Milk Production Performances of Local and Crossbred Dairy Cows in WestGojam Zone, Amhara Region, Ethiopia

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Abstract

The objective of the study was to evaluate milk production performance of Indigenous and their crossbreed of different exotic blood level of dairy cows and factors affecting their performance in rural, peri-urban and urban production systems. A total of 180 small-scale dairy cow owners were purposively selected and interviewed with pre-tested, semi-structured and structured questionnaires. Monitoring and evaluation of dairy cows with different exotic blood level (Holstein Friesians), 25%, 50% and 75%) were purposively selected. The lactation stages, production system, exotic blood level and parity of cows were considered during monitoring and evaluation. The results indicated that the average daily milk yield for local cows were 3.4±0.9, 2.8±1 and 0.9±0.6 liters in early, mid and late lactation stages, respectively. Accordingly, for cows with 25% exotic blood level, the mean daily milk yield was 5.82, 4.84±2, and 2.9±2 liters in the three stages of lactation, respectively. For 50% exotic blood level the mean daily milk yield was 9.9±4, 7.6±4 and 4.6±2 liters, respectively. For 75% exotic blood level, the mean daily milk yield was 11.6±3, 9.2±2.3 and 5.7±1 liters, respectively. The milk production was significantly ($p < 0.05$) decreased in 3rd lactation stage than 2nd and 1st for both for local and for all crossbreed. From the results, it was possible to see that crossbreed dairy cows with exotic blood level of 75% best fits to urban production system, medium exotic blood level (50-62.5 %) to peri-urban and lower exotic blood level (25% to 50%) to rural production system. Therefore, such breeding strategy with appropriate, housing feeding and disease control should be maintained in respective production system so as to increase milk production and productivity.

Keywords: Blood level, Crossbred cows, Indigenous cows, Milk yield, Production systems

Introduction

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economic development of the country. The total livestock population for the country is estimated to be about 56.71 millions of cattle, 29.11 million goats, 29.33 million sheep and 0.92 million camels (CSA, 2015). Out of 56.71 million the female cattle constitute about 55.45 percent and the remaining 44.55 percent are male cattle. From the total cattle in the country, 98.66 percent are local breeds and the remaining 1.19 percent and 0.14 percent are hybrid and exotic breeds, respectively (CSA, 2015). Earlier estimates indicated that the livestock sector contributes about 12-16% of the total GDP, and 47% of total agricultural GDP values for draught power, transport and manure (IGAD, 2010) and contributes to the livelihoods of about 60-70% of the Ethiopian population (Halderman, 2004; Azage Tegegne et al., 2013). The value of the animal draught power input into arable production is about a quarter (26.4%) of the value of annual crop production, and if the value of draught power services is included, the sector contributes up to 45% of agricultural GDP (Azage Tegegne et al., 2013).

Despite the largest cattle population, the milk production performance is very low. The country's per capita milk consumption is estimated to be about 19.2 kg per year, which is far below the average per capita consumption of Africa (37.2 kg per year) (FAO, 2000). In Ethiopia, the poor genetic potential of indigenous cattle for productive traits, substandard feeding, poor health care and management practices, are the main contributors to low productivity.

Genetic improvement of indigenous breeds is possible by way of selective breeding and/or strategic crossbreeding, some effort has been exerted to date to improve any of the indigenous breeds (Kefyalew Alemayehu and Chencha Chebo, 2012; AzageTegegn et al., 2002), increase in milk yield in the F1crossbred (50% exotic blood level) as compared with local stock.

Given suitable government recognition, access to market and services, there is great potential for development of smallholder dairy scheme in peri-urban and urban areas (Stall and Shapiro, 1996). Productivity of crossbreed dairy cattle is believed to be higher than that of local zebu. But the performance status of different exotic blood level of crossbreed and local dairy cows in different farming system of Ethiopia highland in production traits are not well understood. A number of researches have been conducted to monitored and evaluate milk productive performance of indigenous and crossbreeds, especially for different exotic blood levels under a relatively controlled condition at research centers, government owned farms and in some urban and peri-urban dairy areas of a country (Haile-mariam Mekonen et al., 1993; Yosefe Shiferaw et al., 2003). However, there are a few of such works conducted in rural areas especially under the smallholder dairy farming.

