The performance of smallholder dairy farms in West Java

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Abstract. Small farmers dominate dairy farming in Indonesia, and the average productivity is low. An understanding of the performance of farmers and dairy farming businesses is needed to formulate policies for developing small-scale dairy farms. This study aims to provide information about the performance of dairy farms and recommend policies or measures to develop smallholder dairy farms in West Java. The data used in this paper is taken from the IndoDairy Smallholder Household Survey (ISHS) database, covering 600 dairy farm households selected randomly in Bandung, Garut, Cianjur, and Bogor Districts. Data collection took place between August and September 2017. A purposive and proportional random sampling method was utilized to select the samples. Data were analyzed by using descriptive statistical analysis. The results show that the main income activity of households (80%) was dairy farming. In addition to dairy farming, households received 10% of their income from off-farm activities, 8% from horticultural production, 2% from other livestock, and 1% from crop production. On average, dairy herd sizes were 5.6 cows per farm, of which the highest found in Bogor (7.7) and lowest in Garut (3.1). The results also show that milk production per cow ranged from 14.1 to 15.2 liters/day/lactating cows, with an average of 14.9 liters/day/lactating cows. Policies and efforts to increase milk production, productivity, and quality of fresh milk through improving feed technology and better dairy farming management are critically important to increasing smallholder dairy farmers' income in Indonesia, especially in West Java.

1. Introduction

Domestic milk production is still low. The contribution of domestic production only reaches about 23% [1], so that the shortage is fulfilled from imported milk. With the increase in people's income and awareness of nutritious food, the demand for milk and its processed products is getting bigger. It is necessary to make a breakthrough for the improvement and development of the dairy cattle business. Government programs continue to be developed to meet the national demand for milk from local products and are targeted to reach 50% by 2020. Meanwhile, based on data and predictions, the milk deficit in 2020 is around 77% [2]. For this reason, it needs a breakthrough policy to boost milk production in dairy cattle businesses in Indonesia.

Research in Tanzania revealed that the good performance of dairy farming could significantly contribute to improving the standard of living of small farmers, especially in rural areas [3]. The dynamics of government policies to improve the performance and production of dairy cattle in Indonesia have been carried out a lot. However, during this decade, there has been no breakthrough to increase milk production. The Regulation of the Ministry of Agriculture No. 26 of 2017 article 3 states that dairy...
farmers, cooperatives, and business actors supply milk through domestic production. Therefore, it is necessary to increase production in milk supply through increasing productivity, dairy cattle population, and milk quality. The regulation (article 23) also states that business actors are required to enter into partnerships with farmers, farmer groups, and/or cooperatives through the use of domestic cow's milk or promotions on a mutually beneficial basis. It is hoped that this collaborative activity will be beneficial for increasing milk production and quality at the farmer's level.

Dairy farming in Indonesia is dominated by smallholder dairy farms [4]. People's dairy farming is a dairy cattle business carried out by farmers with small-scale ownership. Thus, information about the characteristics of dairy farmers and dairy farms is very relevant for the dairy development in Indonesia, especially in West Java. West Java is the third rank in milk production after East Java and Central Java. In 2019, the dairy cattle population in West Java was recorded at 122,505 heads, around 21.7% of the total national population), spread over several districts [5]. The role of West Java declined from being second rank (in 2016) to third (in 2019), overtaken by Central Java. This study aims to provide information about the performance of dairy farms in West Java, especially regarding the characteristics of the farmers' households, livelihood and sources of household income, farms’ asset management, production, the performance of milk production of dairy farms in West Java.

2. Materials and Methods

2.1. Materials

Data used in this paper are part of the IndoDairy Smallholder Household Survey (ISHS) database, which is the collaborative research data between the Indonesian Center for Agricultural Socio Economic and Policy Studies (ICASEPS) and the University of Adelaide, with financial support from the Australian Centre for International Agricultural Research (ACIAR) through Project No. AGB/2012/099. This research was conducted in four districts, i.e., Bandung, Garut, Cianjur, and Bogor in West Java. The survey was conducted between July and September 2017. The sample size of this study was 600 dairy farmers spreading in the four districts: 300 farmers in Bandung, 140 farmers in Garut, 80 farmers in Cianjur, and 80 farmers in Bogor. The farmer-respondents were selected randomly from the population of farmers who are active members of the corresponding cooperatives. Nevertheless, six samples in Bogor District were not members of the cooperative.

