SJIF IMPACT FACTOR (2015): 5.42 CRDEEP Journals
International Journal of Basic and Applied Sciences Abera & Yayeh Vol. 6 No. 1 ISSN: 2277-1921
International Journal of Basic and Applied Sciences. Vol. 6 No. 1. 2017. Pp. 15-21

Full Length Research Paper

Livestock Genetic Diversity, Rate of inbreeding and Feed Resource: An Assessment in Chira Wenz Micro Watershed East Gojjam Zone North West Ethiopia

Michael Abera*and Zemenu Yayeh
Department of Animal Sciences, College of Agriculture and Natural Resource, Debre Markos University, P.O. Box 269, Debre Markos, Ethiopia.

Article history
Received: 13-12-2016
Revised: 23-12-2016
Accepted: 06-01-2017

Corresponding Author
Michael Abera
Department of Animal Sciences, Debre Markos University, P.O. Box 269, Debre Markos, Ethiopia.

Abstract
This study was aimed to generate basic information on the livestock genetic diversity, rate of inbreeding and feed resource in Chira wenz micro watershed Systematic random sampling was employed based on the potential of livestock genetic diversity. Accordingly, about 90 household heads were selected for household survey. Data were analyzed using statistical analysis system (SAS, release 9.2, 2008) and described using SAS software. The dominant livestock species in Chira Wenz micro watershed is sheep (4.7±2.9) followed by cattle production (4.3±2.6) and chicken production (3.6±3.0) which implies that sheep production is their livelihood as income generation and household heads meat consumption. High rate of inbreeding was observed 0.41, 4.17 and 3.33 for Cattle, sheep and goat, respectively. Even though the area is dominant in sheep production, there was no cross breeding program to improve their local breeds. Among the interviewed household heads majority (83.33%) of them didn't produce their own forage as livestock feed resource. This might be due to lack of awareness on the importance of producing forage, scarcity of land and poor extension system. In Chira Wenz micro watershed from the total land size about (0.04±0.1) was used for direct grazing land while (0.02±0.04) was used for hay production which might be due to the land is majorly allocated for crop production since the area is dominant in crop production.

Keywords: *livestock, genetic diversity, rate of inbreeding, feed resource, Chira Wenz micro watershed*

Introduction

Agriculture in Ethiopia is the foundation of the country economy, accounting for 43 percent of GDP and 86 percent of export earnings, and the sector employs about 85% of the population (CSA, 2009). Livestock production is an integral part of the country agriculture production system. A recent study by CSA (2016) indicated that the livestock sector contributes 26 % of the agricultural GDP and 12 % to the national GDP. The livestock population of Ethiopia is currently estimated to be 57.8 million cattle, 28.89 million sheep 29.7 million goats, 7.8 million donkeys, 2.8 million horses, 0.4 million mule and 1.2 million camels excluding nomadic areas and is diverse genetically. Goats greater than two years accounts about 51.32%; among this 44.73%, 3.48% and 2.64% are used for breeding, milk production and meat production, respectively (CSA, 2016).

Ethiopia is believed to have the largest livestock population in Africa. This livestock sector has been contributing considerable portion to the economy of the country, and still promising to rally round the economic development of the country. It is eminent that livestock products and by-products in the form of meat, milk, honey, eggs, cheese, and butter supply etc. provide the needed animal protein that contributes to the improvement of the nutritional status of the people (CSA, 2016). Livestock also plays an important role in providing export commodities, such as live animals, hides, and skins to earn foreign exchanges to the country. On the other hand, draught animals provide power for the cultivation of the smallholdings and for crop threshing virtually all over the country and are also essential modes of transport to take holders and their families long-distances, to convey their agricultural products to the market places and bring back their domestic necessities. Livestock as well confer a certain degree of security in times of crop failure, as they are a *"near-cash"* capital stock. Furthermore, livestock provides farmyard manure that is commonly applied to improve soil fertility and also used as a source of energy (CSA, 2016).

