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Dairy Farmers' Perception on Dairy Cattle Feeds and Feeding System: Brewery By-product Utilization Practice at Kombolcha Regiopolitan City, Ethiopia

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ABSTRACT

A survey was conducted in three selected kebeles of Kombolcha Regiopolitan City in South Wollo Zone. The selected kebeles were in proximity to brewery factory, Ethiopia. A semi-structured questionnaire was used to collect perception data from purposively selected three kebeles and a total of 57 randomly selected dairy farmers. Data collected were analyzed with a statistical package for social sciences (Version 20) and Microsoft Excel (2010). Smallholder dairy farmers had average herd size of 10.7 and 0.08 hectare total dairy farm per household. Average daily milk yield and lactation length of dairy cows was 10.8 liter/day and 9.5 months, respectively. The majority of farmers (59.6%) reared dairy cows with 50-75% exotic blood. The most smallholder dairy farmers satisfied their feed demand from the market and had a trend of providing both dense and poor quality affordable feed ingredients. Smallholder dairy farmers gave priority to feed different kind of cattle in the order of lactating cows, calve, pregnant, heifers and dry cows and used (100%) wet brewery spent grain as a source of dairy feed. Though, there was a brewery by-product supply deficit for half of year. The majority smallholder dairy farmers delivered brewery by-product directly from the brewery factories and followed by wholesalers and retailers. The majority of smallholder dairy farmers (96.4%) stated that the brewery spent grain was fed and stored freshly using different conservation techniques, and the remaining stored in ensiled (1.8%) and dried (1.8%) forms. Smallholder dairy farmers had no brewery spent grain ensiling practice and feeding brewery yeast to dairy animals. Smallholder dairy farmers indicated that high price due to abnormal market chain and shortage of brewery spent grain supply were the major challenges to sustain dairy industry in the study area, and the majority (40.6%) claimed to get swift solutions at high cost and less accessible brewery by-product.

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Introduction

Dairy production in Ethiopia is mostly a smallholder subsistence sector with a small number of small and medium-sized commercial dairy farms. An estimated 3.6 billion litres of milk were produced nationwide in 2019 from about 6.7 million dairy cows, the majority of which (more than 95%) were from native breeds (CSA, 2019).

comparison to neighboring Kenya, whose per capita milk consumption is 110 litres per year (Corne et al., 2016), Ethiopia's per capita milk consumption ranged from 32.8 to 36.5 litres per head/year from 2003 to 2012 (Yilma et al., 2017). This is far less than the 200 liter per capita that the World Health Organization (WHO) recommends. According to (CSA, 2020), the national average daily milk yield and the lactation length of local cows are 1.37 liters and 6 months, respectively.

Forecasts show that there will be a significant rise in the demand for dairy products, especially in developing nations like sub-Saharan Africa (Delgado et al., 1999). In Ethiopia, The rate of increase in population growth estimated at 3% annually. Therefore, it is anticipated that future population growth and consumer income will lead to a rise in dairy product consumption (Mohammed et al., 2004).

One of the major production systems found in the tropics and subtropics is urban and peri-urban dairy production, which is crucial in bridging the gaps in the supply and demand for dairy products (Tegegne et al., 2000). The primary sources of livestock feed in urban and peri-urban dairy production systems include purchased forages, grass hay, crop leftovers, and compound feeds (Gebreyohanes et al., 2021). Therefore, the current crises in animal feed scarcity may be resolved practically and sustainably by using alternative, non-conventional feed resources like feeds from breweries and sugarcane factories (Geberemariyam et al., 2022).

In South Wollo Zone Kombolcha Regiopolitan City, urban and peri-urban dairy production systems have a lot of potential for milk production. However, the dairy sector in the study area was not operating as predicted, due to limited dairy farms, less government attention to the dairy sector, and poor feeding systems. As a result, this survey study was designed to generate base line information on dairy cattle feeds, feeding systems, and brewery by-product utilization practices and challenges in the study area.

Materials and Methods

Study Population

The study was conducted in four urban and peri-urban kebeles of Kombolcha Regiopolitan City smallholder dairy producers, Amhara National Regional State, Ethiopia.

Study Design

A cross-sectional study design was used from 17 December 2022 to 23 December 2022 across the smallholder dairy farms in the study area, and semi-structured interview was developed and used for data collection.

Sampling Procedure

A purposive sampling technique was used to select four urban and peri-urban kebeles based on long experience on feeding of brewery by-products and dairy farming experience. A simple random sampling technique was used to select smallholder dairy producers, and a total of 57 smallholder dairy producers were chosen on the survey.

