Assessment on Dairy Production Potential and Challenges in Eastern Zone of Tigray, Northern, Ethiopia

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Abstract - Ethiopia holds large potential for dairy development due to its large livestock Population; the favorable climate for improved, and the relatively disease-free environment for livestock are the considerable potential for smallholder income and employment generation from high-value dairy products. Thus development of dairy in Ethiopia can contribute significantly to poverty alleviation and increased employment opportunity in the country. This study was carried out in eastern zone of Tigray region to generate baseline information on dairy production potential, challenges and opportunities. From purposively selected three districts 114 small and micro enterprise dairy farmers were interviewed and focus group discussions were conducted to gather valuable information. Descriptive statistics and PROC GLM of SAS, version 9.2 was employed to analyze data. Figure and tables were used to present results. Majority of the small and micro enterprise dairy producers were using AI service (60%) to breed their cows. The average numbers of dairy cattle at starting and current time were 3.06 ± 0.27 and 2.27 ± 2.52, respectively. The average milk productions at starting and current time were also 22.9 ± 1.52 and 9.43 ± 0.55 liters per day per household. The most common dairy cattle health problems were mastitis, pasteurellosis and hypocalcaemia. The average lactation length of dairy cows in Hawzen, Agulae and Wukro were 9.08±0.2, 8.33±0.33 and 6.9±0.28 months, respectively. The average age of heifers at first service was also 1 9.7±1.66, 15.9±0.92 and 17.1± 0.68 in Hawzin, Agula and Wukro, respectively. Regarding the number of service per conception 66.7% and 23.68% dairy cows were conceived at the first and second service, respectively. The primary purpose of milk production in most of small and micro enterprise dairy producers was for marketing. The major challenges of dairy production system were land, shortage of feed (both in quality and quantity), AI service which is related with the lack of adequate number of AI technicians, gaps in their skill and unwillingness, and lack of market linkage during fasting period. The survey indicated that the number of lactating cows and the milk production potential was increasing from time to time. However, there is less market demand of milk during fasting times as a result a considerable amount of milk is being disposed, hence milk processing plant is necessary to solve these problems.

Key words - dairy production, small and micro enterprise, breeding system, survey, challenges

I. INTRODUCTION

Livestock production as an engine of growth, it provides increased income, employment, food and foreign exchange earnings as well as better nutrition. As income increases with economic development, the share of animal products in total food budget increases faster than that of cereals. This occurs because of the relatively high-income elasticity of demand for animal products [5]. The dairy industry may be viewed as a distinct sector of the livestock economy.

Developing countries have more than two-thirds of the world cattle population, but produce less than a quarter of the world's cow milk. The gap that is manifested in productivity has also a similar trend in consumption in which the per capita consumption of total milk for Africa and Asia for 1993 was about 38 kg and 40 kg, respectively. These figures are, however, far lower than those for Europe and North America which are about 289 kg and 258 kg respectively *(Ibid)*. There is also a belief that total consumption of milk in the developing countries is projected to increase from 64 million metric tons in 1993 to 391 million metric tons by the year 2020, which is 138 percent increase. In the same token per capita consumption is expected to increase from 38 kg to 62 kg / person. Much of this increased demand will be in urban centers in which population is to grow at a rate of 5-6% between 1990 and 2025 [12]. There are cases now that the rapid growth in consumption has been covered by imports of substituting nature for dairy products such as powder milk [2]. Moreover, the trends of population increase; income growth and urbanization will fuel this tremendous growth in demand. It is also natural that urbanization accompanied by modern style of life demands for a shifting of dietary preferences towards better quality food items such as meat, milk and eggs [9].

Marketed dairy production is already increasing in the urban centers as a direct response to consumer demands either by smallholders or commercial dairy enterprises. For smallholders, dairying allows year round employment of the family labor force, and milk often plays the role of a “cash crop", hence increasing regular income [14]. Even though in a process of dynamic change, market oriented dairy production is facing several constraints in its sustainable development. These address the different components: such as animal feed resource, upgrade genotype and management of reproduction, disease, marketing mechanisms, environmental impact, and policy environment.

With specific reference to Ethiopia, the country has the largest livestock population in Africa, with the latest estimate 56.71 million heads of cattle [4], are mostly maintained by smallholder, commercial and pastoral farmers; and more than 98.66% are indigenous low yielders that greeneries a high gap between demand and supply of milk and milk products. Of course, livestock, especially among the majority of the rural livelihood is a security, investment and an additional income.

Ethiopia holds large potential for dairy development due to its large livestock Population; the favorable climate for improved, and the relatively disease-free environment for livestock are the considerable potential for smallholder income and employment generation from high-value dairy products. Thus development of dairy in Ethiopia can contribute significantly to poverty alleviation and increased employment opportunity in the country. Despite the large size of cattle in Ethiopia, the dairy industry remains underdeveloped, inferior in quality and has not been encouraging when evaluated against even the dairy performance of Eastern African countries. The annual growth rate in cow milk production reported in 1990 in Ethiopia was nearly 1% as opposed to 6.2% in East Africa and 3.3% in the whole of Africa. The share of livestock to the agricultural domestic product is 30% [20].

Per capita consumption of milk in Ethiopia is as low as 17 kg per head per year while the average figure for Africa is 38 kg per head per year and the global average of 100 liters per head per year [14]. Milk and milk products are part of the diet for many Ethiopians. Getachew and Gashaw[7] estimated that 68% of the total milk produced is used for human consumption in the form of fresh milk, butter, cheese and yogurt while the rest is given to calves and/or sold.