The mainstay of the population in the Amhara region is rain-fed subsistence agriculture and about 73 percent of smallholders practice mixed crop-livestock farming, 19 percent practice crop cultivation, while the remaining 8 percent undertake livestock rearing (ZDA, 2005). Like other parts of the region, milk production is an integral part of the farming system in West Gojam Zone. Local milk production is mainly from indigenous Zebu cattle which are kept by about half a million smallholder farming households (CSA, 2005) most of whom are poor.

The objective of this study was, therefore, to monitor and evaluate milk production performance of local and cross breed dairy cow and constraints associated with milk production in Bahir Dar Zuria, Mecha and Yilmana Densa districts.

Materials and Methods

Description of the study area

The study was conducted in Mecha, Bahir Dar Zuria and Yilmana Densa district which are located in West Gojjam Zone of the Amhara National Regional State.

West Gojjam is one of the tenth zones in Amhara region and lies between 36° 30' to 37° 5' Longitudes East and 10°16' to 11°54' Latitudes North. Finoteselam, the capital of West Gojam, is located between Addis Ababa and Bahir Dar which is 385 Km from Addis Ababa and 175 Km from the regional capital, Bahir Dar. The three districts were selected purposively based on their potential for production of milk and LIVES project focus. The predominant production system in these areas is mixed crop-livestock farming and cattle are the most important livestock species reared in the areas. According to the 2013 report of Department of Agriculture of West Gojam Zone, 1,399,491 cattle, 554,677 shoat and 176,338 equines exist in the zone (Table 1).

Table 1. Description of the study areas

Parameter	Districts			References
	Mecha	Bahir Dar Zuria	Yilmana Densa	
Altitude m.a.s.l.	1800-2500	1700-2300	1552-3535	DOA 2000[b]
Area coverage	159,898 ha	151,119 ha	-	DOA2000[a]
Annual rainfall	820-1250mm	820-1250mm	1270mm	DOA 2000[b]
Temperature	170- 30°C	100 - 32°C	-	DOA 2000[a]
Total Population	292,080	182,730	214,852	CSA 2007
Men	147,611	93,642	107,010	CSA 2007
Women	144,469	89,088	107,842	CSA 2007
Urban population	7.8%	-	8.9%	CSA 2007
Rural population	92.2%	100%	91.1%	CSA 2007
Cattle population	351,844	199,524	123,440	DOA 2015
Crossbred cattle	2377	1344	1586	DOA 2015
Rural kebele	40	32	26	DOA 2015
Urban kebele	3	-	2	DOA 2015

Figure1. Map of study area: Number 1=Represents Bahir Dar Zuria, Number 2=Represents Mecha and Number 3=Represents Yilmana Densa districts.

Production System of the Study Areas

Based on management practices, marketing situations, feed source and feeding system, herd type and size, land use type and objective of keeping animal, three dairy production systems were identified (Tsehay Redda et al., 2000) and are indicated below.

Urban Production System: All farms found in intra-towns in both Mecha (Merawi) and Yilmana Densa (Adiet) where no access to grazing land. Less access to other feeds like natural pasture, improved forages and other crop residues due to less land to grow but also to a coping mechanism against feed shortage through the use of conserved feed. Stallfeeding and separate house for local and crossbreed were used.

Peri-Urban Production system: This system is found around town and the farmers have access to infrastructure than the rural farmers, they supply their milk to milk union easily and trader and coffee house (Sebat Amit in Bahir Dar Zuria, Enamirt in Mecha and Mosebo in Yilmana Densa district).

Rural Production System: The milk produced is mainly used for home consumption and feed requirements are entirely satisfied from native pasture, crop residues, stubble grazing or agricultural by-products and the market oriented system is based on improved crossbred dairy cattle where milk is an important source of cash income similar to report of Ahmed Mohamed et al. (2003).

