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Assessment of Milk Production and Marketing System in Horro District of Horro Guduru Wollega Zone, Western Ethiopia

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ABSTRACT

The study was conducted to assess dairy production and marketing system of Horro district of Horro Guduru Wollega zone. A structured questionnaire was used and the study area was stratified into highland and Mid-highland agro-ecology. The means and standard deviations of livestock holding was found 12.17±8.69, 13.54±13.98, 3.22±5.25, 2.79±2.84 and 0.96±1.34 for cattle, sheep, goats, horse and donkey, respectively. Cattle herd structure is governed by the overall function of the animal in agricultural production system; however, this study revealed that the proportion of male to female cattle was in-balance (49.5:50.5%) in the total herd studied. The overall means and SDs of milking cow holding was 2.14 ± 1.57 where it was higher for the highland than mid-highland smallholders agro-ecology. Cows' average lactation length was 8.16 months and estimated total lactation milk yield within this lactation period was not more than 360 liters/cow. The major livestock input supply and service delivery expenditure was mainly for veterinary services where animal feed purchase, labour employment and renting grazing land during summer seasons were also another challenges which farmers in the study area were encountering. Udder washing before and after milking was rarely practiced where about 74.23 percent producers do not wash udder before milking and only 25.27 respondents wash udder before milking. However, '*Lantana trifolia, Sida cuneifolia and Cucumis prophetarum*' were the most commonly used plant/herbs for cleaning and washing milking and milk storing equipments in the study area. The means and SD of shelf life of butter in days was studied and butter can be kept un-perished for up to 159.45(84.915) and 68.44(42.416) at highland and Mid-altitude. The difference in butter shelf life was highly significant at (P>0.001) among the highland and mid-highland. The difference in shelf life of yogurt was also significantly (P>0.001) higher for mid-highland than highland.

Introduction

Livestock performs multiple functions in the Ethiopian household economy by providing food, input for crop production and soil fertility management, cash income as well as in promoting savings, fuel, social functions, and employments. With these multiple functions, livestock can serve as a vehicle for improving food security and better livelihood of the rural population. Cattle production plays an important role in the economies and livelihoods of farmers. Ethiopia, with 53.99 million cattle head out of which the female constitute about 55.48 percent has the largest population of cattle in Africa (CSA, 2012). Due to large cattle population, the country holds large potential for dairy development because of various reasons among which is the large population (estimated at 10.7 million) of milking cows (CSA, 2012). Conducive and relatively disease free agro-ecology, particularly the mixed crop–livestock systems in the highlands supports crossbred and pure dairy breeds of cows (Ahmed *et al.*, 2003).

A huge potential for production of high quality feeds under rain fed and irrigated conditions, existence of a relatively large human population with long tradition of milk and milk-product consumption and hence a potentially large domestic market (Holloway *et al.*, 2000) favors dairy productivity. Although the livestock sector has a significant contribution to the national economy, production per animal is extremely low. The average lactation milk production of the indigenous cows ranges from 494–850 kg under optimum management (EARO 1999; Haile *et al.*, 2009a).

Following Redda's (2001) report, milk production systems in Ethiopia is broadly categorized into urban, peri-urban and rural milk production systems, based on location. The rural dairy system is part of the subsistence farming system that includes pastoralists, agro-pastoralist, and mixed crop-livestock producers mainly in the highland areas. Traditional dairy production system is non-market oriented and most of the milk produced in this system is retained for home consumption. The consumption of raw milk and its derivatives is common (Yilma, 2003), which is not safe from consumers' health point of view as it may lead to the transmission of various diseases. This study was therefore, designed to assess the overall milk production and marketing system practiced in the Horro District.

