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Research Article

Determinant of Milk Production in Northwestern and Western Zones of Tigray, Ethiopia

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Abstract

This study identifies the main determinants of milk production in Northwestern and Western zone of Tigray region using both secondary and primary data sources collected through survey, KII and FGD. The cross-sectional data type has collected during 2018 from 309 smallholder dairy cattle keeper farmers randomly selected following multistage sampling technique. It has so found that the average milk yield obtained per cow per day was 2.53 and 3.3 3Lt; milked for the average number of 27 and 26 days per month for the average number of 6.3 and 6.4 months. So that the total produced amount of milk was 1166.25Lt and 2291.29Lt per household, respectively for Tahtay adiyabo and Kafta humera districts. Applying multiple linear regression analysis, the major determinants of milk yield in Tahtay adiyabo district are; number of months that collected/concentrated feed has provided for dairy cows, education level of the household head, place where milk has sold and loan obtained especially for dairy production. These variables have positive and significant relationship. While, variables such as distance of cattle farm from local market, total family size and marital status of the household head has significant and negative relationship. Similarly, in Kafta humera district the determinant factors are; number of months that collected feed provided, occurrence of cattle pests and diseases, education level of household head and experience in cattle rearing has significant and positive relationship. While, variables such as sex of the household head, distance of water source that dairy cattle travel and extension contact in livestock production has significant and negative relationship with milk yield obtained. Based on these findings this study recommends that, capacity building; organizing smallholder farmers by nearby and establish functional milk and its product supplying cooperatives. It is also important that dairy cows should provide concentrated and collected feed; introduction of improved forages with intensive protection from cattle diseases and pests as well as improving access to drinking water source in nearby are important.

Introduction

Background and justification of the study

Livestock production in developing countries like Ethiopia and in the study area particularly, plays major role both in driving economic growth and nutritionally. Besides, for many rural smallholder farmers livestock is a 'living bank' that serves as a financial reserve for periods of economic distress [1]. Dairy is one of the different products obtained from livestock that has so many dietary, food security and food self-sufficiency importance. Similar to the global scenarios, in the study area dairy provides a way to increase assets, diversify income and nutrition. It is also an important tool to address poverty, enhance agricultural development and create employment opportunities.

Despite the significant progress in reducing global hunger over the last few decades, food insecurity and under nutrition, remain serious in many developing countries [2,3]. Even though much of the food in developing country is produced by smallholder farmers [4], those farmers are most affected by food insecurity [5-7] . In consistent with that in SSA, the number of undernourished people is even increasing [8]. Hence, the small farm sector is a crucial entry point for policy interventions to improve food security and nutrition.

In Ethiopia, regardless of the increment in milk amount from year to year, milk demand and its price raises from time to time because of different factors. Of these factors population growth and nutritional focus towards dietary are the major once [9]. The country has highest cattle populations in Africa, estimated to 60.39 million heads of which 98.24% are endogenous breeds

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[10] to produce about 90% of the milk obtained per year [9]. Thus, regardless of the huge cattle population owned (2/3 of the world) milk production is less than ¼ of the world milk production. This shows too low milk yield as the cow milk yield is 1.37 liter per day per cow for the average lactation period of six months [10].

Similarly, in Tigray region, the trend in number of cattle shows an increment across years, but its yield was declining. The number of cattle in Tigray in 2012/13 was 4.065million (of which 49,180 were milking cows milked for six months yielding 1.36 liter per day per cow) CSA (2013), reaches to 4.82 million cattle (of which 52,538 are dairy cows milked for six months providing 1.27Lt per day per cow) [10]. In North Western and Western zones of Tigray also the trend in number of cattle is increased from 1.44 million and 741,824 (in 2012/13) to 1.88 million and 885,100 cattle (in 2016/17) respectively [11]. Similarly, the number of cows was showing an increment.

In lowland areas of Northwestern and Western zones of Tigray, there is high potential for dairy production. Few of the potentials are availability of special breed called Begait cattle, wider rangeland, different grass natural forages and comfortable agro-ecology. As the report obtained from CSA [11], number of cattle in the study zones covers 57.66% of the total cattle population in Tigray and female cattle in these zones also covers about 63%. Being these, under intensive management dairy productivity in the area could be boost to 8Ltr per Begait cow per day [12].

However, regardless of the population available, its dairy production potential, milk productivity in the study area was too lower which was also declining from year to year. As evidence for its productivity trend it is important to understand the report obtained from CSA (2013 and 2017), which is indicating that the average milk yield per cow per day in North western and Western zones of Tigray is decreased from 1.41Ltr and 1.82Ltr (in 2012/13) to 1.25Ltr and 1.47Ltr (in 2016/17), respectively. Nevertheless, this data is lower than the report obtained from the selected districts that is about 5.25Ltr per day [13]. Irrespective of the huge untapped potential for dairy production in the area, milk productivity was lower for unidentified factors. Meanwhile, there were no studies conducted in the area showing the average milk productivity and its determinant factors. This was so to assess the average milk productivity in the area and its determinant factors.

