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The Smallholder Dairy Farmer Strategies to Address Feed Scarcity in Pangalengan, Indonesia

Achmad Firman[1*], Mochamad Ali Mauludin[1], Khansa Nurul Salsabila[2], & Tendy Kusmayadi[3]

[1] Department of Social Economics, Faculty of Animal Husbandry, Universitas Padjadjaran
[2] Postgraduate Animal Science Program Study, Faculty of Animal Husbandry, Universitas Padjadjaran
Jl. Raya Bandung Sumedang Km 21, Jatinangor Sumedang
[3] Agribusiness Program Study, Faculty of Agriculture, Universitas Garut
Jln Cimanuk No 285 A , Kecamatan Tarogong Kidul, Kab *Garut*
* Email Correspondence: achmad.firman@unpad.ac.id

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ABSTRACT. *Livestock feed plays an important role in raising dairy cows. Good feed quality can improve the performance of milk production. In the situation of feed scarcity, dairy farmers provide feed with low nutritional value because of the difficulty in getting quality feed. Therefore, this study aims to explore the habits of dairy farmers in feeding their dairy cows and the strategies of dairy farmers to deal with feed scarcity. This research was conducted in Pangalengan district, from 2 to 30 September 2023 with 100 respondent farmers selected from 2 farmer groups (Cipanas and Los Cimaung). The study uses a mixed method (quantitative and qualitative methods) to find several findings related to feed availability in the context of feed scarcity. Interviews and focus group discussions are used to collect data and information from respondents and key persons in the cooperative (KPBS). The results showed that dairy farmers sought and found forages in their gardens, backyards, open access land (roadside and undeveloped plots), and others. Meanwhile, the cooperative guarantees the supply of concentrates for farmers in all seasons. The situation will be different in the dry season due to feed scarcity, especially for forages. Farmers have to spend money to buy forages with or without collective action. The results also found that there were four strategies to anticipate forages scarcity, such as (1) forages preservation using silage technology, (2) reduction of forages and increasing concentrate, (3) utilization of agricultural waste, and (4) mixed strategies using strategies 2 and 3.*

Keywords: Feed, dairy, smallholder, scarcity, forages, concentrate.

INTRODUCTION

The livestock sector plays an important role in economic development in Indonesia. The existence of this sector is able to stimulate other sectors to develop, both from upstream to downstream. This sector supplies animal protein needs in the form of meat, milk and eggs. In addition, the sector is able to provide employment opportunities to work in the dairy business. The most important player in the sector is smallholder farmers. Nearly 90% of the dairy business is dominated by small farmers. Smallholder producers supply around 30% of the total consumption of fresh milk, and the rest comes from milk imports. The role of dairy farmers is very important in supplying milk for domestic milk consumption needs apart from milk imports.

In Indonesian context, smallholder dairy farmer is farmer who raise a small number of cows in a limited farm size, semi-permanent cages, traditional technology, management and control in the hands of the farmer family, and limited capital (Daud et al., 2015; Lobley, 2010). Dairy business is dominated by small-scale farmers and only few companies participate in this field. Therefore, farmers are the backbone of domestic fresh milk production. In the context of agribusiness, the dairy business has been developed by vertical integration since 1980s, where there are three main actors participate in the business, such as smallholder producers, cooperatives, and milk processors

(Takesima and Joshi 2019). Cooperatives is organization which is built and developed by dairy farmers to support and serve cooperative's member, especially as a marketing agent for the fresh milk produced by farmers (Daud et al., 2015).

The characteristics of small farmers in Indonesia are the same as in other developing countries, such as a small capital and asset, limited land, involving family labor, small-scale business, traditional maintenance, using old technology, low returns, and many economic activities (Rapsomanikis, 2015; Asmara et al., 2017). However, smallholder producers have an important role in creating livelihoods among the rural poor (Food and Agriculture Organization, 2019). Despite agricultural productivity is low, smallholder producers can maintain food security for families.

Feed is the most important production input for raising dairy cattle because the cost of feed can reach around 60-70% of the total production cost (Krasniqi et al., 2018). In addition, feed can affect the quality and quantity of animal production, such as milk production. There are two types of feed in ruminants, such as forages and concentrate (Pramata et al., 2022). Forages is a staple food for ruminants while concentrate is supplementary feed which can improve the quality of livestock, especially dairy cow. In general, smallholder farmers seek forages from gardens, backyards, rice fields, open access land (roadsides and undeveloped plots), or agricultural waste without having to pay. Farmers only spend time and energy to look forages, however farmers must pay to buy concentrate feed from cooperative.