Due to the very important role that the livestock sector plays in the economy of the country, formulation of development plan regarding the sector is indispensable. It is therefore imperative that livestock development plans should be done. One of the development plans is improving the genetic makeup of local animals through cross breeding with improved breeds, improving the husbandry practices such as feeding, Health care, housing and disease management. The essential procedure for genetic improvement

of livestock involves identification of the breeds or strains of livestock and the type of environment in which they are kept, description of the breed characteristics, their adaptation as well as production potentials in those environments (Workneh Ayalew and J. Rowlands, 2004). Moreover, in current scenarios for successful improvement programs, compatibility of the genotypes with the farmers' breeding objectives and the production systems is crucial (Markos, 2006). Chira wenz micro watershed where this study has be done is one of the area where dominant livestock genetic diversity is available in East Gojjam Zone but there is no work done to assess the existing genetic diversity, rate of inbreeding and feed resource. Therefore assessing the current livestock genetic diversity, rate of inbreeding and feed resource and using it as a base line data is paramount important for livestock producers, researchers as well as policy makers. Thus, the objective of this study was to assess the livestock genetic diversity, level of inbreeding and feed resource in chira wenz micro watershed of Sinan district East Gojjam Zone.

Materials and Methods

Descriptions the Study Area

The study was conducted in Chira wenz micro watershed of Sinan disrtrict, East Gojjam Zone. It is found 27 km from Debre Markos, the capital of east Gojam Zone. The altitude of the district ranges from 2949 to 2975 masl and it is located between 10^{o} 32' 28.2'' N and 37 ^{o} 46'14.7'' E. The mean annual rain fall distribution of the area is 1342 mm and the mean annual temperature of the district ranges from 7.2 °C -27.7 °C (RDOEGZ, 2016).

Sampling technique and sample size

Systematic random sampling was employed based on the potential of livestock genetic diversity. Accordingly, about 90 household heads were selected for household survey.

Methods of data collection

Questionnaires was designed, translated to local language, pretested and administered to address livestock genetic resource available, husbandry practices such as forage development practices, Type of livestock reared by the community, breeds available and breeding system. In addition, flock/herd composition, number of different classes of livestock resources, feed source and feeding system were collected.

Methods of data analysis

Data collected through questionnaire survey were entered into Microsoft excel and Analyzed by Statistical Analysis System (SAS, release 9.2, 2008). Survey data were summarized using descriptive statistics like mean, range, standard deviation and percentage values of various parameters.

The rate of inbreeding from effective population size for a randomly mated population was calculated as $Ne = (4N_mXN_f)/ N_m+N_f)$; where Ne = effective population size, N_m = number of breeding males and N_f = number of breeding females. The rate of inbreeding (ΔF) was calculated from Ne as $\Delta F = ½XNe$ (Falconer and Mackay, 1996).

Result and Discussion

Livestock genetic resource composition

The dominant livestock species in Chira wenz micro watershed is sheep (4.7±2.9) followed by cattle production (4.3±2.6) and chicken production (3.6±3.0) as indicated in table 1 which implies that sheep production is their livelihood as income generation and household meat consumption. Similar result was reported in Selale area (Bosenu, 2012). Even though the area is dominant in sheep production, there was no cross breeding program to improve their local breeds. As described by the respondents there was no exotic sheep breed reported.

Table 1. The livestock composition of the respondents in chira wenz micro watershed

Livestock composition	Mean±SD	Minimum	Maximum
Cattle population	4.3±2.6	0	10
Oxen	1.5±0.9	0	4
> 3 Years Breeding Cow	1.3±0.8	0	3
> 3 Years Breeding Bull	0.4±0.6	0	2
<2 Years Heifer	0.4±0.7	0	3
<1 Year Calf	0.7±0.8	0	3
Exotic cattle Breed	0.06±0.2	0	1
Sheep Population	4.7±2.9	0	11
>1 Year Breeding ewe	3.0±1.9	0	8
<1 Year Ram Lamb	0.1±0.3	0	1

< 1Year Ewe lamb	0.3±0.7	0	3
< 1 Year Lamb	1.3±0.9	0	3
> 1 Year Breeding ram	0.03±0.1	0	1
Exotic sheep breed	0	0	0
Goat population	0.3±1.1	0	6
>1 Year Breeding Doe	0.1±0.6	0	3
>1 Year breeding Buck	0.06±0.3	0	2
< 1 Year Young female kid	0.03±0.2	0	1
< 6 month kid	0.03±0.2	0	1
Exotic goat breed	0	0	0