Notwithstanding of the dairy production potential and its importance, the following trends affect dairy production particularly in rural areas smallholder livestock producers leading lower milk productivity and production, increasing pressure on common grazing and water resources; lower intention of the farmer to dairy as business/ source of income, unavailability of structured dairy market access and infrastructures. Heedlessly there were no any studies conducted in the study area focusing on identifying the dairy productivity determinant factors. Therefore, this study has been proposed to estimate milk productivity and identify its determinants so to address these factors, so that to improve the milk productivity.

Objectives

Generally, this study has designed to estimate milk productivity and its determinant factors in lowland areas of North western and Western zones of Tigray.

Specifically, this study seeks to address the following specific objectives:

Identify main determinant factors of milk productivity in Western and North western zones of Tigray;

Identify the key constraints and challenges of milk production in the study area.

Methodology

Description of the study area

The study has conducted at lowlands of Northwestern and Western zones of Tigray, Ethiopia as shown in Figure 1. The study area borders by Sudan from West, Eritrea from North, Laelay adiyabo and Welkayt districts of Tigray regional state from East and Tsegedie district of Tigray regional state from South. The geographical location of the study districts is 14.05-14.89N and 37.34-38.17E, 13.67-14.45N and 36.27-37.53E respectively for Tahtay adiyabo and Kafta humera districts (TARI Working Paper No.1, 2019) [13]. From the same source, it also found that 94.13% and 85.7% of the districts respectively for Tahtay adiyabo and Kafta humera is located in lowland agro-ecology. Tahtay adiyabo district has a total population of 105,871 with the total households of 26499 [13], while Kafta humera district has a population of 103692 with 25,293 households covering 396852 ha cultivable land [14].

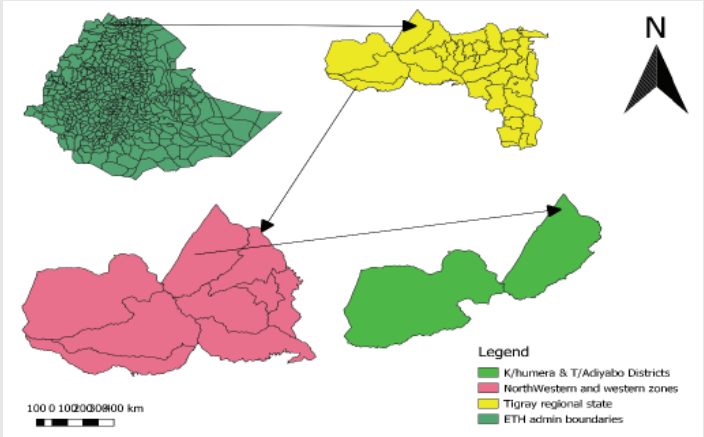

Figure 1: Map of the study areas.
Source own sketch from QGIS 3.2.

Farming system and agricultural production potential of the area

In the lowland parts of the Northwestern and Western zones of Tigray region, the farming community practiced mixed farming system of both crop and livestock production. As presented in Figure 2, the study areas have endowed with higher potential for crop (majorly Sesame, Sorghum and other lowland pulses and irrigation crops) and livestock (special

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Figure 2: The different data obtained from the study Districts.

breed called Begait cattle, goat and sheep). Here there is also relatively rich in forest plants and green forages (during the rainy season).

Sample size and sampling Method

For conducting this study multi-stage sampling technique used for selecting respondents. First, lowland areas of Northwestern and Western zones of Tigray selected purposively for their potential in dairy production. Then districts such as Tahtay Adiyabo from North western zone of Tigray and Kafta Humera from western zone of Tigray are selected randomly (Figure 1). Following, 4 Kebeles from each district; such as A/Aser, M/Kuhli, Z/Gedena and Mentebteb (from T/adiyabo) and Adebay, Rawiyan, M/Kadra and Bereket (From K/Humera) are selected randomly by piking rolled paper. Finally, 309 dairy producers (160 from T/Adebayo and149 from K/humera) selected using simple random sampling based on probability proportionate to size (PPS) of the dairy producers.

Data types and sources

This study used both primary and secondary data sources to collect cross-sectional data type. The primary data sources are from dairy cattle rearing farmers, by interviewing from the selected respondents. While the secondary data sources are from published and unpublished sources and reports.

Methods of data collection

The cross-sectional data used in this study has collected from primary sources by interview using semi-structured questionnaire and KII. While the secondary data collected from published and unpublished documents.