Data Collection

Data obtained from respondents were demographic characteristics, size of farms, herd size and production parameters, blood level of dairy cows, feeds and production strategies, dairy cow feeding and feed cost, prioritization of feeding, availability of brewery by-product, brewery by-product feed gap and cost, brewery by-product conservation and feeding practices, challenges, opportunities, and opinions.

Data Analysis

The Statistical Package for Social Sciences (IBM SPSS statistics) software version 20 computer program was used for data management, coding, entry, and data analysis. Descriptive statistics such as frequencies, percentages, and means were used to summarize the data. The chi-square test was used to examine the association between categorical variables. Rank analysis was conducted using Microsoft Excel 2010.

Results and Discussions

Demographic Characteristics of the Respondents

80.7% of smallholder dairy producers in a sampled dairy farm were male, whereas the remaining 19.3% were females of different educational levels, and was consistent with report which revealed most of the respondents were male (Nibret, 2015; Tefera, 2018). Regarding the educational level of respondents, 7%, 7%, 48%, and 1.8% of them were illiterate, could read and write, attended formal education, and adult education, respectively (Table 1).

Size of Farms, Herd size, and Production Parameters of Dairy Cattle

As shown in Table 2, the average numbers of lactating cows, dry cows, heifers, calve, and bulls per household were 3.8, 2.4, 2.1, 2.3, and 0.25, with average herd size of 10.7, respectively. The average herd size found in this study is higher than that reported by Geberemariyam et al. (2022); Yeshwas et al. (2022); Sara et al. (2022).

In present study average daily milk yield and lactation length of crossed dairy cows was 10.8 liter/day and 9.5 months, respectively. The current finding showed that daily milk yield was higher than the daily milk yield reported for < 50% exotic blood. But, it was lower than daily milk yield reported for 50-75% and > 75% exotic blood in urban and peri-urban dairy producers (Solomon et al., 2016) and comparable with report of Yeshwas et al. (2022) when crossbred cows (local crossed with HF: >50%) in peak lactation period. Besides, it was higher than reports of (Dawit, 2022). The current result showed that average lactation length was comparable and agreed with findings of Solomon et al. (2016); Dawit, 2022.

Smallholder dairy farmers owned average dairy farm size of 0.08 hectare, of which the average 0.03 hectare was allocated for improved fodder production. The present finding indicated that average dairy farm size was far lower than the average farm sizes in peri-urban and urban areas reported by Solomon et al. (2016). In addition, the average land size for fodder production in the present study was lower than 1.32ha in Mieso district (Husien, 2007), 0.26ha of national average grazing/fodder production land size (CSA, 2013) and 0.3ha in regional level per household (BoA, 2014).

Table 1. Sex and Educational Level of Respondents

Sex	Educational Level of Respondents				Total	Percent	X^2 (LR)	P-value
	Illiterate	Read and Write	Formal Education	Adult Education				
Male	3	1	42	0	46	80.7	10.752	0.013
Female	1	3	6	1	11	19.3		
Total	4	4	48	1	57	100.0		
Percent	7.0	7.0	84.2	1.8	100.0			

X^2 (LR) = Chi-square (Likelihood Ratio), * = significant if $p < 0.05$

Table 2. Size of Farms, herd size and Production Parameters of Dairy Cattle

Farm Features	Production and Farm Parameters	Frequency (N)	Mean ± SD
Kind of Cattle and Herd size	Lactating cows	57	3.81±2.81
	Dry cows	57	2.37±2.36
	Heifers older than one year	57	2.07±1.71
	Calve	57	2.25±1.9
	Bulls	57	0.25±0.47
	Average herd size	57	10.74±6.2
Milk Production Traits(Farmers' Estimate)	Average daily milk yield (liter/cow)	57	10.8±4.5
	Lactation length (months)	57	9.5±3.3
Farm Sizes	Size of the dairy farm (ha)	57	0.08±0.06
	Size of land used for fodder production (ha)	57	0.03±0.02

Table 3. Blood Level of Dairy Animals of Dairy Producers

Blood Level of Dairy Cattle Breeds	Frequency (%)
25–50% exotic blood	2(3.5)
50–75% exotic blood	34(59.6)
> 75% exotic blood	21(36.8)

Blood Level of Dairy Cows

Smallholder dairy farmers guesstimated that 3.5%, 59.6%, and 36.8% of blood levels of dairy cows were found to be 25-50%, 50-75%, and > 75% exotic blood, respectively. In contrast to this result, Lencho (2018) reported that most respondents (86%) rear dairy cows with exotic breeds.