Effective Population Size and Level of Inbreeding in livestock population

According to the respondents there was high rate of inbreeding (ΔF) in sheep (4.17) than cattle (0.41) and Goat (3.33) as illustrated in table 2. The current result was higher than the maximum acceptable level (0.063) reported so far (Armstrong, 2006). The rate of inbreeding in sheep obtained in this study was by far greater than Wosenes'(2012) 0.36, 0.40 and 0.13 for Metta, Gorogutu and Deder respectively, in East Haragehe sheep population. The accumulation of inbreeding and the loss of genetic diversity is a potential problem in the modern dairy cattle breeds in Canadian Holstein and Jersey cattle (Stachowicz et al., 2011).

Table 2. Rate of inbreeding in the livestock composition in the study site

Livestock composition	N_F	N_M	N_e	ΔF
Cattle	1.3	0.4	1.22	0.41
Sheep	3.0	0.03	0.12	4.17
Goat	0.1	0.06	0.15	3.33

NB: $Ne = (4N_m X N_f) / (N_m + N_f)$; Where Ne = effective population size, N_m = number of breeding males and N_f = number of breeding females .The rate of inbreeding coefficient (ΔF) was calculated from Ne as ΔF = 1/2Ne (Falconer and Mackay, 1996)

Bee keeping practice and bee feed source

Even though bee keeping activity in East Gojjam zone is major activity but about 80 % of the respondents were didn't involve in bee keeping activity in the study area which might be due to lack of bee forage (83.33%) near to their home and lack of knowledge in bee keeping management as described in table 3. The low yield of honey and other beekeeping products resulted from insufficient management practices and lack of adequate beekeeping training (Bhusal and Thapa, 2005; Masuku, 2013).

Table 3. Bee keeping practice and bee feed source

Description	Frequency	Percentage
Involvement in bee keeping		
• **Involved**	18	20
• **Not involved**	72	80
Type of bee hive used		
• **Traditional**	9	50
• **Modern and traditional**	9	50
Availability of bee forage		
• **Available**	3	16.67
• **Not available**	15	83.33
Knowledge about scarcity of bee forage		
• **Yes**	18	100
Experience in dearth period feed supplementation		
• **Yes**	18	100

The average number of bee hive per household head in the study site was 3.71 while the amount of honey produced from traditional and modern bee hive were 17.88kg/hive and 25 kg/hive, respectively.

Animal health and breeding system

According to the respondents all (100%) of the farmers had access to vaccination service to their livestock in Chira Wenz micro watershed as illustrated in table 4. In the study area it was difficult to found the exotic cattle breeds except 3.33%. In addition, all the

respondents utilized natural mating (100%) which implies there was no utilization of artificial insemination. Artificial Insemination (AI) practicing as cattle genetic improvement program accounted about six decades in Ethiopia but, coming with little success. The most important constraints associated with were loss of structural linkage between AI Center and service giving units, absence of collaboration and regular communication between National Artificial Insemination Center (NAIC) and stakeholders, lack of breeding policy and herd recording system, inadequate resource in terms of inputs and facilities, and absence of incentives and rewards to motivate AI technicians (Desalegn 2008).

Table 4. Animal Health and breeding system

Description	Frequency	Percentage
Vaccination service		
• **Yes**	90	100
On time Vaccination service		
• **Yes**	90	100
Availability of exotic cattle breeds		
• **Available**	3	3.33
• **Not Available**	87	96.67
Mating system		
• **Natural**	90	100
• **Artificial**	0	0

Development of forage and Feed Resource Utilization in the study area

An adequate supply of livestock feed is crucial to the livelihoods of millions of people across the developing world, and not just for smallholders, but also for pastoralists and the large number of landless who depend mainly on common land for grazing (Sanford and Ashly 2008)

Among the interviewed household heads majority (83.33%) of them didn't produce their own forage as livestock feed resource as illustrated in table 5. This might be due to lack of awareness on the importance of producing forage, scarcity of land and poor extension system. In Chira wenz micro watershed from the total land size about (0.04±0.1) was used for direct grazing land while (0.02±0.04) was used for hay production. Nevertheless, under Ethiopian situations, livestock obtains most of their feed from grazing of natural pasture and crop residues which are generally poor in nutritive value. Currently, most of Ethiopian natural pastures are put under intensified crop production as a result of ever increasing human population pressure. The remaining pieces of land are overgrazed severely and cannot meet the nutritional requirement of livestock resulting in reduced growth rate, low production, poor fertility and high mortality particularly in dry season during which animals depend on matured herbage, aftermath and crop residues, which are low in protein, digestible energy and minerals (Temesgen *et al*., 2007). Likewise, in the western part of Ethiopia, sheep production is mostly influenced by the seasonal scarcity and low quality of feed resources since feed availability and quality primarily depends upon the climatic and seasonal factors (Zewdu, 2008).