Population in Ethiopia is estimated to grow at a rate of 2.9% per year while the urban population increases at the rate of 4.4%. Ethiopia's human population is projected to reach 140 million by the year 2025 and the urban population will shoot up to 40 million. This justifies the need for increasing the production of milk and milk products both horizontally and vertically in areas where favorable climatic conditions exist and feed resources are not limiting. Therefore, an increasing population size and consumer income in the future is expected to increase liquid milk consumption.

The development of dairy in Ethiopia indicates that there is a need to focus interventions more coherently. Development interventions should be aimed at addressing both technological gaps and marketing problems. Integration of crossbreed cattle to the sector is crucial for dairy development in the country. This can be achieved either through promotion of large private investment to introduce new technology, input supply and output in the sector such as improved genotypes, feed and processing, or promotion of integration of crossbreed cattle into the smallholder sector through improving their access to improved cattle breeds, veterinary service and credit. Similarly, government should also take the lead in building infrastructure and providing technical service to dairy.

Therefore, for implementation of appropriate intervention, understanding the current production performances of the particular system is a pre-requisite. To this essence, the objective of the study was to generate baseline information on dairy production potential, challenges and opportunities in Eastern zone of Tigray to bridge information gap on the production, consumption and marketing of dairy and dairy products in the zone.

II. MATERIALS AND METHODS

***Study Area*:** the study was conducted in 2014 in Eastern zone of Tigray, Northern Ethiopia. Purposively selected districts namely; Wukro, Agulae and Hawzien were considered (Fig. 1). These areas are situated at 140º 20' N and 39º 29' E. They have altitude ranges from 900-3200 m.a.s.l. The mean annual temperature varies from 15-19^{0}C and mean annual rainfall ranges from 400-800 mm.

***Study design*:** Questionnaire survey and focus group discussion on dairy production potential, challenges and opportunities were conducted in three selected districts. A total of 114 small and micro enterprise (SME) dairy producers were randomly selected and interviewed using semi-structured questionnaire. Large distribution of dairy cows, potential of milk production and no previous study conducted in the areas were bases for selecting the research sites. Group discussions were made with focus group established at each district with group comprising 5-7 members.

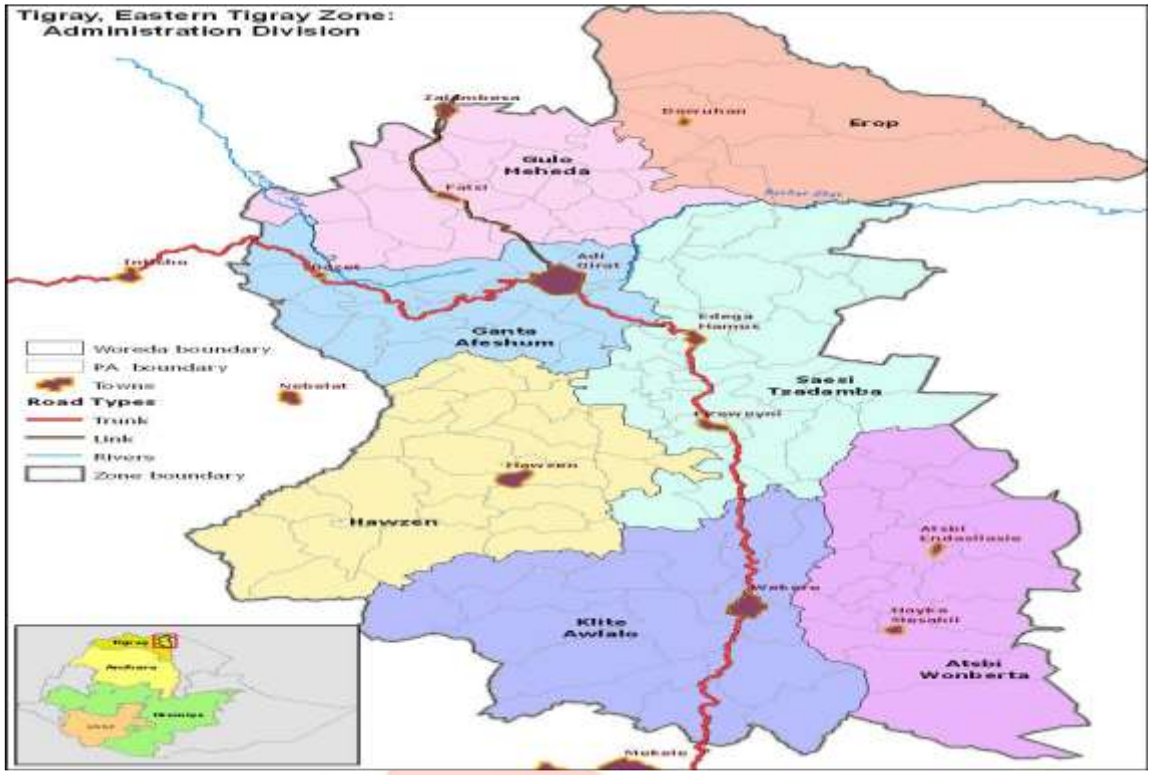

Figure 1. Map of the study area in Eastern zone of Tigray

***Statistical analysis*:** Descriptive statistics such as mean, frequency and percentage were used to analyze the data using SAS version 9.2 [17]. General linear model procedures (PROC GLM) were employed for production and reproduction performance traits to detect statistical differences among the sampled dairy cows in the three districts.

III. RESULTS AND DISCUSSIONS

***Small and Micro Enterprises (SME) dairy producers Characteristics and Profile*:** Small and Micro Enterprise dairy producer's characteristics in the current study areas are presented in Table 1. Out of the total interviewed dairy cattle producers (N=114), 66 % were male and the rest (34%) were female with different age and educational status. Most of the respondents were household heads and their overall average age was 42 years this indicates that they are in the productive age for different agricultural practices. The overall average family size of respondents in the study area was 5.97. In general there was no significant (P>0.05) difference in age and family size among the study Towns.

