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Productive and Reproductive Performances of Ruminant Livestock in Jimma Zone, Southwest Ethiopia

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Abstract: The cross-sectional field survey was conducted in three selected districts of Jimma zone, Southwest Ethiopia with the aim of determining the productive and reproductive performances of ruminant livestock under prevailing management condition. The selection of the study districts based on the livestock production potential and accessibility. Accordingly 122, 188 and 104 households (HHs), from Kersa, Omo Nada and Tero Afeta districts respectively, participated in the study. The livestock production system in the study districts was mixed crop-livestock production system where livestock production is totally based on the indigenous livestock breeds with no improved management and low output. The average number of ruminant livestock holding in Tropical Livestock Units (TLU) was 4.92±0.25/HH, which varied significantly (P<0.01) between the study districts. Overall, the average herd structure comprised of cattle (4.74±0.24 TLU/HH), sheep (0.10±0.01 TLU/HH) and goats (0.06±0.01 TLU/HH). Natural m ating was the only mean of breeding system (P>0.05). The study on productive and reproductive performance of livestock revealed that average Age at First Calving (AFC) of cows was 4.50±0.08 years, Calving Interval (CI) of 25.56±0.43 months, Lactation Milk Yield (LMY) of 203.29±4.75 litters, Lactation Length (LL) of 7.84±0.30 months and 4.56±0.10, 5.61±0.14 years for draught age and life span of oxen, respectively. Average age at first kidding and kidding interval of goats were 2.05±0.04 years and 15.45±0.30 months, respectively (P<0.05). The average age at first lambing and lambing intervals of goats were 2.46±0.24 years and 15.91±0.38 months, respectively. According to 88.52% of respondents, feed scarcity in dry season is the main constraint for poosr body condition of animals in the study area. In general the current livestock output in the study area is not promising to supply the required nutrient for the geometrically increasing human population. Hence, urgent response is needed from responsible parties to keep the livestock production in the study area in pace with the other development activities.

Key words: Age At First Calving · Kidding · Lambing · Lactation Milk Yield

INTRODUCTION

Ethiopia is endowed with huge livestock resource, natural resource and diverse agro-ecological zones suitable for livestock production. These potentials make the country prominent repository for animal genetic diversity. According to CSA [1] Ethiopia has 53.93, 25.5, 24.06, 1.91, 6.75, 0.35, 0.92 and above 50.38 million heads of cattle, sheep, goats, horse, donkey, mule, camels and chickens, respectively. Livestock contribute 15 to17 percent of GDP and 35 to 49 percent of agricultural GDP and 37 to 87 percent of the household income [2]. Accordingly, livestock production plays an important role to the economy of smallholder farmers and the national economy of Ethiopia. Both farming and pastoral households are largely dependent on livestock for their livelihood systems. They provide inputs (draught power, transport, manure) to the other part of the farming system such as crop production and generate consumable or saleable outputs (milk, manure, meat, hides and skin, wool, hair and eggs) [3- 5].

The reproductive performance of the breeding female is probably the most important factor that is a prerequisite for sustainable dairy production system and influencing the productivity [6]. Reproductive performance traits like number of services per-conception (NSC), calving interval (CI) and days open (DO) are important criteria for profitable dairy farming [7]. However, information is

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limited about the productive performance of dairy cows in smallholder urban and peri-urban dairy farms in the tropics, particularly in Ethiopia [8]. Accordingly, assessing the productive (milk and meat yield) and reproductive performances of ruminant livestock under prevailing management condition is a prerequisite to develop improvement strategy. However there is a scanty of information regarding this issue in a mixed-crop and livestock production of Jimma zone, Southwest Ethiopia. Hence this study was initiated to assess the productive and reproductive performances of ruminant livestock under the prevailing management condition in three selected district of Jimma zone, Southwest Ethiopia.

