Factors Influencing the Labor Productivity in Smallholder Dairy Farms (Case Study in Kediri Regency, East Java, Indonesia)

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Abstract. The majority of small-scale dairy industries in Southeast Asia depend on farmers who use their family labor in operating their dairy activities. As dairy farming is a highly labor-intensive production activity, its success is substantially challenged by smallholder farmers' labor productivity. The present study aims to assess the factors affecting labor productivity in small-scale dairy farms in East Java, Indonesia. The data were collected from surveys of 100 dairy farmers in Kediri regency from November to December 2023. Factors affecting labor productivity were examined using an ordinary least squares regression model. The findings suggest that labor productivity increases with increased level of education. Age, family size, number of cattle a household owns, and non-farm employment correlated negatively with labor productivity. Increasing farmers' knowledge and skills about good dairy farming practices is needed to improve labor productivity, for instance, through intensive extension service.

Keywords: dairy production, family labour, good dairy farming practices, small-scale dairy farming.

1 Introduction

The majority of the dairy sector in Southeast Asia is smallholder farms. In Indonesia, the dairy sector is concentrated on Java and is dominated by small-scale ownership [1]. The Indonesian province of East Java is one of the largest milk producers in Indonesia. In 2022, milk production in this province was 445.21 thousand tons, contributing to about one-third of the national milk supply [2].

In East Java, the majority of milk production was managed by 74,976 rural farm households [3]. Therefore, dairy farms constitute an important source of income for rural households in addition to cropping activities. [4] reveals that farmers in East Java often raise two to four dairy cows. These farmers largely use family labor in operating their dairy activities, such as milking, rearing calves, and other activities contributing to the raising of dairy cattle [5].

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Smallholder dairy farming in Indonesia often has low productivity due to small-scale cattle ownership. Therefore, a skilled and productive workforce is crucial for enhancing the productivity of dairy farms [1]. As dairy farming is a highly labor-intensive production activity, its success is substantially challenged by smallholder farmers' labor productivity. The productivity of labor in smallholder dairy farms has barely received attention so far. The literature is limited to household labor allocation in the context of Indonesia in particular [6] [5]. The present paper addresses this knowledge gap by studying the factors that influence labor productivity in smallholder dairy farms. Understanding the importance of labor productivity in smallholder dairy farms is crucial to increasing efficiency and, thus, contributing to the national milk supply.

2 Materials and Methods

2.1 Data Collection

The data have been collected from November to December 2023 in Ngancar district, Kediri regency of the Indonesian province of East Java. We conducted face-to-face interviews with 100 dairy farmers who are members of Karya Bhakti cooperative using the questionnaire. These farmers were selected based on two main criteria, such as operating a maximum of 1 ha of agricultural land and having been keeping cattle for at least one year.

2.2 Data Analysis

The analysis aims to study factors influencing labor productivity in smallholder dairy farms. As the first step of the analysis, we have provided an overview of dairy farmers characteristics, such as age, educational background, type of employment, number of family members, number of cattle owned by farmers, and milk production.

Next, we examined the factors influencing labor productivity in smallholder dairy farming. In equation (1), we regressed the labor productivity Yi of farmer i on the explanatory variables X1 to X7, which are the socio-economic characteristics of farmer i, using the ordinary least squares (OLS) regression model [7]. Several variables of the socio-economic characteristics include age (X1), sex (X2), family size (X3), educational background (X4), types of employment (X5), cattle herd size (X6), and length of farming experience (X7).

Displayed equations are centered and set on a separate line.

$$Yi = \beta 0 + \beta_1 Xi_1 + \beta_2 Xi2 + \beta 3 Xi3 + \beta 4\, Xi4 + \beta 5\, Xi5 + \beta 6\, Xi6 + \beta 7\, Xi7 + \varepsilon i \qquad (1)$$

where β_0 is the intercept of the model, β_1 to β_7 the coefficients of the partial influences of the explanatory variables X_1 to X_7, and ε_i is the error term.

3 Results and Discussion

3.1 Farmer Characteristics

Table 1 highlights several key characteristics of farmers engaged in dairy farming, such as age, sex, educational background, types of employment, family size, and cattle herd size.

Table 1. Characteristics of farmers (n=100 farmers).

No.	Characteristics	%
1.	**Age (years)**	
	20-64	100
2.	**Sex**	
	Male	87
	Female	13
3.	**Educational background**	
	Elementary school	25
	Junior high school	54
	Senior high school	16
	University	5
4.	**Types of employment**	
	Farmers	96
	Civil servant	3
	Traders, Inseminator, etc	1
5.	**Family size**	
	2-4	48
	>4-6	52
6.	**Cattle herd size (AU/farm)**	
	4.5-5.75	42
	>5.75-8.25	58

As shown in Table 1, most farmers remain productive, which can enhance the development of dairy farming businesses. Age is a key factor influencing individual competence and performance [4]. The large number of farmers in this age group can greatly contribute to the growth of dairy farming businesses. Age is crucial in shaping individual competence and performance, especially in business management [8]. Younger farmers typically possess greater physical strength and sharper cognitive abilities, which enable them to adopt new practices in animal husbandry more easily. Conversely, as farmers age, their physical and cognitive abilities may decline, affecting their capacity to innovate and adapt. Successfully managing livestock businesses requires both physical stamina and mental agility to achieve optimal production outcomes.