Methods of data analysis

For analyzing the data and reporting the results, this study applied both descriptive and inferential statistics. Descriptive statistics used for presenting the results in the form of: means, percentages, maximum and minimum and ratios. Besides, multiple linear regression model (MLR) used for analyzing the dairy productivity determinant factors. So that, the significant determinants would be identified.

Result and discussions

Descriptive statistical results

Considering the continues variables, it is found that the average age of the respondents engaged in dairy farming in Tahtay adiyabo and Kafta humera districts is 44 and 50 years old respectively (Table 1). This also found that the average family size is six persons per family with one to one ratio of male to female members in both districts. The average education level of the respondents is about 3rd grade for both districts. The average experience in cattle rearing was 20 and 18 years while the experience in milking was 18 and 17 years respectively for Tahtay adiyabo and Kafta humera districts (Table 1). Regarding the average distance of cattle farm from local market, this study found 20.37km and 23.72km respectively. As presented in Table 1, the frequency of training related to cattle rearing provided per year is almost one time in both districts.

There is significant difference between the two districts regarding; milk market participation, extension service, religion, frequency of extension contact, age and education level of the household heads, experience in agriculture, distance of cattle farm to local market, distance of cattle farm to residence and distance cattle travel to drink water (Table 1). However, insignificant difference regarding experience in cattle and dairy production, total family size, and distance of residence from district town.

Dairy production inputs and dairy yield obtained

Cattle rearing management, feeding system and feed sources

Here in the study area most of the farmers use both family and hired labors for managing their dairy cows. During cattle rearing, most of the farmers in Tahtay adiyabo (i.e. 55%) used their family labor, while most of the farmers in Kafta humera (i.e. 49%) district used hired laborers (Table 2).

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Table 1: Socio-economic characteristics of dairy farming households in both districts and its difference.

Variables Considering Dummy variables		Tahtay Adiyabo In %		Kafta humera In %		Difference	
Milk market participation	Participate	51.25		27.52		chi2(1) = 18.14 P = 0.00	
	non-participant	48.75		72.48			
Extension Service	No	12.5		31.54		chi2(1) = 16.48 P = 0.00	
	Yes	87.5		68.46			
Religion	Orthodox	100		96.64		chi2(1) = 5.46 P= 0.02	
	Muslim	0		3.36			
Considering continues variables		**Mean**	**Std. Err.**	**Mean**	**Std. Err.**	**Mean**	**T-test P (Ha: diff! = 0)**
Family size	Male	3.07	0.12	3.15	0.13	-0.08	t = -0.45, P(v)= 0.66
	Female	3.16	0.12	2.92	0.12	0.23	t = 1.38, P(v)= 0.17
	Total	6.22	0.18	6.06	0.19	0.15	t = -0.62, P(v)= 0.54
Age of the house hold head (Years)		44.24	0.78	50.18	0.98	-5.89	t = -4.75, P(v)= 0.00
Education level (years of schooling)		3.47	0.22	2.91	0.24	0.52	t = 1.6, P(v) = 0.11
Experience in Cattle production (Years)		19.50	0.79	20.26	0.88	-0.77	t = -0.65, P(v) = 0.52
Experience in dairy production (Years)		16.20	0.83	17.5	0.87	-1.30	t = -1.08, P(v) = 0.28
Distance from cattle farm to L. Market		8.24	0.60	5.92	0.63	2.32	t = 2.65, P(v) = 0.01
Distance from Cattle farm to residence		1.42	0.28	8.26	0.83	-6.83	t = -8.05, P(v) = 0.00
Distance from residence to District		18.15	0.84	17.38	1.07	0.77	t = 0.57, P(v) = 0.57
Number of Livestock related Training obtained		0.70	0.08	1.05	0.11	-0.35	t = -2.59, P(v) = 0.01
frequency of extension contact		2.28	0.08	1.94	0.12	0.34	t = 2.34, P(v) = 0.02
Experience in agriculture (Years)		20.47	0.77	23.71	0.86	-3.24	t = -2.81, P(v) = 0.01
distance cattle travel to drink water		1.59	0.21	3.36	0.37	-1.77	t = -4.22, P(v) = 0.00

During the group discussion regarding feeding system, participants explained that; in the rainy season cattle travels far distant from residences and live there by fencing temporary barn that continues for three to four months. These temporary barns where established in places where there is rain and green feed which cattle can graze it (Figure 3). This practice continues for the months from June to September, living in the simply fenced overnight near to communal grazing land. The area is far from homestead and cropland. During these months most of the milk obtained had used by herders. It is because of the reason that the area is far from market and home (residence). Which is so difficult to take milk during all times in the morning and/or in the evening. However, during the next three to four months, the dairy cows as well as the other cattle live and stay near to residence as there have feed availability of crop-aftermath around the homestead area. Unlikely, for the rest months cattle spent without fenced barn, since as the grazing time have changed from day time to overnight to protect the enormously hot air condition.