Materials and Methods

Description of the Study Area

The study was conducted in Horro district of Horro-Gudru Wollega Zone of Oromia Regional state, western Ethiopia. The District town, *Shambu* is located at about 310km west of Addis Ababa. The district has 23 peasant associations out of which Dega (highland), Wey-nadega (mid-highland) and Kola (lowland) constitutes 43%, 56% and 1%, respectively. The average annual rainfall is 1650 mm and the annual minimum

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and maximum temperatures are 18°C and 27°C, respectively. Livestock production is one of the major economic basis in the area and the estimated inventory of holding of livestock of Horro-Gudru zone was 639,162, 188,125, 159,278, 483, 853, and 108,462 cattle, Sheep, Goat, Poultry and Equine, respectively (CSA, 2012/13).

Sampling Techniques and Sample Size

The study was conducted in five 'kebeles' (the smallest administrative structure in Ethiopia) selected from the two major agro-ecologies of the District (Dega and Woyena-dega). Purposive stratified sampling procedure was employed to select the peasant associations that were based on their agro-ecological location, livestock holding and their access to market centers. For this study, two kebeles were selected from Dega (a highland) while three kebeles were selected from Woyena Dega (mid-highland), purposively. From each selected kebeles, twenty households with a total of hundred households were selected purposefully based on their activity in extension services and experience in dairy production in order to obtain reliable information for the interview.

Methods of Data Collection and analysis

Informal and formal survey tools were employed to collect primary data from sample respondents using a semi-structured questionnaire, which was designed to generate data on household profiles (sex, age, family size, education level, livestock production and dairy production and marketing). Personal observations were held on: feeding and housing system employed, cow milking, milk processing and marketing, milk preservation method practiced and preservative plant and herbs used. Observations were also made on the health services provided by governmental and private veterinary Clinics. Experiences and activities in extension services on dairy production and traditions of dairy product processing and preservations used were gathered by group discussion held using development agents' (DA), elder women and innovative farmers of the respective '*kebeles*'.

The primary data collected for this survey was analyzed using descriptive statistics such as mean comparison, frequency distribution, range and percentages and GLM ANOVA using SPSS software version 20. Least Significance Difference (LSD) was employed to separate means having statistically significant difference. Chi-square comparison was also employed to test the variability among '*kebeles*' and household heads with respect to private pastureland holdings, livestock holdings and cattle herd structure, cows' reproductive performances, dairy productivity and marketing system.

Result and Discussion

- Livestock holding and cattle herd structure

Livestock Holding and Herd Composition

The number of animal holding and the comparative mean holding of highland and mid-highland producers of the study area is presented in (Table-1). The predominant livestock species kept in the area were cattle, sheep, goats, horse, donkey, chicken and honey bee colony, where cattle was the priority animal followed by sheep, horse, donkey, goats, chicken and honey bee colony. The means and standard deviations of livestock holding was 12.17±8.69, 13.54±13.98, 3.22±5.25, 2.79±2.84 and 0.96±1.34 for cattle, sheep, goats, horse and donkey, respectively.

The overall (means ± SD) holding for cattle identified by this study was lower than the average herd size of 17.0 of Guduru district reported by (Demissu *et al*, 2013), where sheep flock size was much higher than the 2.9 sheep per household reported by same study in Guduru district of Horro-Guduru zone. The mean and SD of cattle, sheep and horse holding of highland smallholders was significantly higher than that of mid-highland smallholders. However, the mean goats and donkey holding was higher for mid-highland smallholders. The difference in goat holding was significantly higher for mid-highland altitude where it was not significant for donkey holding. The variation in chi-square (Table-1) for all livestock species is an indicator of the difference in animal holding among individual householders.

The overall (means ± SD) cattle holdings of this study is in agreement with cattle holding reported by (Mekonnen *et al*, 2012) for same district, however the variation of cattle holding among the two agro ecologies was contrasting. In the highland, the larger population of sheep, cattle and horse holding might be because of the favorability of the environmental condition to this animals in addition to which grazing land shrinkage is more aggravated in mid-highlands as crops were more productive in the mid-highland agro-ecology. In highlands sheep were the main source of income and therefore were populous compared to mid-altitude where crop production was major source of income. Horse, which is mainly kept in the household for transportation and packing, also comprised a significant number of the livestock holding in highland than mid-altitude agro-ecological zone. This study revealed that sheep and horse possession was significantly ($P > 0.001$) higher for highland than the mid-highland where the difference in cattle holding was higher at ($P > 0.05$) for highland too.