2.2 Methods

Data were analyzed based on the location of the sample districts and the aggregation of all sample locations (West Java). The analysis was carried out using a simple statistical method by analyzing the average value according to the analyzed variables and using graphs and tables.

3. Results and discussion

3.1. Characteristics of farmers' households

Household characteristics are essential information that needs to be considered to provide technological intervention in enhancing dairy farms. The head of household (HH) age in four study sites was ranging between 21 and 84 years old. The average age of HH was around 47 years, while the average age of the wife was about 42 years. The average age of the HH was in the productive category. Some were even classified as young adults (<30 years), while only a small proportion was old (>80 years). The same was true for the wife's age, most of whom were in the productive category and were relatively younger than their household heads. Old HHs were usually assisted by their wives or other family members in managing their dairy farming. The previous study results [6] show that the wife’s age affects the time spent in dairy farming. Thus, wives in productive age would be effectively spending their time in dairy farming.

The average education attainment of the HH and their wives was elementary school. However, some HHs and their wives attained a bachelor's degree, while others never attended school. The various levels of education will undoubtedly affect decisions about the business scale and management of dairy farming. A previous study [7] shows that the education of farmers influences the decision to determine
the scale of a cattle business: the higher the level of education, the more rational the thought of increasing the business scale would be.

The number of household members (HMs) is a human resource (HR) for the family. With more HMs, it is hoped that the number of workers working in dairy farming will increase. The average HM was about four persons, while some households have an HM of 10 or 11 persons. However, the previous study [8] shows that the number of HMs did not directly affect the performance of dairy farming. Only the number of HMs who participated in the dairy farming would affect the workload of the cattle business.

3.2. Livelihood and sources of household income

In general, dairy farming is the main livelihood. It seems that more than 85% of the total respondents made dairy farming the main job of the household. However, in each sample district, there are variations. In Bandung District, almost 90% of the farmers made dairy farming the main occupation of the household, followed by Bogor (89%), Cianjur (80%), and Garut (78%) Districts. These results mean that other households perceive that the dairy cattle business is not their primary job or a side job.

In addition to the dairy cattle business, the HHs could also work as paid workers, generally as laborers on plantations, in addition to being farmers or laborers in food crop or horticulture farming. Only small proportions were laborers or workers in non-agricultural sectors. There are quite a lot of dairy farmers who are also farmers of horticultural crops. Other types of work are non-agricultural businesses, including trading.

Only about 23% of wives made dairy farming their main occupation. This shows that the HHs dominated the family dairy farming, and the wives had a minor role in dairy farming, although, in marketing, the wives played a more significant role. Meanwhile, in terms of the outpouring of women's working time in the maintenance of dairy cattle, it is quite significant. However, despite the relatively large amount of time spent in dairy farming, women were usually not the person in charge of dairy farming or the main decision-maker in dairy farming. In this condition, the wives tended to be unpaid family workers.

Several studies in milk production centers (dairy cows) in Indonesia [6,9] show that the role of female workers is quite large in dairy farms. Research in India [10] also shows the same phenomenon, that the role of women is quite large in raising dairy cows and selling milk. A similar study in Bangladesh also shows that the role of female workers in dairy farming contributed to family income [11].

It can be explained that the respondents who stated that dairy farming was the main business in aggregate were around 91%, while only 9% stated that it was a side business. This condition varies among districts. The highest percentage (95%) was found in Bogor District, followed by Bandung District (92%), while in Garut and Cianjur Districts were 86% and 89%. From a time and economic perspective, dairy farming is the main source of household income.

