	0.636
	Service quality	-1.839	0.523	0.469	0.159
	Livestock group	-1.714	0.773	0.379	0.180

Description :
The reference category is cooperative
* : 10% significance
** : 5% significance
*** : 1% significance
Source: Authors' own elaboration

operatives. Meanwhile, age, milk selling price, and number of milk sales significantly affect consumers' choice of selling location compared to cooperatives.

Table 4 displays the odds ratio values for the significant variables. The milk sales variable had a significantly negative influence on the likelihood of selling fresh milk to a milk collector compared to a cooperative, indicated by an odds ratio of 0.966. This statistical analysis suggested that the increase in milk sales increased the probability of choosing a milk collector over a cooperative by a factor of 0.966. The regression coefficient has a negative value, indicating that increasing milk sales by dairy farmers reduces the chance of selling fresh milk to a milk collector by 0.966 times while increasing the probability of selling to a cooperative. Dairy farmers consider the cooperative a milk market that can provide a guarantee of milk sales in large quantities, thereby reducing the risk of producing milk in large quantities, according to Cheelo and Merwe (2021), who state that farmers who produce large volumes of milk will choose milk sales channels that easily accept large volumes of milk sales. Milk sales volume influences farmers' decisions in selecting the market to sell milk (Kurgat et al., 2023). Tsourgiannis et al. (2005) identify that farmers with higher sales volumes prefer to sell milk to cooperatives.

Participation in a livestock group significantly negatively influenced the probability of selecting a place to sell fresh milk to a milk collector compared to a cooperative, indicated by an odds ratio of 0.606. This statistical result indicated that joining a livestock group increased the probability of selecting a cooperative to sell fresh milk by 0.606. The regression coefficient is negative, indicating that the more active farmers in the livestock group had a lower probability of selling fresh milk to a milk collector and a higher chance of selling to a cooperative. Dairy farmers who are members of livestock groups have the opportunity to discuss higher selling prices with cooperatives through the head of the livestock group, who conducts negotiations. This research is consistent with the findings of Moturi et al. (2015), who discovered that farmers who belong to livestock groups are more likely to choose cooperatives for milk sales cause they have a greater bargaining power.

The age variable had a significantly adverse effect on the probability of choosing the market for selling fresh milk to consumers compared to the cooperative, as indicated by an odds ratio of 0.723. According to the statistical result, age increased the probability of choosing consumers over cooperatives as a place to sell fresh milk by 0.723. The regression coefficient had a negative value, indicating that the older the farmer, the less likely they were to choose consumers as a place to sell fresh milk; in other words, the older the farmer, the more likely they were to sell to the cooperative. Cooperative in Indonesia is a place to sell milk that has been established for many years and is always actively buying and selling milk from dairy farmers every day. Older farmers are hesitant to take risks due to the uncertainty of milk sales, so they prefer to sell fresh milk to cooperatives. This finding was consistent with the research results of Moturi et al. (2015), who report that age significantly influenced where to sell fresh milk. Zegeye et al. (2001) in their research also stated that older farmers are not as risky to sell their products in different markets as younger farmers.

The milk selling price variable had a significantly positive effect on the decision to choose a place for selling fresh milk, as indicated by an odds ratio of 1.009. This statistical result suggested that the price offered a 1.009 times higher probability of being selected by consumers than cooperatives. The regression coefficient has a positive value, indicating that the higher the selling price of milk, the more likely farmers are to choose consumers as a place to sell fresh milk compared to cooperatives. Dairy farmers choose to sell fresh milk directly to consumers, who can offer higher prices than cooperatives and milk collectors. Habiyaremye et al. (2023) stated that farmers will choose a place to sell milk that can provide a higher selling price. Kurgat et al. (2023) identify that the price of milk per liter significantly influences farmers' decisions about where to sell milk. This finding is further confirmed by Artukoglu and Olgun (2008) and Tsourgiannis et al. (2005), who suggest that the price offered by the market significantly influences dairy farmers' decisions regarding which market to sell fresh milk in.

The milk sales variable had a significantly negative influence on the probability of selling fresh milk to consumers, with an odds ratio of 0.636. This statistical result suggested a 0.966 times higher likelihood of selecting a consumer to sell milk than a cooperative. The regression coefficient was negative, implying that as milk sales increased, the possibility of choosing consumers as a place to sell milk decreased by 0.636 times compared to the cooperative. The higher the milk sales, the higher the probability of selecting a cooperative. Farmers will choose the cooperative as a place to sell fresh milk because it is believed to be capable of accommodating the total amount of milk sold. This finding was consistent with Kumar et al.'s (2011) research, which suggests that the higher the number of sales, the higher the probability of selecting a cooperative as a place to sell fresh milk. Kurgat et al. (2023) find that the volume of milk sold significantly affected farmers' decisions to sell milk to official outlets.

Conclusions

This study examines the factors that influence farmers' decisions when choosing a location to sell fresh milk. Primary data were obtained from a sample of 238 dairy farmers who were interviewed using a valid and reliable questionnaire. Multinomial logistic regression was used to analyze the factors that influence dairy farmers' decisions on where to sell fresh milk. The place to sell fresh milk is divided into three categories: cooperatives, milk collectors, and consumers. In the multinomial analysis, cooperatives were used as the baseline.

This study concludes that the variables of the number of milk sales and activeness in the livestock group have a significant impact on farmers' decisions regarding the choice of a milk collector as a milk sales outlet, compared to cooperatives. The variables of age, price, and quantity of milk sold have a significant influence on farmers' decisions regarding where to sell milk, specifically whether to choose consumers or cooperatives.

The number of milk sales has a significantly adverse effect on the choice of place to sell milk to milk collectors compared to cooperatives. The number of milk sales also has a significantly adverse impact on the choice of place to sell milk to consumers compared to cooperatives. Increasing milk sales by dairy farmers reduces the likelihood of selling fresh milk to milk collectors and consumers, while increasing the probability of selling to a cooperative. Farmers prefer places that can accept milk sales in large quantities, namely cooperatives.

Participation in a livestock group significantly negatively influenced the probability of selecting a place to sell fresh milk to a milk collector compared to a cooperative. The more active farmers in the livestock group had a lower likelihood of selling fresh milk to a milk collector and a higher chance of selling to a cooperative. Dairy farmers who are members of livestock groups have the opportunity to discuss higher selling prices with cooperatives through the head of the livestock group, who conducts negotiations.

The age variable had a significantly adverse effect on the probability of choosing the market for selling fresh milk to consumers compared to a cooperative. The older the farmer, the less likely they were to select consumers as a market for fresh milk; in other words, the older the farmer, the more likely they were to sell to the cooperative. Older farmers are hesitant to take risks due to the uncertainty of milk sales, so they prefer to sell fresh milk to cooperatives.

The milk selling price variable had a significantly positive effect on the decision to choose a place for selling fresh milk. Farmers will choose the milk market that can provide a higher price, namely, consumers. Consumers can offer higher milk prices than cooperatives.

Based on the research results, we can offer guidance to dairy business stakeholders, first, for the milk cooperative management. Farmers who sell fresh milk in high volumes and those who are increasingly active in livestock groups prefer cooperatives as a venue for selling fresh milk. The cooperative should establish good cooperation with the management and members of livestock groups in Central Java, so that farmers choose the cooperative as their milk market and can increase the scale of the milk cooperative's business.

Second, for other dairy business actors. Farmers tend to choose a milk market that can provide high selling prices. Business actors who want to increase the scale of their dairy business should consider the selling price of milk when buying and selling milk from farmers. The selling price offered is higher than that of other selling places, which will encourage farmers to choose this place to sell their milk.

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