Feeds and Production Strategies

In spite of majority respondents (84.2%) had no enough land for crop cultivation, 12.3% of crop type grown for crop residue were cereal crops (teff, maize, sorghum, wheat) and the remaining 3.5% were cereals and pulses (grass pea and chickpea). Likewise, Tefera et al. (2018) reported that the majority manifested that land is not enough for agricultural activities. Whereas, 61.4%, 10.5%, 1.8%, and 7% of respondents showed that improved fodder types grown in the study area were elephant grass, sesbania, cowpea, and alfalfa, respectively. In agreement to the present study, Solomon et al. (2016) reported that more farmers grow improved forage in urban and peri-urban than rural areas. 24.6%, 1.8%, 38.6%, and 35.1% of the respondents indicated the source of planting materials for improved fodder production was Bureau of Agriculture (BOA), Agricultural Research Center (ARC), other farmers (neighbors), and no sources, respectively.

63.2%, 1.8%, 1.8% and 33.3% of smallholder dairy farmers involved in backyard, intercropping, solo cultivation and no practice of improved fodder production practices, respectively. 64.9% of respondents practiced with cut and carry system of fodder utilization method, whereas, the remaining (35.1%) had no fodder utilization methods due to lack of information and knowledge.

36.8%, 1.8%, 15.8%, 1.8%, and 43.9% of smallholder dairy farmers obtained information about fodder development and utilization system from Bureau of Agriculture, non-governmental organizations, other farmers, universities or agricultural colleges, and no source of information, respectively. 31.6%, 3.5%, 1.8% and 63.2 of the respondents indicated that land shortage, shortage of planting material, lack of information and knowledge and others were the obstacles to successful fodder development on the farm, respectively (Table 4). As shown in Table 5, most smallholder dairy farmers satisfied their feed demand from the market. Similarly, Solomon et al. (2016) reported that dairy farmers in big cities noticed as more dependent on purchased feeds. In contrary to the present study, own holdings were the major source of animal feed (CSA, 2020).

Dairy Cow Feeding and Feed cost

Smallholder dairy farmers estimated the amount of feed offered (straw, hay, oilcake, brewery residue, wheat bran, salt, and mill leftover) to dairy cow based on their local measuring material. According to the result, smallholder dairy farmers provided both dense and poor quality affordable feed ingredients.

Estimated ration for lactating cow, dry cow, heifer, calve and bull was 15.2, 11.8, 9.4, 4.6, and 15.3kg/day, respectively. In addition, smallholder dairy farmers estimated feed cost based on the prevailing market price, although it might fluctuate with location, year, socio-political dynamics, and other factors. As result, straw, hay, oil seed cake, brewery residue, wheat bran, salt, and other by-products were estimated to be procured with 7.5, 8.8, 33.5, 3.05, 21.81, 16.2, and 25.42 Ethiopian birr(ETB)/Kg, respectively.

Prioritization of Feeding

As shown in Table 7, most smallholder dairy farmers gave priority to feed different kinds of cattle in the order of lactating cows, calve, pregnants, heifers and dry cows. The current finding is consistent with the findings of Michael (2002) who indicated that prioritizing agro-industrial by-products is a sustainable management strategy, and used for dairy cattle feed.

Availability of Brewery By-product

Smallholder dairy farmers (100%) used brewery spent grain as a source of dairy feed. Likewise, Geberemariyam et al. (2022) reported that the majority of the dairy farmers (69.4%) were used wet brewery spent grain (WBSG).

Table 4. Feeds and Production Strategies

Question	Parameters	Frequency (%)
Types of crop grown (aftermath for livestock feed)	Cereals	7(12.3)
	Cereals and pulses	2(3.5)
	No land for cultivation	48(84.2)
Improved fodder grown	Elephant grass	35(61.4)
	Sesbania	6(10.5)
	Cowpea	1(1.8)
	Alfalfa	4(7)
Source of planting materials	Bureau of Agriculture	14(24.6)
	Agricultural Research Center	1(1.8)
	Other(neighbor) farmers	22(38.6)
	No sources	20(35.1)
Improved forage production strategies	Back yard	36(63.2)
	Intercropping	1(1.8)
	Solo cultivation	1(1.8)
	No practice	19(33.3)
Fodder utilization method	Cut and carry system/green chop	37(64.9)
	No fodder utilization practice	20(35.1)
Which is the source of information on fodder development and utilization?	Bureau of Agriculture	21(36.8)
	Non-governmental organizations	1(1.8)
	Other (neighbor) farmers	9(15.8)
	Universities/agricultural colleges	1(1.8)
	No source of information	25(43.9)
Why you didn't cultivate improved fodder?	Land shortage	18(31.6)
	Planting material shortage	2(3.5)
	Lack of information and knowledge	1(1.8)
	Other	36(63.2)