Sample Size and Sampling Techniques

Three representative districts such as Mecha, Bahir Dar Zuria and Yilmana Densa were selected based on ILRI project focus and milk production potentials. Following the three production systems (rural, peri-urban and urban production), all local and cross breed dairy cow owners with local (Fogera) and crossbred (Holstein-Friesian cross with local) dairy cow found in the selected kebeles were properly selected and registered purposively. Systematic simple random sampling technique was applied to choose 20 (twenty) respondents in each of the selected three production system. Equal chance was given for those farmers with different cattle number, cattle management system and other practices. Therefore, from each district a total of 60 (rural=20, peri-urban=20 and urban=20) dairy cow owner households for the interviews were used.

Methods of Data Collection

Reviewing a number of secondary literatures (existing documents and plans, outbreak reports and recommendations, study results and scientific articles) were conducted. Set of checklists for core activities and focus group were used as guideline to accomplish prioritized activities and to discuss with various stakeholders were involved. Collecting primary data through a comprehensive field survey was also conducted. Additional data also be gathered through semi-structured and structured questionnaires.

From the total of 180 households, the first 60 households were lactating cows and 45 for crossbred (with different exotic blood level ((1-3) 25%, 50% and 75% of crossbred) and one third for locals (15). Lactating cows were stratified based on lactation stage early (1-3 months), mid (4-6 months), and late (7-9 months) stages of lactation, for both crossbred and indigenous dairy cattle. The amount of milk produced by sampled crossbred or local dairy cows (n = 45 crossbred and n = 15 local dairy cow) was recorded. Daily cow milk yield (morning and evening) was measured by using calibrated plastic Jog (capacity 1 liters) for three days a week (Monday, Thursday and Sunday) for a period of 9 (nine) months from the total 60 dairy cows. The crossbred daily milk yield was measured from each exotic blood level of (25%, 50% and 75%).

Data-Analysis

For the survey data, descriptive statistics, chi-square tests was used to test the significant value and multiple mean comparisons using Bonferroni's correction were employed for the adjustment made to *P* values for dependent or independent statistical tests are being performed simultaneously on a single data set in Statistical Analysis System (SAS, 2007)

To analyze monitoring data, the General Linear Model (GLM, SAS 2007) and mean procedures of SAS were used. To examine milk production significance differences between different stage of lactation, parity, exotic blood level and production system at critical probability of $P<0.05$ was used.

The study statistical model as follow below;

$Y_{ijkl} = \mu + B_i + S_j + Y_k + M_l + N_m + eijklm$,

Where, Y_{ijkl} = observation on MMY and EMY;

μ = overall mean

B_i = fixed effect of i^{th} production system (rural, peri-urban and urban area);

S_j = fixed effect of j^{th} parity class (j= 1, 2, . . 5);

Y_k = fixed effect of k^{th} lactation stage (1, 2 and 3);

M_l = fixed effect of l^{th} season of calving (February, March and April);

N_m = the fixed effect of exotic breed blood level (m = 0%, 25%, 50% and 75%);

eijklm = random error associated with each observation

Results and discussions

Cattle herd structure per Household Level

More crossbred cattle were found in urban than in peri-urban and rural but the indigenous/local cattle were higher in rural than in peri-urban and urban production system (Table 2). The presence of more crossbred cattle population in urban and peri-urban than rural production system was due to the fact that the famers have more awareness about the milk production capacity of the crossbred cattle. Across the production systems, crossbred genotypes of cattle owned by respondents were described in Table 2. Crossbred genotype composition was higher in urban and peri-urban than rural production system. The proportion of exotic breed genotypes of crossbred cattle is increasing from rural to urban production system. In rural, exotic blood level of crossbred was < 50%, in peri-Urban and urban ranges from 50-75% of exotic blood level. In rural, the highest proportions of bulls with exotic blood levels are used for traction power.