This study also found that about 67% and 76.5% of the respondents in Tahtay adiyabo and Kafta humera districts respectively manages their dairy cows together with the other non-dairy cattle, while the remaining manage their dairy cows separately from the other non-dairy cattle (Table 2). According to the FGD participants in Tahtay adiyabo district, farmers hired laborers during rainy season for the reason that cattle travels far from residences and live there at areas where green feed could be available. During this season as the cattle farm is far distant from residence, one laborer rear and manage by collecting large number of cattle together. However, in Kafta humera district cattle had forced to travel far from residents on daily bases for the reason that grazing around the residents have challenged because there is no free area for grazing. Therefore, it is necessary to use hired laborers to manage their cattle during all months.

Table 2: Cattle rearing and management practices, feeding system and feed supplementation periods of the farmers in Tahtay adiyabo and Kafta humera districts.

Activities			Tahtay adiyabo (in % from 160 respondents)	Kafta humera (in % from 149 respondents)
Cattle rearing and management are performed by		Family members	55	10
		Hired laborers	16	49
		Both family & Hired laborers	29	41
Dairy cows management system		Together with the other cattle	66.88	76.51
		Separately from other cattle	33.13	23.49
Feeding system of the dairy cows		Feed Together	63.76	70.47
		Feed Separately	36.25	29.53
Practices of Feed supplementation	Not supplemented		40.00	44.00
	Feed supplementation in	February -June	33.13	35.57
		March or April -June	15.00	16.78
		May -June	8.75	2.68
		June -June	3.13	0.67

Figure 3: Temporary cattle barn during the rainy season while living far apart from residences for searching green feed.

It is also found that, farmers in the area practice both free grazing and supplementation by different feeds (hey, crop residues, concentrated feed, and even grain). Thus, in most cases supplementation practiced during the dry seasons. Regarding the feeding system, 36% and 29.5% of the farmers allow their dairy cows to feed separately from the other cattle.

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While the remaining 64% and 70.5% allow their dairy cows to feed together with the other cattle, and allows to free graze during the rainy season that green grasses could easily obtained and latter supplement by controlled feed respectively for Tahtay adiyabo and Kafta humera districts (Table 2). This indicates that there was no special management provided for the dairy cows particularly during the rainy season. Thus, there has a similar practice with in the two districts.

This also found that, 40% and 44% of the farmers from the total respondents in Tahtay adiyabo and Kafta humera districts did not provide supplementary feed for their dairy cows. While, the remaining 60% and 56% supplement by providing concentrated feed where 55% and 64% of the supplementation providers start the supplementation on February respectively (Table 2). However, it is important to supplement cattle during the dry seasons particularly a special care is necessary for the dairy cows that large number of farmers were lagging to practice it. Regarding free grazing system, all cattle (including dairy cow) travel and live at least for four months during summer season. But during the other months it live around the residence passing the hottest hours in shed and travel for searching of feed at night and cool hours in nearby around.

As presented in Table 2, in both districts most of the farmers start supplementation of feed for their dairy cows during February and stay until June. It is for the reason that starting the month of February there where scarcity of crop residues and green grass residues. During this month also the temperature starts to increase (becomes warm) which makes difficult for cattle and dairy cows particularly to travel for searching/grazing of feed rather enforce it to rest during the day light under sheds and move around during cool hours and night. This is why most of the farmers start supplementation from February.

Composition of the cconcentrated feed

As shown in Table 3, during their supplementation by providing concentrated feed, it found that 59% and 87% of the farmers provide (supplement by) sorghum grain only. However, there are also farmers who supplement by providing such as sesame seed cake (Asera), fruska and its combinations. As the data obtained from the FGD during their group discussion, the reason why most of the farmers provide sorghum grain is that the area belt for sorghum production so it produced as major crop with in the area. Thus, there is high amount of sorghum grain produce in the districts. However, its storage faces challenges of storage pests. Besides its price is lower which could not cover the price of other concentrated feed. Here also the farmers believe that it can substitute the content of the other concentrated feeds. Due to the reasons explained above, most of the farmers prefer to supplement by providing sorghum grain. With this, it is important to understand that sorghum grain had supplemented in processed form.

Water source and its distance

Similar to the feeding system, in the study area it is familiar that cattle drink water in two systems. One is that during the rainy season cattle drink water in anywhere as can get at naturally created water sources/ponds. Nevertheless, during the dry season cattle travel to either water sources such as rivers and/or communally constructed water ponds (as shown in Figure 4).