Feed is a major component of production input in the dairy business. Good feed quality will improve production performance; such as milk production (Nurhayu et al., 2017). Reducing the cost of feed is very important for small scale farmers to get added value from raising dairy cows. In dairy farming operations, the use of family labor is one solution to reduce costs. Forages cost is delegated to family labor; therefore, the cost is not acquired by farmers. Meanwhile, the concentrate must be ordered and purchased by farmers from the cooperative. Agro-industrial byproducts and concentrate feed are expensive and both are not an option for resource-poor farmers (Abduku., 2020).

The main problems that must be faced by smallholder farmers is feed availability and scarcity of feed (Touch et al., 2024). Both problems are caused by season, amount of open access land, and size of land ownership. Feed scarcity is almost often occurs in the dry season. Farmers must have extra energy to search for feed even places far from where they live as long as there is still fodder available in the area. In addition, the decline in the amount of open access land caused by land conversion has contributed to reducing the amount of feed availability. Fodder cultivation on farmers' land is almost impossible to be able to meet the needs of feed within the limitations of space (Touch et al., 2024).

Forages is the main feed for dairy cows where its composition reaches 73.8% - 94.0% of the total feed use, the rest comes from concentrate feed (Lestari et al., 2015). Forages has a high crude fiber content and is difficult to digest, conversely the concentrate has a low crude fiber content and is easy to digest. Forages is used by dairy cows as an energy source, while concentrate is used to improve production performance (Afrizal et al., 2014: Nurhayu et al., 2017). In general, dairy dairy farmers use various foragess as animal feed, such as grass (Gramina), legumes (Leguminosae), and agricultural waste.

There are many grass varieties and legumes can adapt in the Indonesia's climate, especailly in Pangalengan area such as Elephant Grass (*Pennisetum purpureum*), King Grass (*Pennisetum purpupoides*), Setaria Grass (*Setaria spachelata*), Brachiaria Grass (*Braheachria Brizantha*), Bengal Grass (*Panicum maximum*) and others. Besides, there are some legumes can also grow in Indonesia, such as Gamal (G*liricidia sepium*), Lamtoro (*Leucaena glauca*), Caliandra (*Calliandra calothyrsus*), Sesbania/Turi (*Sesbania grandiflora*), Sentro (*Centrosema pubescens*), Calopo (*Calopogonium mucunoides*), and others. Grass and legumes that mentioned above could give an opportunity for farmers to choose some foragess. Besides, agricultural waste could be a substitute feed when foragess are limited in the dry season or inaccessible.

Farmers have a habit of finding and providing fresh feed for dairy cows every day in field studies. These activities become daily routines for general farmers. While the concentrate has been produced by cooperatives (KPBS) in the form of mass. The cooperative produces two types of concentrates, the first concentrate with crude protein below 16% and above 16%. The prices of the two concentrates are different, concentrates with crude protein below 16% are cheaper than above 16%. However, the price of concentrate produced by cooperatives is still below the feed mill.

A problem often faced by dairy farmers in every year in the study area is the scarcity of feed, especially in the dry season. In the long dry season or drought, foragess do not grow well and it is very difficult to find foragess. Feed that is often used as a substitute for forages is field grass and agricultural waste, such as rice straw and corn straw. Those foragess have a low nutritional value. Lack of feed availability causes the decreasing of milk production level. In certain cases, the feed scarcity causes dairy cows to have a body score condition (BSC) below 3 because of lack of feed and nutrition. Feed shortages can also cause disruption to the reproductive system of dairy cows. According to Kumar et al (2018) states that the significant influence of BCS below 3.5 in one month after calving on the length of calving to the first service interval was demonstrated. In other countries, the feed scarcity is often the main cause of livestock death during drought in a mixed farming system in the Kokosa district on the Bale highlands in Southeast Ethiopia (Ndathi et al., 2013).

Pangalengan subdistrict is one of the centers for developing dairy cows in Indonesia. This development area is adjacent to the city area. There are more than 2,000 smallholder producers who depend their family lives on the dairy business. Raising dairy cattle is a part of livelihood for smallholder farmers in Pangalengan coordinated by cooperative (called KPBS). The problem faced by dairy farming in every year is the availability of feed. The increasing growth of human population in urban areas has caused the conversion of agricultural land into settlements continues to increase. The derivative impact of the land conversion has contributed to reduce open access land where the area could be utilized by farmers to get fodder. On the other hand, increasing human population growth affects the level of milk demand. It gives an economic opportunity for dairy farmers to increase milk production. Therefore, the aims of the study are to explore the habits of dairy farmers in feeding their dairy cows and the strategies of dairy farmers to deal with feed scarcity.