Table 5. Forage development practices and feed resource utilization

Description	Frequency	Percentage
Private forage producers		
• **Producers**	15	16.67
• **Non producers**	75	83.33
Private grazing area		
• **Owned**	21	23.33
• **Not owned**	69	76.67
Use of Extra feed resource		
• **Storage and use during feed shortage**	21	23.33
• **For others(house construction)**	69	76.67
Feed shortage		
• **Happened**	87	96.67
• **Not happened**	3	3.33

Livestock feeding system and available feed resources

The major feeding system in the Chira wenz micro watershed was Semi stall feeding (83.33%) followed by free grazing (16.67%) as described in table 6. About 73.33% of the respondents didn't produce hay for their livestock feed while small number 26.67% produce hay. As indicated in the table 6 available of feed resource, browsing forage and production of hay as livestock feed resource were major livestock constraints in the study area. In the highland parts of Ethiopia, mixed crop livestock farming is a common practice where the major available feed resources are natural pasture, crop residue, aftermath and some fodder trees (Abera et al., 2007). Though, the reliability of grass as a source of roughage is restricted to wet season (Zinash *et al*.,1995), grazing lands play a significant role in livestock feeding and support a diverse range of grasses, legumes, shrubs and trees. In tropical area of Africa, feed resources are mainly native pastures, which is mostly deficient in protein concentration. Their availability fluctuates with seasons, seriously challenging the reproductive performance of animals (Mekasha, 2007). In Ethiopian situations as well, livestock obtains most of their feed from grazing of natural pasture which is generally poor in nutritive value. According to FAO (2001), the proportion of legumes in natural pasture is very small, whereas grasses are the most abundant accounting for 52 % of the total grazing in the central highlands of Ethiopia. According to the respondents about 20% of them obtain the forage seed from the agriculture office while 80% of them didn't produce forage for their livestock as feed resources. Hay is forage harvested during the growing period and preserved by drying. The aim of hay making is to reduce the moisture contents of green crops to 15-20% to inhibit the action of plant and microbial enzymes (Banerjee, 1998). Despite its several advantages, hay has some shortcomings. It varies in nutrient content and palatability more than any other feed, late hay harvest affects its quality (Ensiminger *et al.*, 1990).

Table 6. Livestock feeding system and available feed resources

Description	Frequency	Percentage
Feeding system		
• **Free grazing**	15	16.67
• **Semi stall feeding**	75	83.33
Hay production		
• **Produce**	24	26.67
• **Not produce**	66	73.33
Browsing forage		
• **available**	9	10
• **not available**	81	90

Availability of private grazing area

The average land allocated for private grazing area in the study site was 0.04±0.1 hectare while the average land utilized for hay production was 0.02±0.04 hectare. According to Demissie et al (2014) Availability of different feed types varies based on the season of the year. From the feed type that are available in all season, natural pasture accounts the largest proportion (48.7 %) followed by local brewery by product (atella) (44%). The other feed types such as grazing after math, private gazing land, concentrates, weed and crop tillers are season dependent feed type. For majority of respondents weeds (46%) are abundant feed resources for goats from September to November and grazing aftermath (62.7%), local brewery byproducts atella (40.7%), food leftover (43.3%) and crop residues (50%) are more abundant from December to February. Most of the feed sources are not available for most respondents from March to May. In this season, most of the respondents face shortage of feed for their goats in Enebse Sar Midir district.