The daily milk yield of local and crossbred dairy cows was higher in urban and peri-urban than rural production system (Table 3). The mean milk yield of local cows per day was 3.4±0.7, 2.8±0.3 and 0.7±0.6 liters for the first, second and third stage of lactations, respectively with an overall average of 2.3±0.5 liters per day. The average daily milk yield of crossbred cows for F1 (50%) was 9.8±3, 7.5±3 and 4.5±1 litters for the first, second and third stage of lactations , F2 (25% local) was 5.7±2, 4.9±2 and 2.9±1 liters for the first, second and third stage of lactation and F2 (75% exotic blood level), 11.4±2, 9.2±2 and 5.6±1 liters for the first, second and third stage of lactations, respectively .The overall average of cross F1 (50%), F2 (25% local) and F2 (75% exotic blood level) were 73±2.5, 4.5±2 and 8.7±2 with overall mean (6.8±2) liters per day. This was in line with GebrekidanTesfay et al., 2012 which was 6.83±2.5 liter and less than (Adebabay Kebede, 2009; Zewdu Wuletaw, 2004) which was 8 liters per day per cow.

Table 2. The Mean ± SD herd composition, breed type and number of cattle owned per household.

Items	Rural (N=20)	Peri-urban (N=20)	Urban (N=20)	Overall
Crossbreed cattle	3.6 ± 2.3	5.3 ± 4.1	5.6 ± 4.1	4.8 ± 4
- Cow-indigenous - 25%	0.3 ± 0.7	0.6 ± 0.5	0.4 ± 0.8	0.44 ± 0.7
- 25-50%	0.6 ± 1	0.5 ± 0.6	1.2 ± 2	0.8 ± 1
- 62- 75%	0.3 ± 0.9	0.70.5	0.9 ± 2.4	0.7 ± 1
- 75%	0.1 ± 0.4	0.1 ± 0.3	0.9 ± 2	0.4 ± 1
Local cattle	8.7 ± 4.3	3.7 ± 4.4	2.6 ± 3.8	5.1 ± 4
- Local cow	1.8 ± 0.8	1.1 ± 0.9	1.3 ± 0.8	1.4 ± 1

SD = Standard Deviation; N = Number of respondents

The mean numbers of crossbred cows per household were 2.2±4. The urban (3.3) was greater than (1.9) peri-urban and (1.3) rural production system which was significantly greater than Adebabay Kebede , 2009 report (0.2±1). The ratios of crossbred and local cow per household were different, 61.8% and 38.2%, respectively.

Daily milk yield

The average daily milk yield of local animal across the production system was 1.6±0.5, 2.3±0.4 and 3.2±2 in rural, peri-Urban and Urban, respectively (Table 3). The daily milk yield for crossbred with exotic blood level of 25% were 3.9±0.8, 4.5±2 and 5.1±2 in rural, peri-Urban and Urban, respectively. For those 50% exotic blood level of was 5.6±2, 7.8±4 and 8.6±2.2 in rural, peri-Urban and Urban, respectively. For crossbred exotic with blood level of 75% was 7.3±2, 8.7±1 and 10.3±21 in rural, peri-Urban and Urban, respectively

Daily milk yield of local breed in urban production system greater than daily milk yield of peri-urban and rural production system and daily milk yield of crossbreed blood level increased urban production system than peri-urban and urban production system. Crossbreed daily milk yield greater than local milk yield across the study production system urban better than peri-urban and better than rural.

Estimated Milk Production Compare against Stage of Lactation

The milk production performance at different stage of lactation and lactation dairy cows across the production system are indicated in (Table 4). The milk production had significantly decreased in late stage of lactation than mid and early stage of lactation for both local and for all crossbred of different exotic blood levels.

The average milk production for all crossbred cows with exotic blood level was 9.0±3, 7.2±2 and 4.4±2 liters at early, mid and late stage of lactation which was comparable with Adebabay Kebede, 2009 (11.00±2, 9.1±2 and 5.0±0.7 liters for first, second and third stage of lactations). But it was lower than Yitaye Alemayehu et al., 2007; AsaminewTassew and Eyasu Seifu, 2009 (7.8±0.2 and 7.8±0.2 liters, respectively) . In case of local dairy animal, mean average daily milk yield of local cows was 2.4?0.8 liters, which was better than the national average (1.1 liter).