MATERIALS AND METHODS

Description of the Study Area: The study was conducted at three districts of Jimma zone of Oromia region, Southwest Ethiopia. Jimma Zone, lies between 360 10′ E longitudes and 70 40′ N latitude at an elevation ranging from 880 meters to 3360 meters above sea level (9). The zone has 19506.24 km^2 of land of which 15% is high land, 67% medium land and 18% low land [9, 10].

It is mostly known for its vegetation coverage, suitability for coffee, crop, livestock and bee production. The dominant crops being Maize, Teff, Sorghum, Barley, Wheat, Horse bean, field pea, Coffee, *Chat* (*Cath edulus*) fruits and vegetables. According to JZMSR [11], the climate is humid tropical with bimodal heavy annual rain fall, ranging from 1200 to 2800 mm. In normal years, the rainy season extends from February to early October. The thirteen years mean annual minimum and maximum temperature of the area was 11.3°C and 26.2°C, respectively. The soil type of the study area is characterized with black to red soils.

Kersa, Omo Nada and Tero Afeta are the three selected districts from Oromia region, Jimma zone based on their livestock potential and accessibility (Figure 1). Kersa, Omo Nada and Tiro Afeta districts are situated at an altitude ranging from 1740 to 2660, 880 to 3340 and 1640 to 2800 meters above sea level, respectively, with area coverage of 975, 1589.4 and 1001.9 square kilometers, respectively. Human population of Kersa, Omo Nada and Tiro Afeta was estimated to be 131,150, 194,978 and 100,700 people [10] (Table 1).

Sampling Technique: The three districts (Kersa, Omo Nada and Tero Afeta) were purposively selected for the study depending on their livestock potential and accessibility. From each district three peasant associations (PAs) relatively representing Dega (Lowland), Woinadega (Midland) and Kolla (Highland) agro-ecologies were selected and from each PA's livestock farmers were selected using systematic random sampling technique. Households (HHs) that have at least one species of each livestock at the time of interview were included in the study. Accordingly, 122, 188 and 104 HHs from Kersa, Omo Nada and Tero Afeta districts, respectively and a total of 414 HHs from the three districts participated in the study. The selected farmers were interviewed using a structured questionnaire which was pre-tested with 18 farmers in each district.

The total sample size for household interview was determined using probability proportional sample size-sampling technique [12].

$$no = \frac{Z^2 * (P)(q)}{d^2} \rightarrow n_1 = \frac{no}{(1 + no/N)}$$

where;

n_o = Desired sample size according to Cochran's [12] when population greater than 10,000
n_1 = Finite population correction factors (12) population less than10,000
Z = Standard normal deviation (1.96 for 95% confidence level)
P = 0.1 (proportion of population to be included in sample i.e. 10%)
q = is 1-P i.e. (0.9)
N = is total number of population
d = is degree of accuracy desired (0.05)

Discussion with 10 key informants organized from different groups was held in each studied PAs for triangulation purposes and to gain an in-depth insight about the topics covered in the structured questioner for interview and to check whether patterns found in the HHs were valid by focus groups. Finally, systematic random sampling technique was followed to select the respondent HHs.

Data Collection: Pre-tested structured questionnaire format was used for the interview of sampled HHs and data on livestock herd size and composition; production and reproductive performances; seasonal effects on livestock performances in the study area were collected.

Statistical Analysis: Data (both qualitative and quantitative) was cleaned and entered into Microsoft office Excel sheet every day after administering questionnaire to prevent loss of data. All the surveyed