Cattle Herd Structure

In the areas where crop production is dominant and demand for draught power is high, the herd tends to be comprised of high proportion of male cattle to female. However, in this study, there were proportional male cattle (oxen) to female cattle though crop production was the main stay for the agricultural activity and cattle were mainly reared for draught power supplementation. Cattle herd structure was also governed by the overall function of the cattle in agricultural production system of the area. This study therefore, revealed that the proportion of male to female cattle was 49.5: 50.5% in the total herd (Table-2). This might be because the use of male and female cattle is equally important where male cattle were used for draught power, breeding and for income generation as they could be sold at any circumstances. Female cattle in the same manner are used mainly for dairy production and source of replacement stock where manure production, gift of bride on wedding and heritage are the other purpose that they were reared for.

Among the different age groups in the herd, male cattle found within the age range of greater than 4 years accounts for 27.19 and 54.84 percent of the total and male cattle in the herd, respectively. The higher proportion of oxen (male cattle >4yrs age) in the herd indicates the dominance of crop production which forced farmers in the area to keep more oxen above 4 years in their herd. Similarly, the herd is comprised of the highest proportion of female that was 57.01 and 28.93 percent within the age range of greater than four years out of the female cattle and total cattle in the herd, respectively (Table - 2). This is also an indication for the practice that cows in the age range of greater than four years were retained in the herd and used for replacement stock and milk production.

The overall means and SDs of milking cow holding was 2.14 ± 1.57 where the mean milking cow holding was higher for the highland than mid-highland smallholders agro-ecology, however, the variation was non-significant (P=0.457) (Table-3). Milking cows were used as the major source of weekly income on which housewives depend mainly for their demand of kitchen

input complementation. The productivity of highland cows was slightly higher than the mid-altitude cows though the variation is non-significant. The slight difference in productivity among the cows of highland and mid-highland might be because of wider grazing land was found in the high altitude areas since the crop cultivation was more intensive in the mid highland that results in shrinkage of grazing pastureland.

The 2.14 average numbers of milking cows per household observed in the current study was higher than the result reported by Mekonin (2006) and Nebiyu (2008) in Delbo watershed area 1.2 and 1.1, respectively and Asrat *et al* (2015) around Bodity, South Ethiopia. However, the it was lower than the finding of Lemma (2004) who reported 3.2, 3.1 and 2.2 for Adami Tulu Jido Kombolcha, Arsi Negele and Lume districts, respectively and Tesfaye (2007) which indicated 3.0 ± 0.15 cows holding/household in Metema district, North Western Ethiopia.

The overall (mean ± SD) daily milk production per cow in this study was 1.51±0.787 liters. The mean comparison of milk yield among the two agro ecologies revealed that the difference was non-significant where (P=0.355); however, slight figurative variation was observed (Table-3). The current finding for milk off take was higher than the 1.0 liter/cow/day milk yield for local Arsi cows reported by Lemma (2004) and much lower than the 3.4 liter/cow/day reported by Belete *et al* (2010), and Tesfaye (2007) who reported 1.9 ± 0.045 liters for indigenous cows.

Dairy cattle management and expenditure on livestock input purchase

Feeding system in the study area was mainly dependent on natural pasture grazing on communal pasturelands where crop residue, individual fallow-land and stub grazing were used for complementation. About 89.13 interviewed respondents use grazing on communal grass land primarily for their animal feed where only 9.78 percent smallholders feed crop residue as a primary animal feed source (Table-4). Livestock feeds generally are the major inputs in any dairy production activity (Sintayehu *et al*., 2008). This study also indicated that natural pasture hay, crop aftermaths and non-conventional feedstuffs such as '*attella*'(brewery by-product from locally produced beer) and '*birint*'(a by-product from locally produced catikala) were the sources of feed for cattle in the study area. Generally, residues from cereals such as teff (*Eragrostis tef*) straw, wheat straw, barley straw, noug (*Guizota Abisynica*) husk and maize stover form the crop residue.