In dealing with water sources, 80 and 84% of the farmers in T/adiyabo and K/humera districts respectively enforce their cattle to drink water in nearby water sources (Table 4). During the rainy season, the average distance that the cattle travel to drink water from the water source is 1.59 and 3.36 Km, while during the dry season it travels about 4.7 and 8.45Km respectively for Tahtay adiyabo and Kafta humera districts. This is in-line with the result found by Gebretnsae, et al. [15]. Here 82.2% of the farmers also respond that their dairy cows travel together with the other cattle to drink water regardless of the distance.

Table 3: Composition of the concentrated feed supplemented to dairy cows.

Composition of Concentrated feed	Tahtay adiyabo (in % from 160 respondents)	Kafta humera (in % from 149 respondents)
Sorghum Grain	59.38	87.25
Fruska	13.12	4.70
Asera	18.12	4.70
Sorghum G. and Fruska	3.75	1.34
Sorghum G. and Asera	1.88	1.34
Fruska and Asera	3.75	0.67
Total	100	100

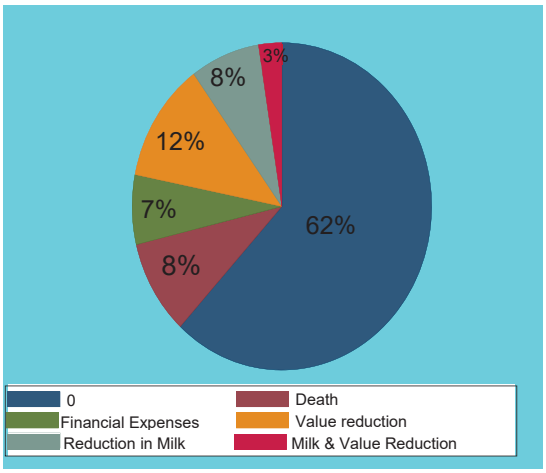

Figure 4: Consequence of feed shortage faced in T/adiyabo.

Table 4: Water sources from which the Cattle drinks.

Cattle's Water Source	Tahtay adiyabo (in % from 160 respondents)	Kafta humera (in % from 149 respondents)
At farm	19.38	13.42
At near water source	80.00	83.99
At Communal ponds	0.63	2.68
Average distance cattle travel to drink water (Km) during rainy season	1.59	3.36
Average distance cattle travel to drink water (Km) during dry season	4.7	8.45

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Cattle breed type owned

Regarding the dairy cattle breeds, all of the farmers own endogenous breeds of that 62.7% and 95.3% of the farmers in Tahtay adiyabo and Kafta humera districts own Begait cattle breed, followed by 30.6% and 2.7% whom owns Arado and the remaining 6.7% and 2% owns both Begait and Arado respectively (Table 5).

This result is similar with the results found by Musa and Mummed (2020) and CSA (2018), which says more than 86% in the study area and 98% of the cattle in Ethiopia are endogenous breeds respectively.

Dairy production feed shortage and its consequences

According to the farmers' response as shown in Figure 5 and 6, regardless of the feed quality they prepare from the total respondents in Tahtay adiyabo and Kafta humera districts about 62% and 74% did not face feed shortage for their dairy cattle beyond the plan they have planned before. Nevertheless, the remaining 38% and 26% faces feed shortage that the amount they planned had finished and faced to feed even by buying from other sources and/or simply accepting with no action.

Here it is important to understand that most of those who faced shortage of feed beyond what they had planned (that is 74% of the respondents) was faced during the months of May and/or June. Due to this feed shortage, different consequences had faced and of which the highest percentage took by value reduction.

Generally, the consequences of feed shortage have presented in Figure 4 and 5. In both figures, the 'o' in the legend is to indicate the percentage of farmers who did not face feed shortage beyond the plan they planned. With this it is important to be-remained you that; they did not face feed shortage means that, it is regardless of the content of the feed they have. Unless otherwise the feed content they consider as feed is crop residues with no other supplements, crop grain not yet re-mixed with other concentrates and/or hay. Thus, feed nutritional content is lower which is incomplete for the contents recommend for dairy cows.

Amount of milk obtained, number of dairy cow owned and length of lactation period

Unlike to the other areas, in these two districts milking by small-scale farmers had practiced once a day from the mother of one-month-old calf. Thus, newborn calf until it reaches one-month age would fully suckle its mother without any intervention. Even after starting milking, there had a trend of leaving at least one teat free to suckle by calf. You can observe this from (Figure 6). This practice is similar with the result found by Gebretnsae [15]. As presented in Table 6, on individual bases the average amount of milk produced per year per individual farmer in T/adiyabo and K/humera districts is 1166Ltr and 2291Ltr. Of which 826Ltr and 1314Ltr has consumed at home and wasted thrown, while the remaining about 340Ltr and 977Ltr has sold at local market respectively. To obtain this total milk amount the individual households held an average of

Table 5: Breed type of the Cattle owned by the farmers in the study districts.