Table 5. Source of Feed Ingredients in the Dairy Farm

Feed ingredients (types)	Source	Frequency (%)
Straw	Own	2(6.3)
	Purchased	28(87.5)
	Both	2(6.3)
Hay	Purchased	54(96.4)
	Own and purchased	2(3.6)
Oilcake	Purchased	21(100)
Brewery residual	Purchased	55(100)
Wheat bran	Purchased	48(100)
Salt	Purchased	49(100)
Others	Own	1(2.3)
	Purchased	42(97.7)

Table 6. Estimated Feed Offered, Normal Ration, and Feed Cost

Parameters	Types	Frequency (N)	Mean ± SD
Estimated feed offered (dairy cow/day/Kg)	Straw	57	3.66 ± 0.02
	Hay	57	4.73 ± 2.7
	Oilcake	57	1.5 ± 0.5
	Brewery residual	57	4.99 ± 3.06
	Wheat bran	57	1.78 ± 0.66
	Salt	57	0.19 ± 0.09
	Mill by-product	57	1.35 ± 0.2
	Water (liter)	57	33.62 ± 2.5
Estimated normal ration(kg/day)	Lactating cow	57	15.2 ± 6.31
	Dry cow	57	11.8 ± 4.73
	Heifer	57	9.4 ± 4.63
	Calf	57	4.6 ± 2.23
	Bull	57	15.3 ± 2.03
Estimated feed cost (ETB/Kg)	Straw	57	7.5 ± 2.42
	Hay	57	8.8 ± 3.3
	Oilcake	57	33.5 ± 0.75
	Brewery residual	57	3.08 ± 1.35
	Wheat bran	57	21.81 ± 2.17
	Salt	57	16.2 ± 3.0
	Others	57	25.42 ± 1.35

Table 7. Ranking of Prioritization to Feed Dairy Cattle

Kinds of Cattle	First Priority	Second Priority	Third Priority	Fourth Priority	Total Score	Rank
Lactating cows	36	0	0	0	144	1st
Pregnant	0	11	0	0	33	3rd
Dry cows	0	7	1	0	23	5th
Heifers	1	5	4	2	29	4th
Calve	0	5	8	4	35	2nd

Table 8. Kind and Availability of Brewery Residual

Questions	Responses	Frequency (%)
Which brewery by-product is mostly used on your farm?	Spent grain	57(100)
	Yeast	0
Which brewery factory is the source of by-product?	Kombolcha(BGI)	49(89.1)
	Debrebirhan beer factories	6 (10.9)
Availability in wet season	No difference in season	37(67.3)
	Better Available	13(23.6)
	Deficit	5(9.1)
Availability in dry season	No difference in season	38(69.1)
	Better Available	6(10.9)
	Deficit	11(20)
What is the main reason to use the specified factory by-products?	Proximity to dairy farm (availability)	40(69)
	Relatively cheap in Price	3(5.2)
	Reliable in quality	15(25.9)

Table 9. Ranking of Sources of the Brewery By-product

Sources of Brewery by-product	Primary Source	Secondary Source	Total Score	Rank
Wholesaler	24	0	48	2nd
Retailer	4	4	12	3rd
Brewery companies	26	5	57	1st

Table 10. Brewery By-product Feed gap and Cost

Parameters	Frequency (N)	Mean ± SD
How much BSG you bought (kg/month)	57	1415± 940.13
How long do you utilize the brewery residual as dairy feed (months)	57	2.6 ± 0.6
How often have you bought in a year (months)?	57	2.7 ± 0.6
How much is the transport cost to the farm (ETB)?	55	2.4± 0.16

Most smallholder dairy farmers had access to brewery spent grain directly from the brewery factories and followed by wholesalers and retailers (Table 9). 89% of producers had access to brewery spent grain from Kombolcha (BGI), Ethiopia. Whereas, 11% of producers had an experience of purchasing from Debrebirhan brewery factories. 69%, 5.2%, and 25.9% of respondents replied that proximity, relatively low price, and reliability in quality were the main reason of brewery residue procurement from Kombolcha (BGI), Ethiopia, and confirmed that no difference in brewery by-product availability was confronted in dry and wet seasons. However, low production potential and middlemen in brewery by-product market were the challenges to get and use the by-product (Table 9).