This finding therefore, is in line with the report of Asaminew (2007) and Seyoum *et al*. (2007) who indicated that the major basal feed resources for cattle in Bahir Dar and Mecha districts and the highlands of Ethiopia, respectively, are natural pasture, crop residue and stubble grazing. Concentrates especially industrial byproducts were rarely used with the exception of those milk producers who keep crossbred cows. However, the tradition feeding teff (*Eragrostis teff*) bread (qixa xaafii) and non-threshed teff for milking and draft oxen was commonly known.

The major livestock input supply and service delivery expenditure was mainly for veterinary services where animal feed purchase, labour employment and renting grazing land during summer season were also other challenges which farmers in the study area faces. Frequency distribution and percentage of householders expending for their livestock are indicated on (Table-4). With respect to individual grazing land, more respondents in the study area keep some of their land for their animal to graze. However, only draft oxen and few of their cows were allowed to graze on private grazing land. Therefore, the productivity of milking cows was much lower because of poor management and low supplementation practices.

Dairy animal and equipment handling practices

Milk is highly nutritious; therefore spoilage as well as pathogenic microorganisms present in the dust, urine, dung and feed refusals, once get access, can easily multiply and deteriorate the quality of milk making it unsafe for consumption and unfit for further processing. Maintaining the sanitary condition of milking area is important for the production of good quality milk.

The drainage condition of the milking area, in this regard, is one of the most determinant factors. Cleaning the udder of cows before milking is important since it could have direct contact with the ground, urine, dung and feed refusals while resting. Not washing udder before milking can impart possible contaminants into the milk.

This study revealed that about 74.23 percent producers do not wash udder before milking and only 25.27 practice washing udder before milking. '*Lantana trifolia*, *Sida cuneifolia* and *Cucumis prophetarum'* are the most common herbs used for cleaning and washing milking and milk storing equipments in the study area (Table-6).

In Ethiopia, there is no standard hygienic condition followed by during milk production. The hygienic conditions are different according to the production system, adapted practices and level of awareness, animal husbandry, and availability of resources. In this study about 74.23 % producers do not wash udder before milking where 98.91% small holders assessed clean milking utensils before use. In most of the cases under smallholder condition, the common hygienic measures taken during milk production especially during milking are limited to letting the calf to suckle for few minutes and/or washing the udder before milking.

Dairy product processing and marketing System

There are basically two marketing systems in the central highlands of Ethiopia: formal and informal. In the formal system, milk is collected at cooperative or private milk collection centers and transported to processing plants. In the informal system, producers supply their surplus production to their neighbors and/or local markets, either as liquid milk or in the form of butter and/or Ayib (traditional homemade cheese) (O'Connor, 1992). Butter was the major dairy product marketed in the study area and marketing system is informal where the dairy product was sold at local market.

The result of this study was in agreement with the reports of Beyene (1994) who reported the practice studied in the southern region, Yilma and Inger (2001a) in the central highlands of Ethiopia, Tola (2002) in eastern Wollega and Fita (2004) in the east Shoa zone of the Oromia region, where most of the farmers do not sell fresh milk but sell butter.

In the current study almost all producers travel on average (2.33 ± 0.767) where they spent not more than half an hour to rich market place.

This study revealed that dairy marketing was based on product sale through informal marketing system where majority of dairy product specifically 'Butter' was sold to consumers and some retailers who collect the product. In this study, the quality of milk and milk products was very poor mainly due to poor udder and teat sanitation which was because producers have limited knowledge coupled with the inadequacy of dairy infrastructures such as electricity and clean water in the production areas.

In Ethiopia, milking animals are kept with the rest of the stock in a shade or enclosure during the night.