Cattle Breed type	Tahtay adiyabo (in % from 160 respondents)	Kafta humera (in % from 149 respondents)
Begait	62.50	95.30
Arado	30.63	2.68
Both Begait and Arado	6.87	2.02

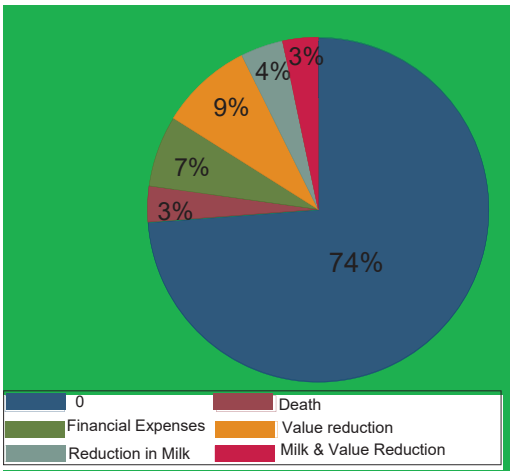

Figure 5: Consequence of feed shortage in K/humera.

Figure 6: Few of the reasons for lower amount of milk-taken-off from milk cows.

Table 6: Number of dairy cows owned, its milk yield, number of milking months and total milk production in the study districts per household.

Variables	Tahtay adiyabo	Kafta humera	Difference	
			Mean	T-test and P-value
Average No. Dairy Cows owned	2.71 (0.13)	4.1 (0.33)	-1.40	t = -4.11, P =0.00
Milk yield per Day per Cow (in Lt)	2.53 (0.09)	3.33 (0.09)	-0.80	t = -6.29, P=0.00
No. Milking Days per Month	27 (0.33)	26.1 (0.47)	0.93	t = 1.61, P=0.11
No. Milking Months / cow per year	6.3 (0.19)	6.43 (0.17)	-0.17	t = -0.66, P=0.51
Total Milk Produce	1166.25 (99)	2291.29 (308)	1125.04	t = -4.01, P=0.00
Average amount of milk Sold at local market (in Lt)	339.87 (44.74)	977.16 (280.43)	-637.29	t = -3.05, P=0.00
Average amount of milk consumed at home (in Lt)	826.38 (82.77)	1314.12 (108.85)	-487.74	t = -3.59, P=0.00
Average milk selling price	12.03 (0.41)	12.36(0.48)	-0.32	t = -0.51, P= 0.60
Average milk production cost	5556.82 (580.59)	10538.39 (939.47)	-4981.57	t = -4.57, P = 0.00

The numbers in the brackets are the standard errors.

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2.7and 4.1cows milked for more than six months providing the average milk amount per day of 2.53Ltr and 3.33Ltr respectively for Tahtay adiyabo and Kafta humera districts.

The number of milk cows found in this study is consistent with the result reported by Gebretnsae (2017) [15], while the milking months is similar with the result found by Tenagnework (2016) and Kitaw, et al. [16]. This milk yield obtained in both districts is also in-line with the yield reported by Musa and Mummed [17], Ayalew (2017) and Kitaw, et al. [16]. However, higher than that of the result found by CSA [10], Tenagnework (2016), Yohannes (2015) and Dejene [19].

The average milking months is also similar with the reports of CSA [10], Gebretnsae [15], Tenagnework (2016), Musa and Mummed [17], Ayalew and Kitaw, et al. [16]. The higher milk yield could be due to the breed type which most of the farmers own Begait breed. However, still the milk yield is lower as compared to the potential reported by HuARC [12] and the plan proposed by the districts', which was about 8Ltr per cow per day. As per the data obtained from the FGD, KII and the researchers' observation, milk was not fully taken-off; rather part of it was remained and sucked by calf (Figure 6). Here also it was once a day that milk had taken-off; either it could be during the morning or evening but not during both times. Thus, regardless of its potential lower amount of milk had taken-off from the milk cows. While the milk production potential per a day is too much higher than the amount taken-off by the individuals.

As shown in Table 6, this study found that there is significant difference between Tahtay adiyabo and Kafta humera districts in the number of dairy cows owned, milk yield obtained per cow per day, total amount of milk produced, amount of milk consumed at home, amount of milk sold at local market and average milk production cost. These all are significant at one percent significance level. While there is insignificant difference between the two districts regarding the number of milking days per month, number of milking days per month per cow and the average milk selling price.