Brewery By-product Supply Gap and Cost

Only 2.7 months of the year were smallholder dairy farmers able to access by-products, and purchase 1415kg of by-product monthly. After purchasing, a by-product would be used for 2.6 months. This revealed that there was a by-product supply deficit for a half of year. In line with this finding, shortage of brewery spent grain, and increasing feed costs are the constraints of dairy production in Gondar (Malede, 2014; Geberemariyam et al., 2022).

According to the majority of respondents, transport cost was added to the costs of brewery by-products and was insignificant (Table 10).

Brewery By-product Conservation and Feeding Practices

The majority (96.4%) of smallholder dairy farmers showed that brewery spent grain was fed and conserved freshly using different conservation mechanisms and the remaining stored in ensiled (1.8%), and dried (1.8%) forms. This result agrees to Geberemariyam et al. (2022) who reported that the majority of the farmers (96.25%) used different conservation techniques. 43.6%, 34.5%, 9.1%, 7.3%, 3.6%, and 1.8% of the respondents indicated that wet brewery spent grain feeding had an advantage to increase milk yield, improve body condition and strength, increase feed intake and rumen bulkiness, suitable for feeding (utilization), require limited storage space, and relatively cheap in price, respectively. The majority (92.6%) smallholder dairy producers fed BSG immediately after delivery, and the rest (7.4%) fed after storing for hours/days. This result in line with the finding of Geberemariyam et al. (2022) that most respondents used wet(fresh) brewery spent grain and served as a replacement of forages (Allen & Stevenson, 1975).

Table 11. Brewery By-product Conservation and Feeding Practices

Questions	Response	Frequency (%)
How does the brewery spent grain stored on the farm?	Dried	1(1.8)
	Ensiled	1(1.8)
	Freshly with different conservation techniques	53(96.4)
How do you fed brewers grain to your animals (utilization practices)?	By product with concentrate	18(33.3)
	By product with concentrate, water and salt	19(35.2)
	By-product with roughage, concentrate, water and salt	16(29.6)
	By-product with concentrate, water, salt and other feed items	1(1.9)
What are the criteria's for using brewery residual in feeding your animals?	Production level	48(88.9)
	Age	2(3.8)
	Others	4(7.3)
Did you conserve BSG before feeding?	Yes(Store for hours or days)	4 (7.4)
	No(Fed immediately)	50(92.6)
Have you faced losses during BSG conservation and feeding?	Yes	2(4.2)
	No	46(95.8)
Do you have BSG ensiling practice?	Yes	1(1.8)
	No	54(98.2)
What is the reason for not practicing BSG ensiling?	Lack of knowledge	26(48.1)
	Ingredients inaccessibility	6(11.1)
	Irregularity of BSG access	2(3.7)
	Not enough amount of BSG for silage preparation	8(14.8)
	Other (no incidence of spoilage)	12(22.2)
Did incidence happen in utilizing the brewery residue as dairy feed	Yes	2(3.6)
	No	54(96.4)
What is the main reason forfeeding brewery residual inmixture with other feed types to dairy cows?	To Improve feed intake and water efficiency	3(4.5)
	To increase milk quality and yield	24(61.5)
	To improve body condition and growth rate	10(25.6)
	Helps for rumen bulkiness and minimize feed cost	9(13.6)
	To improve palatability	20(30.3)
How do you preserve a brewery spent grain?	Compacting	51(42.9)
	Salt inclusion	24(20.2)
	Airtight storage	40(33.6)
	Keep from contact	4(3.4)
Why do you feed fresh brewery spent grain to dairy animals?	Suitable for feeding (utilization)	4(7.3)
	Require limited storage space	2(3.6)
	Increase milk yield	24(43.6)
	Increase feed intake and rumen bulkiness	5(9.1)
	Improve body condition and strength	19(34.5)
	Relatively cheap in price	1(1.8)
How long have you used brewery residual as dairy feed (experience)?	< 5 Years	3(5.6)
	5-10 Years	18(33.3)
	More than 10 Years	33(61.1)

Contrary to the findings of Joachim (2000); Stone (1998), respondents had no practice of feeding brewery yeast to dairy animals in the current study. 61.1%, 33.3%, and 5.6% of respondents confirmed the experience of feeding brewery spent grain for > 10 years, 5-10 years, and <5 years, respectively.