Milk Production performance against Parity

The effect of parity was highly significant for daily milk yield both local, and their cross of 25%, 50% and 75%. Milk production increased as parity increased until 4th parity, then decrease except 50% increased to 5th parity. This result agrees with the finding of Mohamed Ahmede, 2004, who demonstrated that milk yield increased with advancing lactation up to 4th parity in Sudan.

Milk production per Lactation

Average milk production per lactation for indigenous cattle was 311.6±43 liters in 239.3±49 days. This result was higher than overall average estimated lactation, 271.4 litters in Mieso district reported by Kedija Hussen (2007) and lower than 488 liters within 249 days found in Somali region of pastoral areas by (IPS 2000). Milk production per lactation for crossbred cattle with 25%, 50%, and 75% was 398.2±129, 631.7±223 and 762.7±147 litters, respectively. The average milk yield per lactation for all crossbred was 597.5±167 liters (Table 4). A study conducted in North Showa zone indicates that 50% cross breeds (1511.5 L) produce more amount of milk than local breeds (457.9 L) per lactation (Belay Duguma et al., 2012). Mulugeta Ayalew and Belayneh Asefa, 2013 also reported that the mean milk production per lactation between the crosses of Horro and Holstein Friesian was 2333.6 liters.

Table 3. The Mean±SD of milk yield (litter/day/cow) of crossbred with different exotic blood level and local cows across stage of lactation (N = 60).

Items	Lactation				
	Early stage	Mid stage	Late stage	Overall	p-value
Local	3.4 ± 1	2.8 ± 1	0.9 ± 0.6	2.4 ± 0.8	0.00
25% exotic	5.8 ± 2	4.8 ± 2	2.9 ± 2	4.5 ± 2	0.00
50% exotic	9.9 ± 4	7.6 ± 4	4.6 ± 2	7.3 ± 3	0.00
75% exotic	11.4 ± 3	9.2 ± 2	5.7 ± 1	8.8 ± 2	0.00
Total	9.0 ± 3	7.2 ± 2	4.4 ± 22	6.9 ± 2	

N = number of monitored cow; SD = Standard Deviation; Cb = Crossbreed, p<0.001

Table 4. Days of lactation (mean±SD) and Milk production (mean±SD) of crossbred with different exotic blood level and local cows across the production systems.

Items	Blood level				
	Local	25%	50%	75%	p-value
Rural					
LL (Day)	260.5 ± 45	258.8 ± 2	322.4 ± 47	304.6 ± 40	0.00
DMY (Litter)	1.6 ± 0.5	3.9 ± 0.8	5.6 ± 2	7.30 ± 2	0.00
MP/LL (Litter)	1397 ± 48	342.1 ± 8	512.7 ± 156	595.3 ± 105	0.00
Peri-urban					
LL (Day)	204.2 ± 7	281.6 ± 5	313.0 ± 44	313.0 ± 50	0.00
DMY (Litter)	2.3 ± 0.4	4.5 ± 2	7.8 ± 3.77	8.8 ± 1	0.00
MP/LL (Litter)	534.6 ± 5	402.5 ± 17	693.6 ± 338	784.1 ± 94	0.00
Urban					
LL (Day)	253.2 ± 3	293.3 ± 4	297.3 ± 34	292.8 ± 50	0.00
DMY (Litter)	3.2 ± 2	5.1 ± 2	8.6 ± 22	10.3 ± 2	0.00
MP/LL (Litter)	260.4 ± 4	450.1 ± 140	688.8 ± 175	908.7 ± 244	0.00
Overall					
LL (Day)	239.3 ± 5	277.9 ± 34	310.9 ± 42	303.4 ± 46	0.00
DMY (Litter)	2.7 ± 0.8	4.5 ± 2	7.3 ± 3	8.8 ± 2	0.00
MP/LL (Litter)	311.6 ± 4	398.2 ± 130	631.7 ± 223	762.7 ± 147	0.00

SD = Standard Deviation; LL = Lactation Length; DMY = Daily Milk Yield; MP = Milk Production, P<0.001