Major determinants of milk productivity

It is to identify the major determinants of milk productivity obtained by individual households in the study area. Accordingly, the significant milk productivity determinant factors in Tahtay adiyabo district as presented in Table 7 are; number of months that collected/concentrated feed is provided, education level of the household head, place where milk and its product was sold, and loan obtained especially for dairy production has positive and significant relationship. While variables such as distance of cattle farm from local market, total family size and marital status of the household has significant and negative relationship.

On the other hand, of the hypothesized variables experience in cattle production in years, sex of the household head, cattle disease and pests, distance cattle travel to water source to drink water and frequency of extension contact has insignificance relationship. In evaluating the model validity test as shown in

Table 7: Determinants of milk productivity in Tahtay Adiyabo district.

Milk Yield per Cow per a Day	Coef.	Std. Err.	t	P>t
Distance of farm from local market (in Km)	-0.01	0.00	-2.85	0.01
Total family size	-0.04	0.02	-2.35	0.02
Number of months collected feed is provided to dairy cows	0.17	0.02	7.54	0.00
Education level of the household heads (level of schooling)	0.19	0.02	8.77	0.00
Experience of the household in cattle rearing (in years)	0.00	0.00	-0.03	0.97
Sex of the household head	0.01	0.11	0.12	0.90
Marital status of the household head	-0.10	0.06	-1.76	0.08
Incidence of cattle disease and pests	0.08	0.08	0.95	0.34
Distance of water source from farm	0.00	0.01	0.06	0.96
Place where milk and its products sold (in Km)	0.08	0.03	2.66	0.01
Frequency of extension contact	0.02	0.03	0.59	0.56
Availability of Loan specially for dairy production	0.14	0.06	2.35	0.02
Constant	1.69	0.23	7.22	0.00
Model validity test results	F (12, 146) = 55.87		Prob > F = 0.0000	
	R-squared = 0.8212		Adj R-squared = 0.8065	

Table 7, the overall model fits because p-value of the overall model is significant at one percent significant level. Besides, the coefficient of determination which is measured by the Adjusted R-squared is 0.81 is indicating that; the variables in the model explains about 81% of the dependent variable.

Regarding the milk yield obtained in Kafta humera district also variables such as; the number of months that collected feed provided for the dairy cows, cattle pests and diseases occurrence, education level of household heads and experience in cattle rearing has significant and positive relationship. While variables such as; sex of the household head, distance of water source that the dairy cattle travel to drink water and extension contact regarding livestock production has significant and negative relationship with the milk yield obtained (Table 8).

In dealing the model validity evaluation as it shown in Table 8, the model validity test indicates that the overall model is valid. Because the over-all model validity tests such as; p-value is significant at one percent significant level with the coefficient of determination (Adj R-squared) equals to 0.72 indicating that the variables explain about 72% of the dependent variable. While the remaining is not explained by these variables.

Major challenges and constraints of dairy production

Regarding the major challenges and constraints facing the dairy production in the study areas, this study had interviewed the sampled respondents, and conducted FGD and KII.

Accordingly, the major challenges and constraints of milk production in the area were diseases and pests, shortage of grazing land, drought, unavailability of water in nearby, unavailability of organized milk markets, unavailability of milk processing technologies and shortage of improved feed (Table 9). Improper milk packing and handling as well as shortage of processed milk, low level of market linkage, high and ever increasing feed prices, lower productivity of the local

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dairy cattle and poor dairy management skill of smallholder dairy farmers were found to be the most important constraints hindering the dairy production [16].

Here during the group discussion in prioritizing these challenges, it was conducted by discussing and debating among the group members and finally to reach in agreement. Therefore, the challenges with its priority rank identified from the individual interview is in-line with the rank arranged during the FGD and KII in Table 9. From the literatures perspective also, these major challenges and constraints found are consistent with the results found by Musa and Mummed [16], Godadaw, et al. [15], Mesay, et al. [20] and IPMS [21-31].

Table 8: Determinants of milk productivity in Kafta humera districts.

Milk yield per cow per a day	Coef.	Std. Err.	t	P>t
Total family size	0.00	0.02	-0.14	0.89
Number of months collected feed is provided to dairy cows	0.06	0.02	2.61	0.01
Education level of the household heads (level of schooling)	0.04	0.02	1.76	0.08
Experience of the household in cattle rearing (in years)	0.06	0.01	7.40	0.00
Sex of the household head	-0.62	0.14	-4.38	0.00
Marital status of the household head	0.09	0.07	1.22	0.22
Incidence of cattle disease and pests	1.06	0.12	8.89	0.00
Distance of water source from farm	-0.02	0.01	-1.90	0.06
Place where milk and its products sold (in Km)	0.01	0.04	0.31	0.76
Frequency of extension contact	-0.45	0.13	-3.55	0.00
Availability of Loan specially for dairy production	0.09	0.14	0.62	0.53
Constant	1.17	0.37	3.20	0.00
Model validity test results	F (11, 137) = 35.16		Prob > F = 0.00	
	R-squared = 0.7384		Adj. R-square = 0.72	

Table 9: Major constraints of milk production in the study districts.