With respect to educational status of the respondents, the majority of urban and peri-urban dairy producers were primary school completed and a few were above secondary school (Table 3). This result could suggest the presence of good extension and training program in the study towns that can improve dairy production and marketing. Most of the Small and Micro Enterprise (SME) dairy producers (70%) were used family members as a labor force whereas 19% of the SME dairy producers had employee one labor force and those SME dairy producers who had employee more than one labor force was 11%.

Table 1. Household characteristics and the socio-economic status of SME dairy producers in the study area

Variables	Towns			overall
	Hawzien	Agulae	Wukro	
Sex of respondents (F, %)				
Male	7 (53.85)	22 (91.67)	46 (59.74)	75 (65.79)
Female	6 (46.15)	2 (8.33)	31 (40.26)	39 (34.21)
Respondents age (Mean ±SE)	39.3 ± 1.99	45.6 ± 1.69	41.5 ± 1.23	42.0 ± 0.94
Family size (Mean ±SE)	6.77 ± 0.44	6.46 ± 0.32	5.69 ± 0.33	5.97 ± 0.24
Educational background (F, %)				
Illiterates	0 (0)	4 (16.67)	22 (28.57)	26 (22.81)
Primary school	11 (84.61)	16 (75.00)	42 (58.44)	69 (60.52)
Secondary school	2 (15.38)	3 (8.33)	8 (6.49)	13 (11.41)
Above	0	1	5 (6.49)	6 (5.26)
Labor force (F, %)				
0	10 (76.92)	14 (58.33)	56 (72.73)	80 (70.18)
1	3 (23.08)	7 (29.17)	12 (15.58)	22 (19.30)
More than 1	0	3 (12.5)	9 (11.69)	12 (10.53)

***Breeding System and their Constraints*:** Dairy cattle breeding practices and AI service delivery were assessed in the study area Table 2. Majority of the SME dairy producers were using AI service (60%) while 6% of the SME dairy producers were use bull service to breed their cows. The informants reported that even though few of the SME dairy producers get AI service regularly, majority of the SME dairy producers do not get the AI service on time due to less number of AI technicians and their involuntariness to give service on weekends and holidays especially in the urban areas. By comparing the breeding systems, most of the SME dairy producers were also reported that AI service was best rather than bull service, their reason was that it enables to generate genetically improved calf, prevent disease transmission and need small price per conception. On the other hand, a considerable number of SME dairy producers had report drawbacks of AI service in all the study areas. As per the informants the drawback on AI service was repeated service per conception which is associated with the skill gaps in AI technician during service provision and follow up problems by owners to detect heat. Therefore, to alleviate this problem training for AI technicians to build their skill and increasing their number in one AI station should be done by the office of agriculture and rural development together with agricultural TVET colleges.

Table 2. Breading system, difference among bull service and AI, and AI drawbacks in the study area

Variables (F, %)	**Town**			**overall**
	Hawzien	**Agulae**	**Wukro**	
Breeding system				
AI	9 (69.23)	12 (50.00)	47 (61.04)	68 (60)
Bull	1 (7.69)	2 (8.33)	4 (5.19)	7 (6)
Both	3 (23.07)	10 (41.67)	26 (33.77)	39 (34)
Comparison of AI with bull service				
Best	8 (61.54)	12 (50.0)	58 (75.32)	78 (68.42)
Same	2 (15.380	6 (25.0)	7 (9.09)	15 (13.16)
Has problem	3 (23.08)	6 (25.0)	12 (15.58)	21 (18.42)
Drawbacks of AI [a]				
AI technician skill gap	1 (7.69)	9 (37.51)	35 (45.45)	45 (41.49)
Repeated service per conception	8 (61.54)	13 (54.17)	43 (55.84)	64 (56.15)
Owners heat detection problem	1 (7.69.)	2 (8.24)	7 (9.09)	10 (8.78)
No Response	4 (30.77)	6 (25.00)	11 (14.29)	21 (18.42)

[a=]Percentages do not add up to 100% since respondent's selected more than one answer

***Dairy Cattle Holding Trend and Milk Production Potential at Current and Starting Time*:** The dairy cattle trend and milk yield is presented in Table 3. The overall mean of current time number of dairy cattle 3.06 ± 0.27 was higher than the number at starting time 2.27 ± 2.52 per household. This indicates that as the demand of milk increases the producer also aware to increase their dairy cows from time to time. That's way the current number of lactating cow which was 1.89 ± 0.14 in the study area was higher than the starting number of lactating cow which was 1.29 ± 0.06 per household. The current milk production per day per household which is 22.9 ± 1.52 was higher than starting time which is 9.43 ± 0.55 (Table 4). This result indicates that there is an increase in milk production potential from time to time; as a result, the informants in all the study area reported to have milk processing plant to solve the milk marketing problem during fasting because at this period small amount of milk is sold and the rest was disposed.