Conclusion

Form this study it was possible to see that there are significance differences in performance among indigenous and different exotic blood level (0%, 25%, 50% and 75%) within three production systems. Milk production performance of crossbred cattle with different exotic blood level and indigenous dairy cows was affected by blood level, production systems and management practice (feeding practices, health care and housing). Properly placing the genotype to right production system (urban, peri-urban and rural production system) i.e high exotic blood level (75%) to urban area, medium exotic blood level (50-62.5%) to Peri-urban and lower exotic blood level (25% to 50%) to rural area with appropriate management practice (feeding practices, health care and housing), and improving management and regularly supplying dairy inputs can improve dairy productivity

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References

Adebabay Kebede: Characterization of Milk Production Systems, Marketing and On- FarmEvaluation of the Effect of Feed Supplementation on Milk Yield and Milk Composition of Cows at Bure District, Ethiopia. M. S thesis submitted to Bahir Dar University; 2009. pp: 14.

Ahmed Muhamed M, Bezabih Eshetu, Jabbar, MA, Tangka F, Ehui S: Economic and nutritional impacts of market-oriented dairy production in the Ethiopian highlands.Socio-economics and Policy Research Working Paper 51.ILRI (International Livestock Research Institute), Nairobi, Kenya; 2003. pp: 27.

AsaminewTassew and Eyasu Seifu: Journal of Dairy & Food Sciences, Smallholder Dairy Production System and Emergence of Dairy Cooperatives in Bahir Dar Zuria and Mecha districts, Northwestern Ethiopia. Department of Animal Sciences, Haramaya University; 2009. ISSN 1817-308X.

Asaminew Tassew: Production, handling, traditional processing practices and quality of milk in Bahir Dar milk shed Area, Ethiopia. M.Sc. Thesis. Alemaya University, Ethiopia; 2007.

Assemu Tesfa, Kerealem Ejigu and AdebabayKebede: Assessment of current beekeeping management practice and honey bee floras of Western Amhara, Ethiopia; 2013 Inter J Agri Biosci, 2(5): 196-201. www.ijagbio.com.

Azage Tegegn, Workineh Ayalew, Berhanu Gebremedhin and Salvador FR: Opportunities for improving dairy production in Ethiopia. In: Resource management for poverty reduction, Approaches and Technologies selected contribution to Ethio-Forum; 2002. pp: 107-122.

AzageTegegne, Berhanu Gebremedhin, Dirk Hoekstra: Smallholder dairy production and marketing systems in Ethiopia: IPMS experiences and opportunities for market-oriented development: 2013. Working Paper No. 31

Belay Duguma, AzageTegegne and Hegde BP: Smallholder Livestock Production System in Dandi District, Oromia Regional State, Central Ethiopia: 2012.College of Agriculture and Veterinary Medicine, Jimma University, P.O. Box: 307.

CSA:Federal Democratic Republic of Ethiopia Agricultural sample survey. Livestock and livestock characteristics bulletin: 2005 Volume II. Addis Ababa, Ethiopia.

CSA : Federal Democratic Republic of Ethiopia Agricultural sample survey. Livestock and livestock characteristics (private peasant holdings); 2015 Volume II. Addis Ababa, Ethiopia.

Desta Kelay : Analyses of Dairy Cattle Breeding Practices in Selected Areas of Ethiopia; 2002. PhD thesis. Humboldt-Universitytzu Berlin, Germany.

DOA: Annual progress report; 2000a. Bahir Dar ZuriaWoreda Department of Agriculture, Bahir Dar,

DOA: Annual progress report; 2000b. MechaWoreda Department of Agriculture, Mecha, Ethiopia.

DOA: Baseline line report. Mecha, Bahir Dar Zuria and Yilmana Densa district of Development of Agricultural office, Ethiopia; 2015.

Enyew Nigusie, Brannang E, Kebede Bayle and Rottmann O J: Reproductive performance of dairy cattle at Asella livestock farm, Arsi, Ethiopia. I: Indigenous cows versus their F1 crosses; 1998. J. Anim. Breed. Genet. 115: 267-280.