Table 7. Animal feeds, feed resource and utilization of excess feed resources

Description	Frequency	Percentage
Utilization of excess feed source		
• **Conservation and utilization**	21	23.33
• **Selling**	0	0
• **Compost preparation**	69	76.67
Scarcity of feed shortage		
• **Yes**	87	96.67
• **No**	3	3.33
Hay preparation		
• **Yes**	24	26.67
• **No**	66	73.33
Utilization of browsing forage		
• **Yes**	9	10

• **No**	81	90
Source of forage seed/seedling		
• **Agricultural office**	18	20
• **Not available**	72	80
Availability of multipurpose indigenous trees		
• **Yes**	90	100
Development and utilization of multipurpose indigenous trees		
• **Yes**	87	96.67
• **No**	3	3.33

Animal feeds, feed source and Utilization of excess feed source

According to the respondents 76.67 % of household heads use excess feed sources for compost preparation while 23.33 % conserve and utilize when the scarcity of feed happened as described in table 7. In the study area 96.67 % of the respondents had experience in the scarcity of feed shortage. Shortages of feeds and forages are especially acute during the dry season. Much research attention has been devoted to feed problems and solutions and optimal feeding practices (Lukuyu et al 2009; Lenne and Wood 2004) but there has been relatively little systematic consideration of the constraints smallholders face, the feeding strategies and coping mechanisms they use, and the ways scientific knowledge and indigenous technical knowledge can be combined to help the farmers improve livestock productivity and livelihoods.

Conclusion and Recommendations

The dominant livestock species in Chira wenz micro watershed is sheep (4.7±2.9) followed by cattle production (4.3±2.6) and chicken production (3.6±3.0) which implies that sheep production is their livelihood as income generation and household meat consumption. Therefore emphasis should be given to improve the genetic back ground of their local sheep breed through selection and cross breeding program. In almost all of their livestock species (sheep, poultry, cattle, goat etc.) exotic breeds weren't reported, therefore, intervention should be made to change this condition. Feed shortage throughout the year was common problem in the study area. Therefore, forage development program as to be undertaken to alleviate feed shortage.

Among the interviewed household heads majority (83.33%) of them didn't produce their own forage as livestock feed resource. Therefore, emphasis has to be given to the farmers to adopt the forage development technology.

Even though bee keeping activity in Chira wenz micro watershed is major activity but about 80 % of the respondents were didn't involve in bee keeping activity which is due to lack of bee forage (83.33 %) near to their home and lack of awareness on bee keeping activity. Therefore, motivating of planting bee forage development around their home and providing training service for the community is very important to fully involve in bee keeping activity.

Acknowledgements

We would like to express our sincere appreciation to districts Administration office and Livestock Development, Health and Marketing Agency and all staff members for providing the necessary baseline data for this study. We would like to appreciate and acknowledge the farmers who participated on the interview. We would also like to acknowledge the Development Agents in the study Peasant Associations for their critical support in data collection.

References

Abera Seyoum, Yoseph Mekasha and Azage Tegegne, 2007. Effect of supplementation with noug seed cake and wheat bran mix on body weight gain, testicular growth and seminal traits of horro rams under grazing management. M.SC. thesis submitted to the school of graduate studies school of Animal and Rang Sciences Haramaya University

Armstrong, J.B., 2006. Inbreeding: Why we will not do it? Accessed on June 13, 2010 from http://www.parispoodles.com/Inbreeding.html

Banerjee, G.C., 1998. A textbook of animal husbandry 8th edition, Oxford and IBH publishing CO. PVT.LTD.New Delhi Calcutta, India.1079p.

Bhusal, S.J., Thapa, R.B. (2005). Comparative study on the adoption of improved beekeeping technology for poverty alleviation. *J. Inst. Agric. Anim. Sci.* 26:117-125.

Bosenu Abera, 2012. On-Farm Phenotypic Characterization of Indigenous Sheep and their Husbandry Practices in Selale area, Oromia Regional State, Ethiopia. An M.Sc. Thesis presented to the School of Graduate Studies of Haramaya University.

CSA (Central Statistical Authority), 2009. Agriculture Sample survey Statistical bulletin. Addis Ababa, Ethiopia.

CSA, 2016. Federal Democratic Republic of Ethiopia, Agricultural sample survey. Report on livestock and livestock characteristics. Statistical Bulletin No.573, Vol.2, Addis Ababa Ethiopia, pp: 194.