Table 3. Dairy cattle holding trend and milk production potential at current and starting time

Variables (mean ± SE)	**Towns**			Overall mean
	Hawzien	**Agulae**	**Wukro**	
Starting number of dairy cattle/HH	2 ± 0.57	2.22 ± 0.49	2.18 ± 0.3	2.27 ± 2.52
Current number of dairy cattle/HH	3.54 ± 0.63^{ab}	4.65 ± 0.5^{a}	2.51 ± 0.34^{b}	3.06 ± 0.27
Starting number of lactating cow/HH	1 ± 0.11	1.25 ± 0.14	1.35 ± 0.08	1.29 ± 0.06
Milk production at starting time/day/HH	7.5 ± 0.95	10.5 ±1.27	9.42 ± 0.69	9.43 ± 0.55
Current number of lactating cow/HH	1.54 ± 0.27	1.92 ± 0.23	1.94 ± 0.19	1.89 ± 0.14
Current milk production/day/HH	17.5 ± 4.19	28.6 ± 4.17	22.0 ± 1.65	22.9 ± 1.52

[a,b] means in the same row with different superscripts are significantly different ($P < 0.05$); HH= household; SE= Standard error

Table 4. Daily milk production from the total number of SME dairy producers in each study town

Towns	Total number of SME dairy producers	Total number of dairy cows	Total number of lactating cows	Average milk yield /SME dairy producers / day in liter	Average Milk yield/cow/day in litter	Total milk yield/total SME dairy producers /day in liter
Wukro	300	753	582	22.0	11.3	6600

Agulae	90	419	173	28.6	14.88	2574
Hawzen	40	142	62	17.5	11.29	700
Total	430	1314	817 (62.2%)	22.96	12.08	9874

***Husbandry and Management*:** Management status, type of house and record keeping of dairy cattle in the three towns are summarized in Table 5. The current survey showed that the majority of the SME dairy producers 69.23% in Hawzen, 62.50% in Agula and 58.44% in Wukro had good dairy management system. The only few SME dairy producers (10.39%) in Wukro had medium dairy management status. All of the SME dairy producers had dairy cattle sheds in the main house and majority of them 84.62%, 100% and 72.73% from Hawizen, Agula and Wukro, respectively, had semi–modern type of house which is free stall with feeding trough. In the survey it was observed that most of the SME dairy producers kept the dairy cows and their calves together in the same house in which the calves kept in one corner and the dairy cow in the other corner of the house. In all the surveyed areas it was also observed that they use hand milking and cows were milked twice a day at morning and evening. None of the SME dairy producers in Hawzen and Agulae had breeding bulls mainly due to shortage of space and difficulties of management including shortage of feed where as in Wukro only one SME dairy producers had breeding bull as an alternative to artificial insemination.

Lactating and dry cows were managed together. Similarly male and female calves and heifers were also managed together. The general farm /kaizen/ hygiene 84.62%, 83.33% and 83.78% from Hawizen, Agula and Wukro had good hygiene (kaizen), respectively.

According to [16] regarding housing the major problem in dairy herds is the lack of sufficient space for each group of animals according to age and production status. The need to group cows, based on their physiological state of production or reproduction was reported as mandatory especially in large herds. Some of the most important reproductive problems were associated with the design of facilities and management of the environment [18].

Record keeping of production and reproduction was exercised in 76.92%, 75.00% and 58.44% of SME dairy producers in Hawizen, Agula and Wukro, respectively. From the above SME dairy producers 53.85 in Hawizen, 62.5 in Agula and 41.56 in Wukro had known the importance of record book but very small amount of them even if they had the recording systems, it was not well functional. In all the surveyed towns a considerable number of SME dairy producers especially in Wukro had no record book and their reason was lack of awareness, carelessness and some of them were ongoing to have record book (Table 5). This shows there is less effort in industrial extension agents in supporting the SME dairy producers to use a record book and the SME dairy producers had lack of awareness in entrepreneurship.

***Feed Resources and Feeding System*:** The feed types, source of feeds and the base for feeding are presented in Table 6. In the study area, it was observed that the availability of feed resources varied with season with respect to type of feed in both quantity and quality as a result there was price fluctuation. As indicated in the survey result the major feed resources for dairy cows in all the study area were include; straw, hay, wheat bran and "Atela" and for majority of the surveyed SME dairy producers the sources of feed for their dairy cattle were found from nearby and distant markets. The survey also revealed that for majority of the SME dairy producers in all the study Towns the base for providing daily feed requirement of their cows was by guess whereas the few SME dairy producers were provide their cow based on milk production. However, no one of the SME dairy producers in all the study area was feed their animal based on body weight. This could be due to either lack of awareness or absence of heart girth measurement. It was reported by the producers that the cost of livestock feed is increasing from time to time due to the in adequate feed resources and expansion of dairy and beef farming around towns. Though the cost of feed is expensive, almost all (90%) the SME dairy producers in the study Towns reported that dairy production was profitable.

The costs of concentrates were unaffordable for the majority of the dairy farmers particularly to the peri-urban small and micro enterprises of dairy farms. Regardless of the cost, large proportion of urban farms were using concentrate feed since they become conscious about the advantage of using concentrate feeds for increased milk yield. This indicates that the existence of massive opportunity for local retailers to run their business and potential for investors to establish feed processing plants. So that farmers could get the concentrate feeds near and increase the productivity of their dairy animals. Hence, the supply of dairy products to the high demand in the area could be optimized.