Table 1. Means and SD livestock holding of the study area

Agro ecology		cattle	Sheep	Goats	Donkey	Horse
Highland	Mean	14.98	22.82	1.93	0.83	4.18
	N	40	40	40	40	40
	Std. D	7.03	16.01	3.99	1.29	3.42
Mid highland	Mean	10.02	6.4	4.21	1.06	1.73
	N	52	52	52	52	52
	Std. D	9.27	5.76	5.89	1.378	1.68
Total	Mean	12.17	13.54	3.22	0.96	2.79
	N	92	92	92	92	92
	Std. D	8.69	13.98	5.25	1.342	2.84
$\chi 2$		58.043[a]	86.630[b]	439.848[c]	96.870[d]	91.652[e]
Sig.		0.006	0	0.038	0.413	0

Table 2. Cattle herd structure and frequency distribution of each age and sex in the herd

Age Group (Year)	Total Herd (N)	Male				Female			
		Total	% within male	%within Total	Means ± SD	Total	%within Female	%within Total	Means ± SD
0-1	92	102	17.06	8.55	1.11±1.19	77	12.66	6.38	0.84±1.11
1-2	92	64	10.7	5.31	0.70±1.05	80	13.16	6.63	0.87±1.45
2-4	91	104	17.39	8.62	1.14±1.53	102	16.78	8.55	1.11±1.45
4-6	91	166	27.76	13.76	1.82±1.48	197	32.01	16.33	2.14±2.13
6-8	91	87	14.55	7.21	0.96±1.82	85	13.98	7.05	0.92±2.1
>8	92	75	12.54	6.22	0.82±2.4	67	11.02	5.55	0.73±2.14

Table 3. Comparative Means ± SD Milking cow holdings and Productivity of dairy cows

Agro ecology		Milking cow holding	Milk off-take /cow/litter	Lactation length in month
Highland	Mean	2.29	1.6	8.77
	N	38	40	40
	SD	1.374	0.409	3.109
Mid highland	Mean	2.04	1.44	7.65
	N	52	49	49
	SD	1.703	0.993	1.627
Total	Mean	2.14	1.51	8.16
	N	90	89	89
	SD	1.569	0.787	2.458
	p- value	0.457	0.355	0.031

Table 4. Animal feed sources, feed supplementation practices and challenges

Variables		N hh	Frequency	%
Livestock Primary Feed source	Natural pasture	92	82	89.13
	Crop residue	92	9	9.78
	Improved pasture	92	1	1.90
Use improved forage	Yes	92	37	40.22
	No	92	55	59.78
Practice LS feed supplementation	Yes	92	47	51.09
	No	92	45	48.91
Season of LS feed shortage	Dry season	92	56	60.87
	Wet season	92	2	2.17
	Whole year	92	34	36.96

Table 5. Animal input service delivery and expenditure

Variable	Study 'kebeles'*														
	Gitilo D.			R. Chabir			A. Sambat			O. Buluk			A. Dulecha		
	N	F	%	N	F	%	N	F	%	N	F	%	N	F	%
Feed purchase	20	1	5	20	0	-	20	0	-	20	0	-	20	1	5
Vet service	20	0	-	20	10	50	20	4	20	20	3	15	20	3	15
Labor	20	6	30	20	3	15	20	0	-	20	0	-	20	0	-
Feed and vet service	20	1	5	20	0	-	20	0	-	20	2	10	20	1	5
Feed and labor	20	1	5	20	0	-	20	0	-	20	0	-	20	0	-
Labor and vet service	20	3	15	20	1	5	20	0	-	20	4	20	20	2	10
All input purchase	20	3	15	20	0	-	20	3	15	20	2	10	20	9	45
Not at all	20	5	25	20	2	10	20	12	60	20	3	15	20	4	20