Table 1 shows that 87% of dairy farming is primarily operated by men, which is similar to the finding [4], showing that dairy farms in Malang, East Java are often managed by men as compared to women. This finding reflects traditional gender roles within the community, where women often assist their husbands rather than manage farms independently.

Table 1 presents that 54% of farmers have completed junior high school as their highest level of education. According to [9], education is closely linked to individual performance, as skills are often developed in sectors that offer relevant training and resources, such as livestock farming. A solid education provides breeders with the knowledge needed to enhance their farming techniques, which contributes to the overall success of their businesses.

Table 1 indicates that 96% of farmers are engaged in both food crop farming and livestock raising. This dual occupation enhances their skills in both areas and supports the sustainable development of their livestock business. By participating in crop farming, farmers can produce feed for their livestock and make effective use of agricultural waste, thereby optimizing available resources [10].

Table 1 shows that 52% of farmers have families with 5 to 6 members. This implies that there is a potential labor force within these households, which can be beneficial for managing daily farm operations [5]. However, caution is warranted, as larger family sizes can lead to increased financial pressures. If the farming income is insufficient, these families may be at risk of falling into poverty.

Lastly, Table 1 points out that 58% of farmers own more than five dairy cows, indicating that livestock ownership in the area is relatively large, as also found [6] in Pasuruan, East Java. A greater number of cows necessitates more skilled labor, which can significantly impact overall labor productivity and the success of the farming enterprise.

3.2 Factors That Influence Labor Productivity in Smallholder Dairy Farming

Table 2 illustrates several key factors that affect labor productivity in dairy farming, highlighting both positive and negative relationships with various characteristics of farmers.

Table 2. Regression of labor productivity on farmers' characteristics (between brackets: s.e.).

Variables	Coefficients	Sig
Age	-0.465 (0.073)	<0.01***
Sex	3.967 (0.854)	0.264
Family size	-0.270 (0.240)	<0.01***
Educational background	1.420 (0.431)	0.01***
Type of employment	-6.517 (1.532)	<0.01***
Cattle herd size	-3.903 (0.537)	<0.01***
Length of farming experience	-0.037 (0.048)	0.443
Constant	139.109 (5.168)	<0.01***
R^2	0.956	
Adjusted R^2	0.959	
Number of observations	100	

*** indicates a significant difference from zero at the 1% level.

Table 2 shows that age is negatively ($p<0.001$) associated with labor productivity. This suggests that as farmers age, their productivity tends to decrease. This finding is supported by the observation that breeders within the productive age range of 24 to 60 years typically perform optimally due to their physical strength and experience. However, those over 60 often experience a decline in productivity when managing livestock businesses. This decrease in productivity is likely attributed to the natural decline in both physical and cognitive abilities that come with aging [8].

The size of a family has a negative impact ($p<0.001$) on labor productivity, as shown in Table 2. A larger family may place greater demands on household resources, which can divert attention and energy away from productive work. Furthermore, having more family members does not necessarily mean that there are more individuals available for labor, particularly if some family members are not directly involved in farm work.

Table 2 shows that non-farm employment types negatively ($p<0.001$) affect labor productivity. Many breeders in the study area hold side jobs in farming and animal husbandry, which complement their primary dairy farming activities. According to [1], experience in related fields can enhance the development of dairy farming businesses. However, for farmers in Ngancar District, side jobs like trading or private employment can consume valuable time and energy that otherwise could be dedicated to livestock care. Despite this, these jobs are often essential for supplementing household income [11].

Table 2 indicates that the number of livestock owned by farmers is negatively ($p<0.001$) correlated with labor productivity. This can be explained by the labor demands associated with managing many dairy cows. Farmers who have limited family labor may find it challenging to manage the increased workload, which can result in decreased productivity. Therefore, it is essential to carefully balance the scale of livestock operations with the available labor resources.

Conversely, educational background is positively ($p<0.001$) linked to labor productivity, as shown in Table 2. [9] explains that education enhances farmers' critical thinking and problem-solving skills, making them more adaptable to changes and innovations in farming. This aligns with [10] that education directly affects the acquisition and development of skills, especially in sectors like livestock farming that provide opportunities for learning and improvement.

In summary, Table 2 shows that factors such as age, family size, non-farm employment, and the number of livestock owned can hinder labor productivity. In contrast, education is a key factor in boosting it. These findings indicate that strategies aimed at improving labor productivity should focus on minimizing the impact of limiting factors while highlighting the importance of education in empowering farmers [1].

4 Conclusion

The study identified key factors that influence labor productivity in smallholder dairy farming. Most of the farmers surveyed were male, in their productive years, with significant farming experience, and typically only had a junior high school education.

They mostly worked full-time as farmers and lived in households with an average size of four.

The findings revealed that labor productivity was significantly affected by factors such as the farmer's age, gender, family size, education level, type of employment, number of livestock owned, and farming experience.

To enhance productivity, farmers should actively seek advice from more experienced peers or participate in training programs focused on livestock management. Gaining additional knowledge can help them manage their farms more efficiently and increase their output. Farmers' investment in training, education, and skill development can yield long-term benefits, such as increased efficiency, innovation, and higher-quality products and services. We also recommend that future research explore other relevant factors, such as economic conditions, time management, and resource allocation, to provide deeper insights into improving productivity in smallholder dairy farming.

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