Table 5. Management of dairy cattle and record keeping in the study area

Variables (f, %)	**Town**			**Overall**
	Hawzen	**Agulae**	**Wukro**	
Management status				
Very good	4(30.77)	9(37.50)	24(31.17)	37(32.46)
Good	9(69.23)	15(62.50)	45(58.44)	69(60.53)
Medium	0	0	8(10.39)	8(7.02)
Satisfactory	0	0		
Poor	0	0		
Dairy cow house				
Yes	13(100)	24(100)	75(97.4)	112(98.25)
No	0	0	2(2.6)	2 (1.72)
Type of house				

Traditional	2(15.38)	0	19(24.68)	21(18.42)
Semi-modern	11(84.62	24(100)	56(72.73)	91(79.82)
Modern			2(2.6)	2(1.75)
Have record book				
Yes	10(76.92)	18(75.00)	45 (58.44)	60(52.63)
No	3(23.08)	6(25.00)	32 (41.56)	54(47.37)
If yes importance of record book				
To know the profit and expense	7(53.85)	15(62.5)	32(41.56)	76 (66.67)
Not functional	3(23.08)	3(12.5)	13(16.89)	30(26.32)
No response	3(23.08	6(25.00)	32(41.56)	8(7.02)
If no why				
Lack of awareness	0		6(7.79)	6(5.26)
On going	1(7.69)	2(8.33)	5(6.49)	10(8.77)
Carelessness	2(15.38)	4(16.67)	21(27.27)	26(22.81)
No responce	10(76.92)	18(75.00)	45(58.44)	72(63.16)

***Common Dairy Cattle Health Problems*:** As per the survey result the most common dairy cattle health problems in all the study Towns were mastitis, pasteurellosis and hypocalcaemia (Table 7). As a solution, most of the SME dairy producers 84.62%, 100% and 62.34% from Hawzen, Agulae and Wukro, respectively were taken their animals to veterinary clinic. All of the SME dairy producers from Hawzen and Agulae have got veterinary service whereas in Wukro the only 48% were get access of veterinary service. The informants reported that even if there is access of veterinary clinic, its service is poor because there is no regular and well organized service. In the survey it was also observed that in this year a considerable number of calves were dead to the unknown case. Therefore, this needs a further study to identify the case.

Table 6. Feed types, source of feeds, base for feeding, and profitability in the study area

Variables (F, %)	**Towns**			**overall**
	Hawzien	**Agulae**	**Wukro**	
Feed types[a]				
Straw	13 (100)	24 (100)	77 (100)	114 (100.00)
Wheat bran	13 (100)	24 (100)	75 (97.4)	112 (98.56)
Nouge cake	0	23 (96)	63 (81.81)	86 (75.68)
Hay	13 (100)	22 (91.67)	40 (51.95)	75 (66.00)
Urea treated straw	2 (15.38)	8 (33.33)	15 (19.48)	25 (22.00)
Atela	13 (100)	24 (100)	77 (100)	114 (100.00)
UMB	2 (15.38)	5 (20.83)	5 (6.49)	12 (10.56)
Source of feed[a]				
Own	3 (23.08)	11 (45.83)	2 (2.60)	16 (14.08)
Market	13 (100.0)	24 (100.0)	77 (100.0)	114 (100.0)
Base for feeding				
Body weight	0	0	0	0
Milk production	2 (15.38)	14 (58.33)	23 (32.39)	39 (34.00)
Guess	11 (84.62)	10 (41.67)	54 (76.06)	75 (66.00)
Profitability of dairy production				
Profitable	13 (100)	24 (100)	65 (84.42)	102 (89.47)
Equivalent	0	0	9 (11.69)	9 (7.89)
No profit	0	0	3 (3.9)	3 (2.63)

[a]=Percentages do not add up to 100% since respondent's selected more than one answer

Table 7. Health management and disease

Variable (F %)	**Town**			**Over all**
	Hawzen	**Agulae**	**Wukro**	
Common health problems[a]				
Abortion	0 (0)	0 (0)	5 (6.5)	5 (4.4)
Mastitis	5 (38.46)	12 (60)	20 (25.98)	37 (32.45)
Hypocalcaemia	2 (15.38)	4 (20)	7 (9.09)	13 (11.41)
Dystocia	0 (0)	1 (5)	3 (3.9)	4 (3.52)
Bloat	0 (0)	0 (0)	3 (3.9)	3 (2.64)
Hoof and leg problems	0 (0)	2 (10)	8 (10.39)	10 (8.77)
Retained placenta	0 (0)	1 (5)	2 (2.6)	3 (2.64)
External parasites	0 (0)	0 (0)	2 (2.6)	2 (1.75)

CBPP	0 (0)	3 (15)	6 (7.8)	9 (7.92)
Anthrax	0 (0)	0 (0)	1 (1.3)	1 (0.88)
Pasteurellosis	4 (23.08)	3 (15)	8 (10.39)	15 (13.2)
Solution for disease outbreak				
Treatment	11 (84.62)	24 (100)	58 (84.06)	93 (96.88)
Nothing do	2 (15.38)	0 (0)	0 (0)	2 (2.08)
Use traditional treatment	0 (0)	0 (0)	1 (1.45)	1 (1.04)
Presence of Veterinary service				
yes	13 (100%)	24 (100)	48 (62.34)	85 (74.56)
No	0 (0)	0 (0)	6 (7.79)	6 (5.26)
Limited	0 (0)	0 (0)	23 (29.87)	23 (20.18)

[a=]Percentages do not add up to 100% since respondent's selected more than one answer, CBPP= Contagious Bovine Pleura Pneumonia

Reproductive Performance Efficiency of Dairy Cattle

***Lactation Length (LL)*:** The mean of the lactation period of the dairy cows are shown in Table 8. According to the respondents the average lactation length were significantly (P<0.05) different among the study Towns. Both Hawzen and Agulae had longer lactation length which is 9.08±0.2 and 8.33±0.33 months, respectively, whereas Wukro had relatively short lactation length which is 6.9±0.28 months. This variation might be due to the difference in management, availability of feed and the exotic blood level of the breed found in the study area. This finding was lower than the generally accepted 305 days of LL for crossbred and high grade cows and slightly longer than 5.9 months reported by [19] in Metema district. Moreover, the LL of crossbred cows obtained in this study was shorter than the LL of 11.7 months reported for crossbred cows in the Central Highlands of Ethiopia [22]. Similarly, longer mean of LL which is 11.67 months for crossbred cows was reported from Asela research station [6]. However, the survey result of this study was comparable to the LL of high-grade cows which is 7.3 months in Ethiopia [7].