*= lower level administrative structure in Ethiopia

Table 6. Cow's udder and teat management and equipment cleaning practices

Milk handling	Variables	N hh	Frequency	%
Wash udder	Yes	91	23	25.27
	No	91	68	74.23
Wash milking utensils	Yes	91	90	98.91
	No	91	1	1.09
Herbage plants used to wash/rub milk utensils	Kusaayee (*Lantana trifolia*)	91	68	74.23
	Guftee (*Sida cuneifolia*)	91	3	3.30
	Hiddii hoolotaa (*Cucumis prophetarum*)	91	2	2.20
	All as obtained	91	18	19.78
Use aromatic preservative for milk & product	Yes	91	87	95.60
	No	91	4	4.40

Table 7. Dairy product handling, processing and product market access

Variables		Mean storage time Milk products			Time spent on processing and market access	
Agro ecology		Butter storage time in days	yogurt storage time in days	Cheese storage time in days	Time spent on churning	Distance of market for product sale in km
Highland	Mean	159.45	4.36	3.9	1.29	2.46
	N	40	40	40	36	35
	SD	84.915	1.24	1.336	0.492	0.611
Mid-highland	Mean	68.44	10	3.93	1.85	2.23
	N	32	28	29	33	43
	SD	42.416	4.769	0.753	0.459	0.868
Total	Mean	119	6.68	3.91	1.56	2.33
	N	72	68	69	69	78
	SD	82.585	4.228	1.121	0.551	0.767
P-value		30.589	51.259	0.013		1.667
Sig.		0.000	0.000	0.911	0.000	1.667

Although various traditional milk processing and storage equipment are used in different parts of Ethiopia, clay pot is the most commonly available and used in the study area where plastic containers and utensils made of grass were also used to a limited extent.

To extend the shelf life of milk and milk products, milk utensils were cleaned with different herbage plants, spicing and smoking of milk and milk product containers with Ejersa/*woira (Olea africana)* and 'Waato' (un identified indigenous tree) were used. The means and SD of shelf life of butter in days was studied and butter can be kept un-perished for up to 159.45(84.915) and 68.44(42.416) at highland and Mid-altitude (Table 7). The difference in butter shelf life was highly significant at (P>0.001) among the highland and mid-highland. The difference in shelf life of yogurt was also significantly (P>0.001) higher for mid-highland than highland where the difference might be because of the difference in utensil handling and udder and teat management.

Clay pot, plastic and steel buckets were the most commonly used utensils for storage and processing of milk products depending on the availability and peoples' tradition. Sanitation of the milking and milk storage utensils enables to improve the flavour, taste and quality of milk and milk products, and extends the shelf life of dairy products. These utensils were smoked and cleaned with different tree plants, and aromatic herbs and bushy plants.

Conclusions

- Cattle in the livestock herd of the study area were the second populous and first important

animals. However, the feeding management was mainly communal grazing land based where there were feed insufficiency. The quantity and quality of feed of livestock determines the productivity of animals where for dairy animals the quantity and quality of milk and its product is also determined mainly with the feed constituent. This study revealed therefore, that the low productivity of dairy cattle in the study area was because of poor feeding management coupled with poor genetic makeup where majority of dairy animals were local breed (Horro) cows.

- More than 50% of cattle in the herd were male and female cattle above 4 years age where the proportion of male to female was almost equivalent. The higher proportion of aged cattle in the herd implies the demand for animals at age of production where the balance in proportion of female to male at this age was an indicator of high need for milk production though the area is a mixed crop-livestock production area that mainly depends on oxen's draught power for crop production.
- Milk production potential of the area was minimal where the average yield per cow was about 1.5lit/cow/day. This yield per lactation length (8months) studied implies the total milk yield per cow per lactation to be only 360 litres.
- Milking cow management practices before and after milking with respect to teat cleaning, housing system used and milkers' sanitation problems might be the most important factors that can affect the milk quality and exposes dairy cows to mastitis and other infectious diseases.
- Dairy processing was only to butter and cheese where raw milk marketing was not known and was considered as a taboo. The marketing tradition does not encourage producers to high yielding and improve animal management for better productivity. The marking system known was also informal where only local consumers and few retailers buy the product. These all affect the productivity of milk and product processing and handling.

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