Table 1. The proportion of household income by the source of income by the study sites, 2017.

| Source of income | Bandung | Garut | Cianjur | Bogor | Total |
|------------------|---------|-------|---------|-------|-------|
| Dairy farming    | 82.69   | 75.36 | 74.13   | 81.03 | 79.61 |
| Off-farm         | 7.56    | 8.26  | 16.97   | 16.98 | 10.28 |
| Crops            | 0.24    | 1.77  | 1.17    | 0.48  | 0.75  |
| Horticulture     | 8.01    | 12.43 | 5.45    | 1.03  | 7.77  |
| Aquaculture      | 0.00    | 0.02  | 0.00    | 0.13  | 0.02  |
| Other livestock  | 1.40    | 2.17  | 2.28    | 0.35  | 1.56  |

Income from dairy farming, which includes sales of fresh milk, processed milk, and dairy cows, accounted for an average of 79.6% of total household income. The highest proportion was found in the Bandung District (83%), while the lowest was in the Cianjur District (74%), although the proportions were not significantly different (Table 1). Following the main livelihood of the dairy farmers, income
generated from dairy farmers was dominant. However, farmers also relied on other income, although the proportion was relatively small compared to dairy farming. In addition to dairy farming, households received 10.3% of their income from off-farm activities, 7.8% from horticultural production, 1.6% from other livestock, 0.8% from crop production, and very little from aquaculture (0.02%).

3.3. Farms’ asset management
The assets discussed here are agricultural assets grouped into land and non-land assets (dairy cow and other livestock). As a farmer's asset, the land can be used for dairy farming, i.e., for cages and forage cultivation (CFC). Besides, agricultural land in the form of dryland or wetland (rice field) is used for farming food crops and horticultural commodities and partly for plantation commodities or wood.

Meanwhile, livestock, especially dairy cows, are the main assets in dairy farms. The larger the scale of the business, the more efficient the business [12,13]. Besides, the scale of the livestock business has a positive effect on household income. Meanwhile, the results of a study in Kebun Pedes, Bogor District [14] revealed that medium and large-scale farming was relatively more profitable than small-scale farming. In the dairy cattle business, the land is also an important asset. Research in Lembang, West Java [15] shows that an adequate land base is a key requirement for the sustainable development of dairy farming.

3.4. Ownership and management of dairy cows
The performance of cattle management by dairy farming management in West Java by category of cattle and research location is presented in Figure 1. On average, across the study sites, dairy farmer households in West Java managed about 5.6 heads of dairy cow, of which 2.8 heads or about 49% were lactating cows (Figure 1). Further information, the proportion of calves which was on average more than one and heifers about 13% or one head.

Based on Figure 1, the average number of dairy cows managed by the farmers was 5.6 heads. However, Table 2 shows that most farmers (48.3%) managed less than four heads of dairy cows. Meanwhile, 44.3% of dairy farmers were in the range of 4–7 cows in terms of ownership. In this condition, dairy cow management could be transferred from one farmer to others through profit sharing. In this case, the corresponding dairy cows are managed by farmers who maintain them. The revenues generated from the transaction are divided according to the agreement of both parties, which generally applies is divided by two (50% of each party) of the output produced in the form of milk and calves and also production costs that are borne by 50% each. Most farmers owned and managed less than four heads of lactating cows, 79.7% and 84.0%, respectively.
Table 2. Percentage of ownership and concession distribution of lactating dairy cattle and total in the study sites 2017.

| Dairy farm scale | Total dairy cows owned and managed (% farmer) | Lactating cows owned and managed (% farmer) |
|------------------|---------------------------------------------|------------------------------------------|
|                  | Owned                                      | Managed                                 | Owned                      | Managed                      |
| <4 heads         | 37.0                                       | 48.3                                    | 79.7                       | 84.0                         |
| 4–7 heads        | 44.3                                       | 36.8                                    | 15.7                       | 12.0                         |
| >7 heads         | 18.7                                       | 14.8                                    | 4.7                        | 4.0                          |

3.5. Performance of milk production
When comparing milk production at the farm and cattle levels, as shown in Table 3, there is no clear pattern across districts. On the one hand, farmers in Garut produce the least amount of milk per farm (25.5 liters), but production per cow is above average (15.0 liters). Compare this with Cianjur, where farmers produce above the average at the farm level (43.1 liters) but are the least productive per cow (14.1 liters) across districts.