MATERIALS AND METHODS

The research was conducted at the Center for Dairy Cattle Development (Pangalengan area), West Java province, Indonesia from two to 30 September 2023. This research uses a mixed method to identify and explore how small dairy farmers anticipate feed scarcity and strategies to anticipate feed scarcity.

Data was collected from 100 dairy farmers as respondents from two groups of dairy farmer, such Cipanas and Los Cimaung groups. Samples are selected using proportional random sampling, therefore samples can represent farmers to illustrate the purposes of the study. To collect data and information, respondents were interviewed using questionnaire guidelines. Substantially, the question is focused on how dairy farmers anticipate feed scarcity in the context of feed sustainability.

Analysis method used quantitative and qualitative methods. The quantitative method was used basic statistic, meanwhile the qualitative method was used to focus group discussion attended by 1 KPBS extension worker and 5 group representatives from Cipanas and Los Cimaung.

RESULT AND DISCUSSION

Identification of respondents

Pangalengan subdistrict has been a center for the development of dairy farming in Indonesia since the 1980s. This period can be regarded as the golden period for the dairy business because the Government of Indonesia fully supports this business (Firman et al., 2018). The majority of dairy farmers are members of dairy cooperatives, especially in the study area (KPBS Pangalengan). The number of dairy

farmers who are members of KPBS is 4,557 members, but there are around 2,000 active members in 2018. Half the inactive members are more interested in switching to other businesses.

Based on respondent data, smallholder dairy farmers can be identified into 5 classifications, such as ownership of dairy cattle, cow productivity, land ownership, and land rent. According to Table 1, farmers who have 1-5 cows dominate the total respondents. This situation reflects the ownership of dairy cattle in the study area. Dairy cows are an important asset for farmer to support the family income. Cow productivity is measured by the amount of fresh milk production per cow per day. The average milk production of cow is 12.5 liters/day/cow. The highest productivity can reache 20 liters/day/cow. According to Asmara et al. (2017), the average milk production of cow in KPBS is 13.03 liter/day/cow. There is a slight different of milk production with the other research results.

Based on the data, usually smallholder producers feed their dairy cows twice per day, such as 05.00-06.00 (forages and concentrates) and 14.00-15.00 (forages and concentrates), but there are some farmers feeding dairy cows in three times, other times are 11.00-12.00 (concentrate or added tofu dregs). The purpose of feeding management is to optimize milk production. In Table 2 can seen the feed needs per farmer per month. In the lactation period, cow needs 8 kg/day concentrate (with crude protein >16%) and forage requires 30-35 kg/day or 10% by weight of cow (Utami, 2018). A number of dairy farmers who need forage more than 3 tons/month are 78.05% of respondents. In general, farmers use cutting and hauling systems to obtain forage on their own land, open access land, or others. Smallholder farmers spend time to looking for and cutting forage without buying forage. A number of dairy farmers who need concentrate of more than 500 kg/month are 85.37% of respondents. The cooperative supplies and distributes concentrates to the farmers. The concentrate price determined by the cooperative for its members is IDR 2600/kg for crude protein below 16%, while concentrate with crude protein above 16% is sold at IDR 3600/kg. Therefore, farmers must prepare forages and concentrates as much as dairy cows they have. Meanwhile, only 28.7% of respondents provide additional feed to their dairy cows in the form of tofu dregs which is purchased from tofu factories. The tofu dreg is in the wet form. Respondents think that the tofu dregs can increase cow productivity. Farmers have to spend some money to buy the tofu dregs which the price is IDR 1500/kg.

Table 1. Identification of respondents.

No	Classifications	Criteria	Number of farmers (%)
1	Cow ownership	1 - 3 heads	56.10
		4 - 5 heads	24.39
		> 6 heads	19.51
2	Cow productivity	1 - < 10 liters/day/cow	27.64
		10 - < 20 liters/day/cow	71.54
		20 > liters/day/cow	0.81
3	Land ownership except for stall	0 m^2	73.98
		1 - < 500 m^2	6.50
		> 500 m^2	19.51
4	Land rented	0 m^2	60.16
		1 - < 500 m^2	13.01
		> 500 m^2	26.83
	n = 100 repondents		

Table 2. Identification of feed requirements

No	Classifications	Criteria	Number of farmers (%)
1	Cow ownership	1-3 heads	56.10
		4-5 heads	24.39
		>6 heads	19.51
2	Cow productivity	1-< 10 liters/day/cow	27.64
		10-< 20 liters/day/cow	71.54
		20> liters/day/cow	0.81
3	Land ownership except for stall	0 m^2	73.98
		1-< 500 m^2	6.50
		>500 m^2	19.51
4	Land rented	0 m^2	60.16
		1-<500 m^2	13.01
		>500 m^2	26.83
	n = 100 repondents		