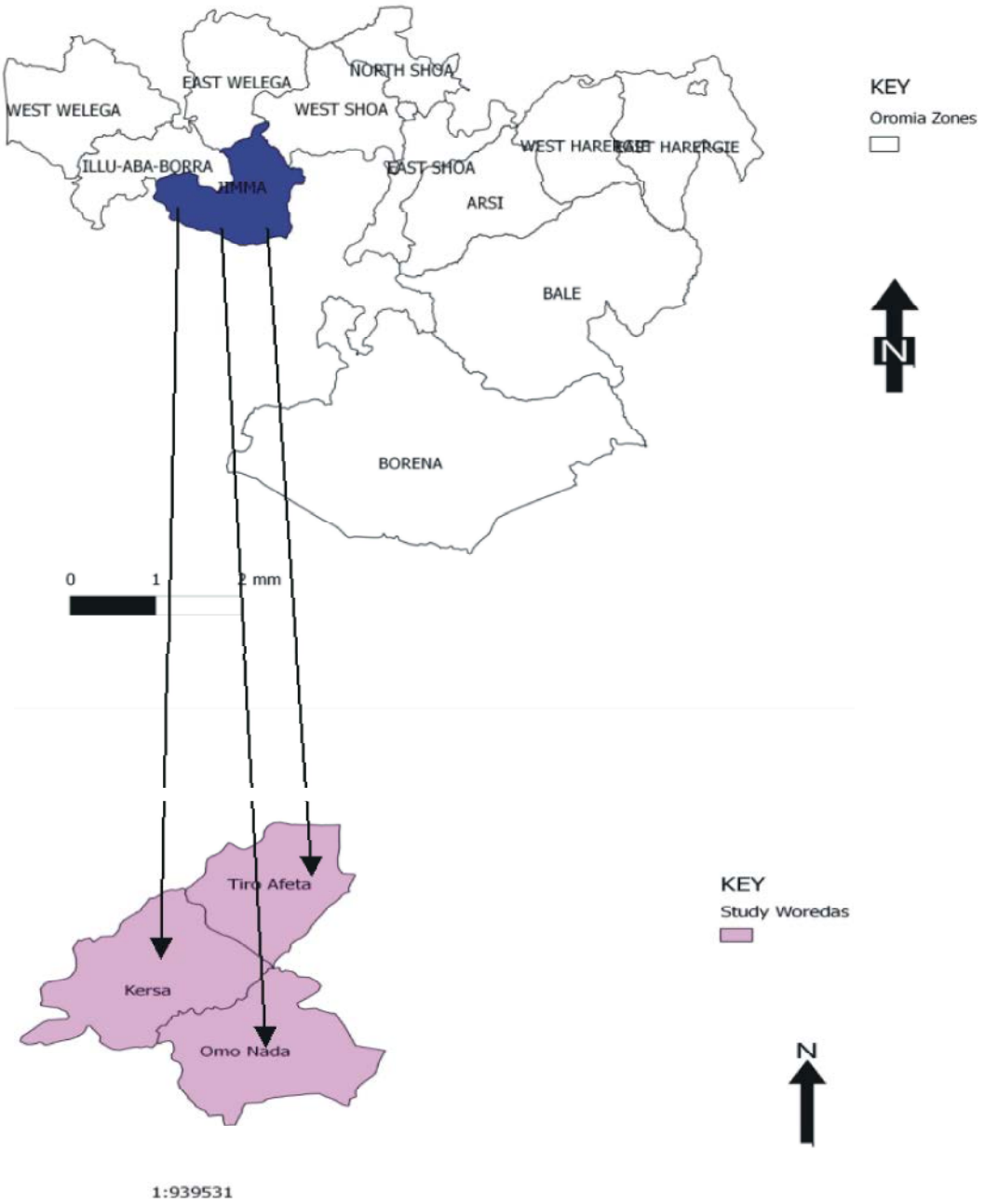

Fig. 1: Map of Oromia region, Jimma zone and study districts

data were analyzed using Minitab Statistical software [13]. Statistical variations for categorical data was tested by means of cross tabs, with significant differences at $P< 0.05$; while the descriptive statistics for the numerical data were subjected to one way analysis of variance (one-way ANOVA) using the general linear model procedure of Minitab. Mean comparisons were done using Duncan's multiple range tests. Levels of significance also considered at $P < 0.05$.