Age at first service (AFS): The least square means for the age at first service in the study Towns are summarized in Table 8. As per the current finding the age at first service had no significant (P>0.05) difference among the study towns. The mean for age at first service was 1 9.7±1.66, 15.9±0.92 and 17.1± 0.68 in Hawzin, Agula and Wukro, respectively. The present result of the least square means for age at first service was within the range reported by many authors on exotic and indigenous crosses. Estimates for age at first calving in Ethiopian cattle were reported to be longer for Zebu [11, 1, 13, and 15] than for crossbreds [1; 13]. The work done in the central highlands and Addis Ababa milk shed, the overall means for age at first service was found to be 29.6 months and 20.1 months [20], respectively which is longer than the current finding. This difference might be associated to the variations in management, production system, blood level of the breed or breed and the agro-ecology.

Different factors advance or delay age at first service. Environmental factors, especially nutrition, determine pre-pubertal growth rates, reproductive organ development and onset of puberty and subsequent fertility. Substantial evidence exists that dietary supplementation of heifers during their growth will reduce the interval from birth to first services and calving [10; 3], probably because heifers that grow faster cycle earlier and permit easier estrus detection. The present study in this respect seems to indicate that there is a moderate management because the recorded age at first service was not faster and not delayed.

***Calving to first service interval*:** the mean value for calving to first service interval is presented in Table 8. The survey result for calving to first service interval revealed that there was no significant (P>0.05) difference among the study Towns. However, the value was higher than the most scientifically accepted value for the calving to first service interval which is two month. This is due to the fact that the owners miss the first two cycles deliberately to increase the lactation length and might be also due to the drawbacks in management, feed availability and breed difference.

***Number of service per conception*:** The percentage values for number of service per conception are shown in Table 8. According to [8], the number of services per conception is the number of services (natural or artificial), required for successful conception. The number of inseminations required to produce a live calf is one of the most useful parameters of reproductive efficiency which mainly depends on the breeding system used. It is higher under uncontrolled natural breeding than hand-mating and artificial insemination. According to [15], the numbers of services per conception greater than two are regarded as poor. As per the present survey result most of (66.7%) the dairy cows in all the study area was conceived at the first service whereas 23.68 % of the dairy cows were conceived at the second service. However, a few numbers of dairy cows (9.62%) were conceived at more than two services which are considered as poor. Therefore, further study in the skill of AI technicians, semen quality, nutrition and genetics of these dairy cows is recommended.

Table 8. Production and reproduction potential of the dairy cattle in the study area

Variables	Towns			Overall mean
	Hawzen	Agulae	Wukro	
Lactation period of a cow (month) (mean ± SE)	9.08±0.2[a]	8.33±0.33[a]	6.9±0.28[b]	7.51±0.21
Age at first service (month) (mean ± SE)	1 9.7±1.66	15.9±0.92	17.1± 0.68	17.2±0.53

caving to first service interval (month) (mean ± SE)	2.46±0.22	2.17±0.20	2.21±0.20	2.23±0.1
Number of estrus cycle from calving to first service (f, %)				
1st	4(30.77)	10(41.67)	26(33.77)	40(35.09)
2ed	6(46.15)	11(45.83)	39(50.65)	56(49.12)
3rd	2(15.38)	3(12.50)	11(14.29)	16(14.04)
>3rd	1(7.69)		1(1.3)	2(1.75)
Number of service per conception (f, %)				
1st	11(84.62)	20(83.33)	45(58.44)	76(66.67)
2ed	0	3(12.50)	24(31.17)	27(23.68)
More than two	02(15.38)	1(4.17)	8(10.39)	11(9.62)

[a,b] means in the same row with different superscripts are significantly different ($P < 0.05$); HH= household; SE= Standard error

***Milk Production Purpose and Marketing System*:** In Ethiopia it is obvious that small-scale dairy farming is common in urban and peri-urban areas. As per the present survey result on milk production the primary purpose of the most small and micro enterprise dairy producers in all the study areas were for both household consumption and marketing though majority of the milk took to the market (Table 9). In this study majority of the informants also reported that there was a milk marketing problem during fasting as a result the solution took by most of the producers were churning to collect butter and butter milk and sold it. However, majority of the butter milk was either disposed or use it for household consumptions with their relatives and neighbors. This is due to the fact that there is a strong cultural and religious believes in the community that marketing of butter milk is considered as taboo. Therefore, there is a need for market linkage with milk processing plants and other stalk-holders during such periods.

In the present study form of milk selling was also assessed and the informants informed that they were sale in the form of raw milk, butter, butter milk and yoghurt. However, majority of the producers sold in the form of raw milk because they lack a technology that process milk to other milk products and they also reported that relatively there was less market demand for the other milk products especially for butter milk. Even though this is the fact, most of the milk producers had great interest for milk processing because of the less milk market demand during fasting (Table 9). This indicates that the producers need sustainable year round market demand to have sustainable economic growth; therefore governments, NGO's and other stalk-holders must contribute their own role for.