According to the majority of respondents (35.2%), brewery spent grain was combined with concentrate, water, and salt before being fed to the dairy animals. In addition, the majority indicated that in mixture feeding had an advantage to increase milk quality and yield, improve body condition and growth rate. The current study is consistent with the finding of Geberemariyam et al. (2022), wet brewery spent grain was combined with concentrate, salt, and roughage before being fed to the animal.

42.9%, 20.2%, 33.6%, and 3.4% of respondents experienced on brewery spent grain conservation by compacting, airtight storage, salt inclusion and kept free from contact, respectively (Table 11). In contrary to the finding of Geberemariyam et al. (2022), majority smallholder dairy farmers (98.2%) in this study area had no brewery spent grain ensiling practice predominantly due to lack of knowledge on silage preparation (48.1%), no incidence of spoilage with their common practice (fresh storage) (22.2%), and limited brewery by-product supply (14.8%). In the current study, no spoilage of wet brewery spent grain was encountered, in contrary to the findings of Geberemariyam et al. (2022); Boateng et al. (2015).

Most farmers (95.8%) responded no loss was confronted while feeding and conserving brewery spent grain. Many respondents (88.9%) prioritized to feed brewery spent grain based on dairy animals' production level, whereas just a few farmers (3.8%) prioritized dairy animals based on age. This result agrees with Andrew et al. (2014); Geberemariyam et al. (2022), who indicated that prioritization of BSG feeding improves production level (milk yield and growth rate).

Table 12. Challenges, Opportunities and Opinions

Questions	Response	Frequency (%)
Opportunities	Proximity of brewery factory	8(14.04)
	Relatively low price of brewery spent grain	8(14.04
	High feed value and palatability of brewery spent grain	41(71.9)
Challenges	Shortage of supply (BSG)	35(67.3)
	Shortage of supply and high price due to abnormal market chain	17(32.7)
Demand and opinions of dairy producers	Need satisfactory loan	1(3.1)
	Need adequate Land for dairy animals, forage development and waste disposal	7(21.9)
	Need a solution for high cost and less accessible brewery spent grain	13(40.6)
	Need improved forages	9(28.1)
	Need technical trainings	2(6.3)

Opportunities, Challenges, and Opinions

Most of smallholder farmers (71.9%) showed high feeding value and palatability of brewery spent grain as an opportunity to invest in this sector. However, 94.1% and 5.9% of smallholder dairy farmers indicated that high price due to abnormal market chain and shortage of brewery spent grain supply were the major challenges to sustain dairy industry in the area, respectively. In line with this findings of Geberemariyam et al. (2022); Malede (2014); Getu et al. (2018); Lombebo & Wosoro (2019); Ahmedin & Yusuf (2019); Sara et al. (2022) indicated that shortage of wet brewery spent grain and increasing feed costs are the constrictions of dairy production. In addition, the majority (40.6%) claimed to get swift solutions on high cost and less accessible brewery spent grain (Table 12).

Conclusion

The dairy sector was confronting a challenge due to inadequate dairy farm and land for fodder production, shortage of feed supply and high feed cost. As a result, the majority smallholder farmers satisfy their feed demand and dependent on purchased feeds. Brewery spent grain was the main source of dairy feed in the study area. Smallholder dairy farmers indicated that the proximity of brewery factory (Kombolcha BGI, Ethiopia) and high quality of brewery spent grain were an opportunity to the dairy sector. However, brewery spent grain supply shortage and abnormal rising prices due to brokers and surpass marketing cooperatives were the major challenges. As a result, smallholder dairy farmers claimed to get enough dairy farm land and brewery by-product at reasonable prices.

Declarations

Ethical Approval Certificate

This study was approved by Amhara Agricultural Research Institute research review forum, and decision and permission were obtained from Sirinka Agricultural Research Center to conduct the dairy survey in the selected areas with decision number 532/0020/2024 and date 05/02/2024.

Author Contribution Statement

Shambel Kiros: Data collection, investigation, formal analysis, and writing the original draft

Solomon Tiruneh and Belay Deribe: Project administration, supervision conceptualization, methodology, review and editing

Abto Asres and Demlie Chanie: Data collection and investigation

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Conflict of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

Data Availability

Data used to support the findings of this study are available from the corresponding author upon request.

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