Statistical Model:

$$Y_{ij} = \mu + l_i + \varepsilon_{ij}$$

where y_{ij} = the response of the j^{th} HH in the i^{th} district

μ = overall mean
l_i = effect of i^{th} district (i= 3)
ε_{ij} = random error

Table 1: Description of the study areas

	Study Districts		
Variables	Kersa	Omo Nada	Tero Afeta
Area (km^2)	975	1589.4	1001.9
Topography	platues, hills plains, mountains, valley	dissected plateaus, mountains, plains valleys	dissected platues, mountains, valleys
Altitude	1740 to 2660 m.a.s.l	1000 to 3340 m.a.s.l	1640 to 2800 m.a.s.l
Climate	33% Dega, 67% Woinadega	40% Dega, 45% W/Dega and 15% Kolla	85% Woinadega, 15% Dega
Soil type	Orthic Acrisols and Pellic Vertislos	Pellic Vertisols and Orthic Acrisols	Chromic and Pellic vertisol, Orthic acrisol
Vegetation	high forests, hoodlands, reverie and manmade forests	high forest, woodland, riverine, shrub and manmade forests	high forest, woodland, reverine, bush and shrub and manmade forests
No. pop.	131,150	194,978	100,700
Land use	58.6% arable, 17.3% grazing land, 6.3% forest	56.8% arable,25.2% grazing land, 14% forest	26% arable, 8.3% grazing, 14% forest
Livestock population	184,551 cattle, 12,364 sheep, 7,032 goats, 5690 Equines	1,207,732 cattle 22,336 sheep, 12,924 goats, 15,334 equines	42,563 cattle, 4,377 sheep, 4,120 goats, 2157 Equines
Widely cultivated crops	*teff*, maize, sorghum, wheat barley, horse bean, field pea and haricot bean	maize, *teff*, sorghum, wheat, barley, horse bean, lentils and filed pea	*teff*, maize, sorghum, barley, horse bean, field pea, wheat, *neug* and haricot bean

Source: GOR, [10]

RESULTS AND DISCUSSIONS

Livestock Holding and Composition: There was a difference (p<0.001) in total ruminant livestock composition in TLU between the study districts (Table 2). The overall average holdings of ruminant livestock per HH were 4.91±0.19 TLU. The highest number of livestock in TLU was observed in Tiro Afata 5.73±0.21 followed by Omo Nada 4.62±0.27 TLU and the smallest number was found in Kersa district 4.39±0.08 TLU. In the current study all farmers keep only local breeds of livestock in all the study areas.

The combination of livestock owned in this study was similar to other findings conducted in other rural areas of Ethiopia [14, 15]. Out of the total livestock cattle accounted 4.74±0.24 TLU (96.54%), which could imply that, the importance of cattle in the farming system. The higher proportion of cattle in the study area was probably due to the existing farming system of mixed crop livestock production and according to the respondents in the study areas they used cattle (oxen) primarily for traction purpose in addition to their use as sources of beef and milk for rapidly growing human population.

The result of the current finding is lower than the finding of Yeshitila [16], who reported 9.87 TLU of livestock and 7.38 TLU of cattle in Alaba district of Southern Ethiopia. However, contrary to the present study, there were more proportion of goats (44%), than cattle (42%) in Mieso district of Hararghe zone [17].

There was a significant difference (P<0.05) in total cattle composition between the study districts. Accordingly, the highest number of cattle in TLU was observed in Tero Afeta 5.54±0.23 TLU followed by Omo Nada 4.47±0.25 TLU and the smallest cattle number was observed in Kersa 4.22±0.24 TLU. Generally, in all the study districts the herd structure was female dominated (P>0.05) compared to males. This shows that cow is the most important animal because it is a source of milk and milk products, replacement stock (calves) and cash. Besides, female animals are highly valued and counted as live resources than male animals. Having a large number of cows are considered by the communities as a prestige and used as markers of wealth status in the studied districts. This finding is in agreement with Teshager *et al.* [18], in Ilu Aba Bora zone of Southwest Ethiopia in which the proportion of cow is higher from all cattle herd structures.