Table 9. Milk production purpose in the study area

Variables (f, %)	**Towns**			**overall**
	Hawzen	**Agulae**	**Wukro**	
Milk production purpose (f, %)				
Consumption	0	0	0	0
Market	2(15.38)	9(37.5)	7(9.21)	18 (15.93)
Both	11(84.62)	15(62.5)	69(90.79)	95 (84.07)
Milk consumption/HH (litter) (mean ± SE)	1.27±0.17	1.23±0.17	1.35±0.09	1.32 ± 0.07
Marketed milk/HH (litter) (mean ± SE)	16.3±4.15	27. 4±4.21	21.2±1.59	22.0 ± 1.49
Milk marketing problem (f, %)				
Yes	6(46.15)	24(100)	59(76.62)	89 (78.07)
No	7(53.85)	0	18(23.38)	25 (21.93)
If yes when (f, %)				
During fasting	6(46.15)	24(100)	59(76.62)	89 (78.07)
No response	7(53.85)	0	18(23.38)	25 (21.93)
Solution for no market (f, %)				
Churning	6(46.15)	24(100)	58(75.33)	88 (77.2)
No response	7(53.85)	0	19(24.68)	26 (22.8)
Form of milk selling[a] (f, %)				
Raw milk	10(76.92)	24(100)	77(100)	111 (97.68)
Butter	12(92.3)	13(54.167)	30(38.96)	55 (48.4)
Butter milk	3(23.07)	8(33.33)	2(2.60)	13 (11.44)
Yoghurt	1(7.69)	6(25.00)	10(13.00)	17 (14.96)
Milk processing interest (f, %)				
High	7(53.85)	15(62.50)	57(75.00)	79 (69.91)
No	6(46.15)	7(29.17)	16(21.05)	29 (25.66)
No awareness	0	2(8.33)	3(3.90)	5 (4.4)

[a=]Percentages do not add up to 100% since respondent's selected more than one answer, HH= household; SE= standard error

***Input Needed and Challenges of Dairy Cattle Production System*:** Results of the survey had shown that land, shortage of feed (both in quality and quantity), AI service which is related with the lack of adequate number of AI technicians, gaps in their

qualification and unwillingness of AI technicians, and lack of market linkage during fasting were the major and economically important constraint for the existing dairy production system of the study areas (Table 10). The other dairy production and reproduction constraints includes; lack of regular and organized veterinary service, disease, capital, lack of vaccination program, lack of credit facilities, water and electricity, lack of improved bull, lack of technology, lack of improved dairy cow and absence of milk processing plant were mentioned by the respondent's as an important constraints of dairy production system beside the above four major constraints (Table 10).

Table 10. Challenges and input need in dairy cattle production in the study area

Variables (f, %)	Towns			overall
	Hawzen	Agulae	Wukro	
Challenges in dairy production[a]				
Lack of market linkage	1 (7.69)	20 (83.4)	27 (35.1)	47 (41.36)
Shortage of feed	4 (30.76)	19 (79.23)	26 (33.8)	51 (44.88)
Land	7 (53.83)	14 (58.38)	38 (49.4)	59 (51.92)
Veterinary service	0 (0)	4 (16.68)	19 (24.7)	23 (20.24)
Disease	0 (0)	0 (0)	6 (7.8)	6 (5.28)
AI service	2 (15.38)	15 (62.55)	31 (40.3)	48 (42.24)
Capital	2 (15.38)	0 (0)	2 (2.6)	4 (3.52)
Vaccination program	0 (0)	1 (4.17)	0 (0)	1 (0.88)
Credit facilities	2 (15.38)	1 (4.17)	5 (6.5)	8 (7.04)
Perception (attitude)	1 (7.69)	0 (0)	0 (0)	1 (0.88)
Water & electricity	1 (7.69)	2 (8.34)	1 (1.30)	4 (3.52)
Lack of improved bull	2 (15.38)	0 (0)	0 (0)	2 (1.76)
Lack of technology	2 (15.38)	2 (8.34)	14 (18.2)	18 (15.84)
Lack of improved dairy cow	0 (0)	1 (4.17)	2 (2.6)	3 (2.64)
Absence of milk processing plant	0 (0)	1 (4.17)	11 (14.3)	12 (10.56)
Inputs or technologies needed[a]				
Churner	8 (61.52)	7 (29.19)	33 (42.9)	48 (42.24)
Urea molasses block (UMB)	9 (69.21)	3 (12.51)	8 (10.4)	20 (17.6)
Lactometer	7 (53.83)	0 (0)	3 (3.9)	10 (8.8)
Urea treatment	3 (23.07)	5 (20.85)	9 (11.7)	17 (14.96)
Molasses	9 (69.21)	3 (12.51)	5 (6.5)	17 (14.96)
Milk processing plant	3 (23.07)	15 (62.55)	18 (23.4)	36 (31.68)
Credit facilities	0 (0)	0 (0)	1 (1.3)	1 (0.88)
Wheat bran & Nuge cake	7 (53.83)	4 (16.68)	5 (6.5)	16 (14.08)
Aluminum coated or galvanized nickel	1 (7.69)	6 (25.02)	3 (3.9)	10 (8.8)
PPE & vehicle	0 (0)	1 (4.17)	0 (0)	1 (0.88)
Improved dairy cow	0 (0)	2 (8.34)	0 (0)	2 (1.76)
Nothing	0 (0)	1 (4.17)	28 (36.4)	29 (25.52)

[a]=Percentages do not add up to 100% since respondent's selected more than one answer

In the present survey the inputs or technologies which are required for the dairy production sector was assessed. As indicate in Table 15 the inputs or technologies like churner, milk processing plant, UMB, urea treatment, molasses, wheat bran & nuge cake were among the most needed mentioned by the respondent's. Therefore, cooperatives, privet enterprises, NGO's and other stalk-holders should participate in supplying the above inputs to the small holder dairy producers.