FAO: Food and Agriculture Organization 2000 year book; 2000. Rome, Italy Intergovernmental Authority on Development: About us: History IGAD; 2010 Retrieved 29 December 2014. http://faostat.fao.org/. Jun 12- August 25, 2000.

Haile-Mariam Mekonnen, Banjaw K, Gebre-Meskel Tesfaye, KetemaHizkias: Productivity of Boran cattle and their Friesian crosses at Abernossa Ranch, Rift Valley of Ethiopia. I. Reproductive performance and pre-weaning mortality; 1993. Tropical Animal Health and Production. 25 (4), pp: 239-48.

Halderman MN: The political economy of pro-poor livestock policy making in Ethiopia; 2004. FAO working paper No.19. Rome: FAO

Kedija Husien: Characterization of milk production system and opportunity for market orientation, A Case Study of Mieso District, Oromia Region, Ethiopia; 2007. MSc. thesis.Haramaya University, Ethiopia.

KefyalewAlemayehu and ChenchaChebo: Trends of cattle genetic improvement programs and Challenges and opportunities in Ethiopia; 2012.

Keralem Ejig: Honeybee production systems, opportunities and challenges in enebseEsarmidir district (Amhara region) and Amaro Special district (Southern Nations, Nationalities and Peoples Region), Ethiopia: 2005. M.Sc. thesis, Alemaya University, Ethiopia.

Mohamed Ahmed, Simeon Ehui And Yemesrach Assefa: Dairy development in Ethiopia; 2004. EPTD discussion paper no. 123. International food policy research institute. Washington, DC 2006 U.S.A. October 2004.

Mulugeta Ayalew and Belayeneh Asefa: Reproductive and lactation performances of dairy cows in Chacha Town and nearby selected kebeles, North Shoa Zone, Amhara Region, Ethiopia 2013; World Journal of Agricultural Sciences, 1(1), pp. 008-017. Available online at http://wsrjournals.org/journal/wjas ISSN 2329-9312 ?2013 World Science Research Journals.

SAS: SAS Users' guide, Statistical Analysis System (SAS) Institute, Inc, Cary, NC; 2007 (9.2 version).

Solomon Bogale: Assessment of livestock production systems and feed resources base in Sinana and Dinsho districts of Bale highlands, Southeast Oromia; 2004. MSc. thesis. Alemaya University, Dire Dawa, Ethiopia. 141 pp.

Stall S and Shapiro B: The economic impact of public policy in smallholder peri-urban dairy producers in AddisAbaba; 1996. ESAP publication no. 2.

Tesfaye Mengistie: Characterization of cattle milk and meat production, processing and marketing system in Metema district, Ethiopia, 2007. MSc. thesis, Hawassa University, Hawassa, Ethiopia.

Tsehay Redda: Small-scale milk marketing and processing in Ethiopia. 352-367 pp. In: Smallholder dairy production and market opportunity and constraints; 2002. Proceeding of a south-south workshop held at NDDB, Anand, India, 13-16 march 2001. NDDB (National Dairy Development Board), Anand, India, and ILRI (International Livestock Research Institute), Nairobi, Kenya.

Yitaye Alemayehu, Wurziger M, AzageTegegne and Zollitsch W: Urban and peri-urban farming systems and utilization of the natural resources in the north Ethiopian highlands; 2007. In Proceedings of Conference on International Agricultural Research for Development, 9-11 October 2007, University of Kassel-Witzenhausen and University of Göttingen, Germany.

Yoseph Shiferaw, Tenhagn B, MergaBekana and Tesfu Kassa: Reproductive performance of crossbred dairy cows in different production systems in the central Highlands of Ethiopia;2003. Tropical Animal Health and Production, 35 (6):551-61.

ZDA (Zonal Development Agencey): Annual progress report.West Gojjam Zone Department of Agriculture, Ethiopia; 2005.

Zewdu Wuletaw: Indigenous Cattle Genetic Resource, Their Husbandry Practices and Breeding Objectives in North-western Ethiopia; 2004. MSc Thesis. Alemaya University, Ethiopia.