There was a significant difference in male cattle holding (P<0.001) and oxen (P<0.05) in the study districts. The number of male cattle and oxen in Tiro Afeta district was (1.20±0.10 TLU) and (0.42±0.05 TLU), respectively were higher than the two study districts.

Sheep was the second populous livestock next to cattle in all the studied districts. The overall average sheep holding in the study areas was 0.10±0.01 TLU (P>0.05). According to the discussion with key informants across the study districts, the primary purpose of keeping sheep was for cash income and as a source of meat. In times of insufficient crop harvest, sheep are the first animals to be sold to purchase food grain and other family needs and the skin of sheep is also an important source of income in all the studied districts.

Like sheep, goats are mainly kept for meat and cash income. During periods of low crop harvest, goats, like sheep, are sold in order to purchase food and serve as one of the means to minimize food insecurity.

Table 2: Mean (±SEM) ruminant livestock holding and herd composition per/HH across the study areas

	Districts, (mean ± SEM)				
Livestock in TLU	Kersa	Omo Nada	Tiro Afeta	Overall	P
Total Livestock	4.39±0.08[b]	4.62±0.27[b]	5.73±0.21[a]	4.91±0.19	**
Cattle	4.22±0.24[b]	4.47±0.25[b]	5.54±0.23[a]	4.74±0.24	*
Oxen	0.28±0.04[b]	0.20±0.03[b]	0.42±0.05[a]	0.3±0.04	*
Male Cattle	0.59±0.08[b]	0.82±0.10[b]	1.20±0.10[a]	0.87±0.09	**
Female Cattle	3.35±0.20	3.45±0.18	3.92±0.18	3.57±0.19	ns
Sheep	0.08±0.01	0.10±0.01	0.13±0.01	0.10±0.01	ns
Goats'	0.09±0.02	0.05±0.01	0.06±0.01	0.06±0.01	ns

SEM, standard error of means; means with different superscripts in a row indicate statistically significant difference between the districts ($p<0.05$); *$p<0.05$; **$p<0.001$; ns, non-significant difference ($p>0.05$); TLU: Tropical Livestock Unit

Table 3: Productive and reproductive performances of ruminant livestock across the study areas

		Districts, (means ± SEM)				
Species	Variable	Kersa	Omo Nada	Tiro Afeta	Overall	P
Cattle	Age at first calving (*years*)	4.59±0.08	4.48±0.08	4.42±0.09	4.50±0.08	ns
	Calving interval (*months*)	25.31±0.43	25.92±0.40	25.45±0.46	25.56±0.43	ns
	Lactation length (*months*)	7.75±0.31	7.76±0.30	8.02±0.30	7.84±0.30	ns
	Lactation milk yield (*liters*)	208.24±5.12	201.13±5.04	200.48±4.93	203.29±4.75	ns
	Days open	247.56±5.84	244.16±6.06	243.68±6.01	245.13±5.97	ns
	Reproductive lifespan of cows (*yea*)	8.30±0.20	8.35±0.20	7.97±0.21	8.21±0.02	ns
	Draught age of male cattle (*years*)	4.75±0.11	4.43±0.10	4.41±0.10	4.56±0.10	ns
	Draught life span of oxen (years)	5.48±0.14	5.65±0.14	5.70±0.15	5.61±0.14	ns
Sheep	Age at first lambing (*years*)	2.44±0.25	2.53±0.25	2.39±0.21	2.46±0.24	ns
	Lambing interval (*months*)	16.01±0.34	15.99±0.44	15.74±0.35	15.91±0.38	ns
Goats	Age at first kidding (*years*)	2.06±0.04[ab]	2.12±0.04[a]	1.97±0.05[b]	2.05±0.04	*
	Kidding interval (m*onths*)	15.89±0.29[a]	15.63±0.33[ab]	14.83±0.27[b]	15.45±0.30	*