IV. Conclusion

The survey indicated that the number of lactating cows and the milk production potential was increasing from time to time. However, there is less market demand of milk during fasting times as a result a considerable amount of milk is being disposed, hence milk processing plant is necessary to solve these problems. It was also observed that AI service was best rather than bull service, because it generates genetically improved calf, prevent disease transmission and need small price per conception. However, majority of the SME dairy producers do not get the AI service on time due to absence of AI station in urban and no AI technicians were employed to serve for urban AI users. Therefore, AI stations need to be established in urban areas and AI technicians need to be employed in each station. The survey also revealed that the cost of livestock feed is increasing from time to time due to the in adequate feed resources, and expansion of both dairy and beef farming around towns. Therefore, cooperatives, NGO's and investors have the opportunity to establish feed processing plant in the study area. Most of SME dairy producers reported that there was irregular and disorganized veterinary service. Therefore, the government should give emphasis to solve this problem.

V. ACKNOWLEDGMENTS

We are indebted to Wukro Agricultural Poly-technique College for fully sponsoring our study and research work. Many thanks also go to the staff members of Department of Animal Sciences of Wukro Agricultural Poly-technique College for their

contribution in the process of developing the research proposal and provision of various services. We greatly thank Wukro, Agulae and Hawzen Offices of Small and Micro Enterprises and all staff for providing necessary baseline data required for this study. We are also sincerely grateful to the Small and Micro Enterprise dairy producers who participated in the study as they provide us their time without any incentive.

VI. REFERENCES

[1] Alberro, M., 1983. Comparative performance of F1 Friesian x Zebu heifers in Ethiopia. Animal Production. 37: 247 - 252.
[2] Amha Kasahun, 2008.An Integrated Urban, Peri-Urban and Rural Dairy Development Program in Tigray.Draft Document Livestock Development Consulting Group. REST, Mekelle.
[3] Azage T, 1989. Reproductive development and function in zebu and crossbred cattle in Ethiopia. Australia: James Cook University,Dissertation.
[4] CSA (Central Statistical Authority), 2015. Agricultural Sample Survey of the Federal Democratic republic of Ethiopian, Addis Ababa.
[5] Ehui. S, 2008. Livestock Policy Analysis: The Role of Livestock in Food Security. New York, McGraw.
[6] Enyew Negussie, Brannang E, Benjaw, K. and Rottman, O. J. (2000) Reproductive performance and herd life of cross-bred dairy cattle with different levels of European inheritance in Ethiopia. In: Livestock production and the environment–implications for sustainable livelihoods.
[7] Getachew Felleke and Gashaw Geda, 2006. The Ethiopian Dairy Development Policy: A Draft Policy Document, Ministry of Agriculture. Addis Ababa, Ethiopia.
[8] Gidey Yifter., 2001. AssesSME dairy producers nt of Calf Crop Productivity and Total Herd Life of Fogera Cows at Andassa Ranch in North-western Ethiopia. M.Sc. Thesis, Alemaya University. Dire Dawa, Ethiopia.119p.
[9] Harold G., 2007. Agricultural Policy Analysis. New York, McGraw.
[10] Kayongo-Male, H., C.N. Karue and E. R. Mutiga, 1982. The effect of preconception supplementation on the productivity of dairy heifers grazed on medium quality pasture under East African conditions. Bulletin of Animal Health and Production in Africa, 30: 65-72.
[11] McDowell, R. E., 1972. Improvement of Livestock Production Under Warm Climates. WH Freeman, San Fransisco, California, USA. 711p.
[12] Mehret Ayenew,2006."Poverty and Urban Government Institutions', ed. Desalegn Rahmewto ,Some aspects of Poverty in Ethiopia. Forum for Social Studies, Addis Ababa.
[13] Mekonnen, H/M. and M. Goshu, 1987. Reproductive performance of Fogera cattle and their Friesian crosses. Ethiopian J. Agric. Sci.. 9 (2): 96-114
[14] Mohamed A.M., S.K. Ehui and Yemesrach Assefa, 2007. Dairy Development in Ethiopia, Conference paper No.6. International Livestock Research Institute, Addis Ababa, Ethiopia.
[15] Mukasa Mugerwa E., 1989. A review of reproductive performance of female Bos indicus (Zebu) cattle. ILCA, Monograph No. 6. International Livestock Center for Africa, Addis Ababa, Ethiopia. 134p.
[16] Rey, B., Thorpe, W., Smith, J., Shapiro, B., Osuji, P., Mullins, G. and Agymang, K. 1993. Improvement of dairy production to satisfy the growing consumer demand in sub-SaharanAfrica: A conceptual frame work for research. International Livestock Center for Africa (ILCA), Addis Ababa, Ethiopia.
[17] SAS (Statistical Analysis System), 2008. SAS Institute Inc., Cary, NC, USA.
[18] Sharm, R.C. and D.S. Bhatnagar, 1975. Influence of sex of the calf and order of lactation on the reproductive efficiency in dairy Animals. Indian Veterinary Journal 52: 813-822.
[19] Tesfaye Mengsitie (2007) Characterization of cattle milk and meat production, processing and marketing system in metema district, Ethiopia. M.sc. Thesis, Hawassa university, Ethiopia.
[20] Tigray Bureau of Agriculture, 2008. Regional Strategy of Livestock Resource Development.
[21] Yoseph, S., B.A. Tenhagen, B. Merga and K. Tesfu, 2003. Reproductive performance of crossbred dairy cows managed under different production systems in central highlands of Ethiopia. Tropical Animal Health and Production, 35 (6): 551-561.
[22] Zelalem Yilma and Ledin Inger (2001) Milk production, processing, marketing and the role of milk and milk products on smallholder farmers' income in the central highlands of Ethiopia. pp. 139-154. In: proceedings of the 8th Annual Conference of the Ethiopian Society of Animal Production (ESAP). 24-26 August, 2000, Addis Ababa,Ethiopia