Major dairy production challenges and constraints	Tahtay adiyabo (% from 160 resp.)	Kafta humera (% from 149 resp.)	Mean Rank
Diseases and pests	40.65	43.82	1
Shortage of grazing land	21.72	15.35	2
Drought	13.05	14.42	3
Unavailability of water in near by	09.48	12.86	4
Unavailability of organized milk markets	07.25	04.91	5
Unavailability of milk value addition and processing technologies	04.75	05.05	6
Shortage of improved feed at all seasons	3.10	3.59	7

Conclusion and recommendations

Conclusion

This study found that there is significance difference between the Tahtay adiyabo and Kafta humera districts regarding frequency of extension contact, extension service, age of the household head, Experience in agriculture, distance of cattle farm to local market, distance of cattle farm to residence number of livestock related trainings obtained, distance cattle travel to drink water and milk market participation. However, insignificant difference regarding experience in cattle and dairy production, education level of the household head, total family size, distance of residence from district town.

The amount of milk yield, which was 2.53Ltr and 3.33Ltr per cow per a day respectively for Tahtay adiyabo and Kafta humera districts shown significant difference between the districts. Considering the number of dairy cows owned by an individual household per a year that were 2.7 and 4 cows had also significant difference between the districts. So the total milk obtained (that is 1166.25Ltr and 2291.29Ltr) that shown also significant difference between the districts. Regarding the milk allocation this also found that the total amount of milk sold at local market (that was 339.87Ltr and 977.16Ltr) and consumed at home (that was 826.38Ltr and 1314.12Ltr) respectively for Tahtay adiyabo and Kafta humera districts has significant difference between the two districts. Nevertheless, there is similarity in the total number of milking months (6.3 and 6.43months), average number of milking days per month (27 and 26 days).

Considering the dairy cattle management system, this study found that it depends on the status of the cow, season and availability of rangeland in nearby the residence (search feed at night and rest in the day light time at shed). This also found that, on average about 58% of the farmers in both districts supplement by providing concentrated feed to their dairy cows that is mostly sorghum grain which most of them start during February. In the area, cattle enforced to travel the nearby water source to drink water. That is more than 80% of the cattle keepers enforce their cattle to drink water in the nearest water source even travelling the average distance of 2.44Km (1.59 and 3.36 Km in Tahtay adiyabo and Kafta humera districts respectively).

As compared to the potential and the benchmarks obtained in other parts of the glob, farmers in the study area obtained lower milk yield due to different factors. Where the significant milk productivity determinant factors found by this study for Tahtay adiyabo district are, such as number of months that collected/concentrated feed is provided to dairy cows, education level of the household head, place where milk and its products sold, and loan obtained especially for dairy production has positive and significant relationship. On the other hand, variables such as distance of cattle farm from local market, total family size and marital status of the household has significant and negative relationship.

Similarly, in Kafta humera district the significant determinants of milk productivity were; number of months that collected feed provided for dairy cows, cattle pests and diseases occurrence, education level of household heads and experience in cattle rearing has significant and positive relationship. While variables such as; sex of the household head, distance of water source that the dairy cattle travels to drink water and extension contact regarding livestock production has significant and negative relationship with the milk yield obtained.

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Recommendations

According to the results found in this study in order to improve milk yield and profitability obtained from the dairy production business:

- Education level of the household heads shows significant and positive relationship to milk yield. Because, education allows farmers to have financially focused, practice better management practice and to make by near follow-up. Therefore, it is important if concerned individuals could focus on capacity building that could improve the knowledge and perception regarding dairy production business.
- The distance of cattle farm from local market also shows significant and negative relationship with productivity. So it is important to organize producers as in nearby and establish and make functional cooperatives, facilitating milk and its products storing and processing technologies so producers could easily sell at their nearby.
- The farmers should also provide collected feed for the dairy cows while in its shed for the months other than green feed could grazed in rangeland. Because, it had significant and positive relation with milk productivity.
- As solutions for shortage of grazing land and drought incidence, it is important to verify and introduce improved forages that used for all seasons.
- It will be good if collected feed could provide to the dairy cows with the intensive protection from diseases and pests.
- Additionally, to increase milk productivity obtained by farmers, it is better if these dairy cows has access to drinking water source in nearby so that the distance these travels to drink water could be reduced as it significantly and negatively affects milk yield.

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