The average milk production per cow per day is 14.9 liters. As with total livestock production, milk production per cow per day differs significantly between districts. Farmer in Bandung produces the highest amount of milk per cow per day with an average of 15.2 liters. Farmers in Cianjur produce less milk per cow (14.1 liters).

Table 3. Milk production by the study site, 2017.

| Variable                     | Bandung | Garut  | Cianjur | Bogor  | Total  |
|------------------------------|---------|--------|---------|--------|--------|
| Total farm (L/day)           | 41.05   | 25.50  | 43.09   | 51.05  | 39.02  |
| Per cow (L/cow/day)          | 15.17   | 15.00  | 14.11   | 14.79  | 14.92  |
| Per period lactation (1,000 L/cow/lactation) | 4.53   | 4.48   | 4.04    | 4.28   | 4.42   |

The milk yield in the morning milking is generally greater than that in the afternoon. Results of a New York study [16] on average, Holstein cows that produce 20.4 kg of milk per day and are milked at 14:10 hour intervals produce 37% more milk in morning milking than in afternoon milking. Also, milking comprises 57% of daily production and is secreted in 59% of 24 hours.

The average milk production in Indonesia is still low [17], which is less than 10 liters per lactating cow. Relatively similar figures were found on farms in Bogor [18], indicating an average of 10 liters. In contrast to the study results in Sleman, Yogyakarta [19], the average milk production was about 12 liters. The same finding was reported in East Java, the average was also about 12 liters. Thus, the average milk production in the study area is relatively large but lower than the study results in Lembang, West Java, which reached an average of 16 liters per lactating cow [15].

To see the productivity of milk can also be seen from the yield of milk during lactation. When compared to districts, 15.2 liters per day in Bandung means 4,534.8 per lactation, while 14.1 liters in Cianjur means 4,047.6 per lactation. This means that farmers in Bandung, on average, produce about 500 liters more than Cianjur in one lactation.

The productivity of lactating cows in large-scale farms is higher than that of small-scale ones [20]. Results in Northern Malawi suggest that some of the obstacles in small-scale dairy farming are poor quality breeds, poor animal health, lack of feed, and prices that do not provide incentives to farmers [21]. Other influential factors are the management of feeding (quantity and quality), the frequency of lactation, and external factors such as the environment. This is in line with other research [22,23], which revealed that production factors are in a constant return to scale. Thus, an increase in the production scale of dairy farms will provide incentives to dairy farmers if the increase in the price of output (milk) is more significant than production factors.
Meanwhile, improving the quality of milk will increase the selling value of the product, or in other words, farmers will receive a better price [24]. With the same amount of production but at a higher price, the income of farmers will increase. In this case, improving the quality of milk will indirectly increase the income of farmers. Improving the quality of milk can be done, among others, by providing feed with good type, quantity, and quality (feed technology), good management of livestock business, and maintaining sanitation and cleanliness of the cage. In addition, the case of developing a digital MCP (milk collection point) at KPBS Pangalengan can encourage farmers to produce better quality milk because of transparency in weighing, measuring milk quality, and the fraction of prices received by farmers according to what is produced.

4. Conclusions
Small-scale farmers dominate dairy farming in West Java. Smallholder dairy farm households are characterized by a low level of education, limited asset resources, and a dominant labor force for the dairy cattle business.

Dairy farming is the main household business that contributes about 80% of total household income. Most farmers' income depends on dairy farming, and only 26% of farmers have side jobs. If dairy farming is less profitable, it will threaten the welfare of the farmer's family. Dairy farming requires land, both as a place of dairy cattle maintenance and for forage cultivation. Thus, the provision of land can support the sustainability of dairy farming.

To increase the dairy farmers' income, a fair price policy is essential, both at the output (milk) and input prices. For this reason, support from the government is needed to develop a Digital Milk Collecting Point (MCP), as carried out by KPBS Pangalengan, which is expected to encourage farmers to improve the quality of fresh milk which in turn increase milk price and farm income.

Considering land is a constraint in dairy farming, the policy solution is to utilize government or company land by granting the rights to cultivate to develop their business scale. Meanwhile, for the provision of forage land for animal feed, dairy farmers can cooperate with plantation owners around the farm's location to plant grass or other forages on the edge of tree stands.

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