Table 3. Dairy cattle feed procurement by farmer

No	Identification	Criterias	Number of farmers %
1	Forages (grasses, legumes, agriculture waste)		
	a. procurement	- daily procurement	92.68
		- no daily procurement	7.32
	b. forages stock	- one day	81.30
		- 2–7 days	18.70
	c. obtaining forages	- in farmer's land	64.23
		- in open acces land	35.77
		- both of farmer's land and open access land	100.00
	d. agriculture waste	- utilize agriculture waste	87.22
		- not utilizing agriculture waste	12.78
	e. resources expenditure in forages procurement	- no cash money	81.30
		- cash money	18.70
2	Concentrate		
	a. procurement	- daily procurement	0.00
		- weekly procurement	100.00
	b. concentrate is dropped and bought by	- cooperative (KPBS)	100.00
		- other companies	0.00
	c. resources expenditure in forages procurement	- no cash money	0.00
		- cash money	100.00
3	Agro-industrial by product		
	a. procurement	- no procurement	81.30
		- daily procurement	0.00
		- weekly procurement	18.70
	b. resources expenditure in forages procurement	- no cash money	0.00
		- cash money	100.00
	n = 100 respondents		

In general, no farmer resources, such as money, must be allocated to obtain forage due

to obtain it from their own land, backyard, open access land, and others. Farmers only need time and energy to find and get forage. The time needed for this activity is approximately 4 hours from 08.00 to 12.00. However, time can reach more than 4 hours during the dry season. During the dry season, some farmers have to spend their money to buy agro-industrial by products and agricultural waste such as rice straw. The availability of concentrate has been guaranteed by the cooperative (KPBS) because the cooperative supplies concentrate every week as much as farmers' orders. Farmers order a number of concentrates to the cooperative and the payment is made by deducting from the sale of milk to the cooperative. Milk payments have been set every 14 days by the cooperative.

There are several respondents who utilize agro-industrial by products as additional feed. Farmers mix these products with concentrate to increase milk production. Based on Table 3, 18.7% of respondents utilize tofu dregs. According to Suprapti (2005), the nutritional value of tofu dregs in wet and dry conditions is as follows: the value of dry matter is 14.69% and 88.35%; crude protein 2.91% and 23.39%; crude fiber 3.76% and 19.44%; and crude fat 1.39% and 9.96%. Farmers have to spend some money to buy tofu dregs from tofu factory.

Strategy to anticipate feed scarcity in Pangalengan area

Animal feeds and concentrates are very important production inputs for dairy farming. Smallholder producers will try to get feed every day in any situation. It is impossible for a dairy cow too fast for one or two days due to lack of feed. Farmers will look for animal feed to locations far from their farms in situations of feed scarcity. Feed scarcity conditions often occur in the dry season in the study area. Meanwhile, the availability of concentrates has been guaranteed by the cooperative.

To find out how farmers anticipate the scarcity of forage, we invited 1 KPBS extension agent representative and 5 representatives of the Cipanas and Los Cimaung farmer groups to conduct a focus group discussion (FGD) at the Milk Collection Point (MCP) Los Cimaung. Based on the FGD results, there are four strategies used by dairy farmers to overcome the feed scarcity, namely (1) forage preservation using silage technology, (2) reduced forage and increased concentrate, (3) utilization of agricultural waste, and (4) mixed strategies using strategies 2 and 3.