Demissie Chanie, Zeleke Mekuriaw and Mengistie Taye, 2014. Husbandry practices of Western highland goats in Enebse Sar Midir district, East Gojjam Zone, Ethiopia. http://www.lrrd.org/lrrd26/7/cont2607.htm
Desalegn Gebremedhin, 2008 Assessment of problems/constraints associated with artificial insemination service in Ethiopia.MSc thesis, Addis Ababa University, Ethiopia.
Ensninger, M. E., J.E., Oldfield, and W.W., Heinemann, 1990. Feed and nutrition, 2nd edition. The Ensiminger publishing company. 1544p.
Falconer, D.S. and T.F.C. Mackay, 1996. Introduction to Quantitative Genetics. 4th ed. Harlow, England, Longman. 438P.
FAO, 2001. Grassland Resource Assessment for Pastoral Systems, FAO plant production and protection paper No. 162. 150p.
Lenne J M and Wood D, 2004. Is there logic for fodder legumes in Africa? *Food policy* 29: 565-585
Lukuyu B A, Kitalyi A, Franzel S, Duncan A and Baltenweck I, 2009 Constraints and options to enhancing production of high quality feeds in dairy production in Kenya, Uganda and Rwanda. ICRAF Working Paper no. 95. Nairobi, Kenya: World Agroforestry Centre.
Markos Tibbo, 2006. Productivity and health of indigenous sheep breeds and crossbreds in the central Ethiopian highlands. Doctoral Thesis, Swedish University of Agricultural Sciences. Uppsala, Sweden.
Masuku, M.B. (2013). Socioeconomic analysis of beekeeping in Swaziland: A case study of the Manzini Region, Swaziland. *J. Dev. Agri. Econ*. 5(6): 236-241.
Mekasha, Y., 2007. Reproductive traits in Ethiopian male goats, with special reference to breed and nutrition, PhD dessertation. Department of Clinical Sciences, Faculty of Veterinary, Swedish University of Agricultural Science (SLU), Uppsala, Sweden. University. 56p.
RDOEGZ (Rural development Office of East Gojam Zone), 2016. Survey on livestock population size in East Gojam Zone.
Sanford J and Ashly S., 2008. IGAD Livestock Policy Initiative: Livestock Livelihoods and Institutions in the IGAD region. IGAD LPI Working paper No. 10-08
SAS (Statistical Analysis System), 2008. SAS for windows, Release 9.2. SAS Institute, Inc., Cary, NC, USA.
Stachowicz K., Sargolzali M, Miqlior F and Schenkel FS, 2011. Rates of inbreeding and genetic diversity in Canadian Holstein and Jersey cattle. J Dairy Sci. 2011 Oct; 94(10):5160-75. doi: 10.3168/jds.2010-3308.
Temesgen Jembere, Gemeda Duguma, Ketama Demisse and Diriba Geleti, 2007. Evaluation of cow pea hay (*V. unguaculata*) vs. nougcake supplementation of Cynodon dectylon on growth performance and carcass characteristics of Horro rams. pp. 23-29. Proceeding of the 11th Annual Conference of the Ethiopian Society of Animal Production (ESAP) held in Addis Ababa, Ethiopia, October 4-6, 2007.
Workneh Ayalew and J. Rowlands (eds), 2004. Design, execution and analysis of the livestock breed survey in Oromiya Regional State, Ethiopia. OADB (Oromiya Agricultural Development Bureau), Addis Ababa, Ethiopia, ILRI (International Livestock Research Institute), Nairobi, Kenya.
Wossenie Shibabaw, 2012. On farm Phenotypic Characterization of Hararghe Highland Sheep and Their Production Practices in Eastern Hararghe Zone, Ethiopia. An M.Sc. Thesis Presented to School of Graduate Studies of Haramaya University, Ethiopia.
Zewdu, 2008.Characterization of Bonga and horro indigenous sheep breeds of smallholders for designing community based breeding strategies in Ethiopia M.SC.thesis Haramaya University
Zinash, S. Seyoum, B. Luelseged, G. and Tadesse, T. 1995. Effect of harvesting stage on yield and quality of natural pasture in the central high lands of Ethiopia. pp. 316-322.In: proceedings of the 3rd annual conference of the Ethiopian society of animal production (ESAP) held in Addis Ababa, Ethiopia, 27-29 April 1995.