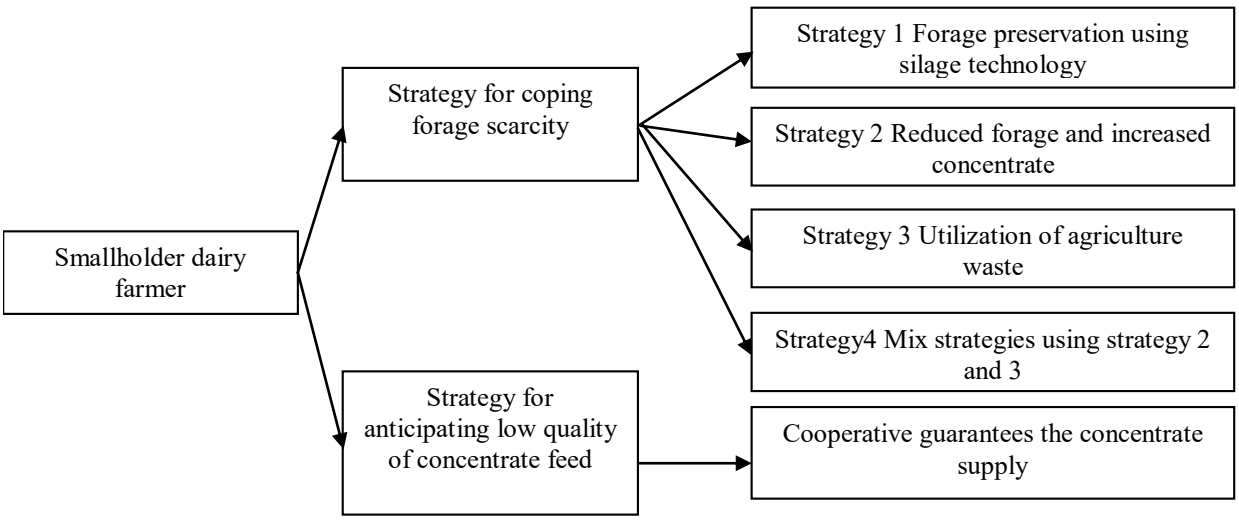

Figure 1. Strategy to address feed scarcity in the study area

Strategy 1: forages preservation using silage technology

Forage preservation is intended to preserve forage and can be stored for a long time. Forage preservation technology which is often applied by some dairy farmers is silage technology. Generally, dairy farmers make forage silage using plastic drums as a storage device to achieve anaerobic storage conditions.

Forages that can be used for silage production are fresh foragess (grass, leaves) or can also be rice straw or corn straw. Silage can improve the nutritional value of forages and be stored for more than one month without damage to dry matter and organic matter. Unfortunately, only a few dairy farmers use silage technology to anticipate feed scarcity.

Strategy 2: reduced forages and increased concentrate

In the situation of food scarcity, dairy farmers have extra time to look for and obtain forage. Reducing forage and followed by increasing concentrate is another strategy that has been implemented by farmers. However, this strategy can increase production costs due to the addition of concentrate.

Strategy 3: utilization of agriculture waste

Agricultural waste is the feed of choice for overcoming feed scarcity. Farmers use agricultural waste, such as rice straw or corn straw as a fodder. Farmers in collective action rent a small truck (with a capacity of 3 tons) to load rice straw or corn straw from the agricultural area because the distance is far from the farms. This action is done every 3 or 4 days. Even though in collective action, farmers have to spend some money to rent a truck and pay for lawn mowers, but agricultural waste is obtained free of charge. The time spent on searching for feed is around 8 hours or more. The use of agricultural waste to feed dairy cows is more than in the rainy season.

Strategy 4: Mix strategy using strategy 2 and 3

In the context of feed scarcity, the majority of dairy farmers tend to use a mix strategy to provide animal feed for their dairy cattle. Farmers apply the mix strategy due to combine the fooder for feed availability in the farms. Farmers must spend some money to apply this strategy.

Concentrate supply strategy

There is no specific strategy for coping concentrate scarcity because cooperative gurantee the supply, even in the dry season. Farmer orders the number of concentrate, then cooperative will supply and distribute the product to farmers as much as order.

The explanation above has identified that dairy farmers face feed constraints in the situation of feed scarcity, especially in the dry season. Farmers spend time and a lot of money to obtain forage or concentrate feed to meet their cows feed needs. The research results also prove that the need for forage and concentrate every month is quite a lot. Based on research, there are four strategies to overcome the scarcity of feed in the study area, such as (1) forage preservation using silage technology, (2) reduction of forage and increasing concentrates, (3) utilization of agricultural waste, and (4) mixed strategies using strategies 2 and 3. In addressing feed scarcity, it is essential for smallholder dairy farmers in Pangalengan, Indonesia, to adopt a combination of these strategies while considering their specific circumstances and available resources.

CONCLUSION

The study result could be concluded that the majority of farmer maintain 1 to 5 heads of cow in the family farming. Besides, more than 70% of farmers have a limited land. The average forages and concentrate per month that needed by farmer is at least 5 ton and 1 ton. In the situation of feed scarcity, there is no specific strategy for concentrate supply because cooperative guarantee concentrate supply. Unfortunately, cooperative could not prepare forages for farmer, therefore there are four strategies for anticipating forages scarcity, such as (1) forage preservation using silage technology, (2) reduction of forage and increasing concentrates, (3) utilization of agricultural waste, and (4) mixed strategies using strategies 2 and 3. Mixed strategy is the most preferred choice made by farmers in order to meet the needs of dairy feed in the condition of feed scarcity.

CONFLICT OF INTEREST

We certify that there is no conflict of interest with any financial, personal, or other relationships with other people or organization related to the material discussed in the manuscript.

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