Different superscripts in a row indicate statistically significant difference between the districts ($p<0.05$); ns, non-significant difference ($p>0.05$); *$p<0.05$

Productive and Reproductive Performances of Ruminant Livestock

Age at First Calving (AFC) and Calving Interval (CI) of Cattle: In the current study, the overall mean AFC and CI in the study districts were 4.50±0.08 years and 25.56±0.43 months, respectively (Table 3). The average CI obtained in the current study falls within the range of calving interval for Ethiopian zebu cattle of 12.2 to 26.6 months reported by (7). However, the overall mean AFC obtained in this study was below the range reported by (19) of 35-53 months. The average AFC and CI in the current study agrees with the finding of Yisehak *et al*. [20], in Jimma zone of Southwest Ethiopia. Similarly Tesfaye [21], has also reported longer age at first calving of 4.54±0.05 years in Metema district of Amhara region. The mean AFC and CI reported in the current study are higher than the finding of Belay *et al*. [22], who has reported the mean age at first calving of 50.59±6.94 months and calving interval of 22.19±7.73 months, in Dandi district of Oromia region. Also the current result is higher than the finding of Kedija [17], who has reported an average AFC of 52.49±0.91 months and average CI of 16.01±0.49 in Mieso district, Oromia region. The long calving interval in the current study might be an indication of the poor nutritional and management status of cattle under smallholder farmers. This fact is in line with the report of Mukasa- Mugerwa [7], who indicated that heritability of age at first calving is generally low, indicating that this trait is highly influenced by environmental factors, feed and health. In contrary to the present study, the longer mean AFC of 60 months (5 years) for Horro cattle on farm level was reported [23].

Lactation Milk Yield and Lactation Length: In this study, the average milk yield per cow per lactation and lactation length were 203.29±4.75 liters and 7.84±0.30 months respectively (Table 3). The mean lactation length in this study is in agreement with Teklay [24], who reported lactation lengths of 7.49 months for indigenous cows. The finding of this study is lower in average milk yield per cow per lactation and higher in mean lactation length reported by Kedija [17], in Mieso district of Oromia region which was 271.4 liters per cow per lactation and 7.29±0.17

months respectively. Similarly Yisehak *et al*. [20], has also reported higher average milk yield per cow per lactation and lower lactation length in Jimma zone of Southwest Ethiopia. The mean lactation length in this study is lower than that of Belay *et al*. [22] and Ulfina *et al.* [25], which was 8.96±4.63 and 9.3±0.9 months in Dandi district and Jimma town respectively. In the current study the average milk yield per cow per day is around 0.86 litters when adjusted to lactation length of 235 days and this is below the national average value of 1.3 liter/cow/day [26]. The low lactation milk yield in the current study may be attributed to shortage of livestock feeds both in quantity and quality, especially during dry season which is in agreement with the finding of Ahmed *et al.* [27], in the central high lands of Ethiopia.

Reproductive Lifespan of Cattle: The overall mean reproductive lifespan of cow in the current study depicts 8.21±0.02 year (Table 3). The reproductive life span of cow in this study is shorter than Horro a cattle 10.1±0.01 year which was reported by (28). According to Yisehak *et al.* [20], the reproductive life span of indigenous cows in Jimma zone was 7.69±0.14 years.

In the current study the overall mean draught age of male cattle and draught lifespan of oxen were 4.56±0.10 and 5.61±0.14 years respectively. The current finding is in agreement with Yisehak *et al.* [20], who has reported age at first ploughing of 4.47±0.07 and draught lifespan of 5.07±0.08 years for indigenous male cattle in Jimma zone.

Reproductive Performances of Sheep and Goat: The mean Age at First Lambing (AFL) and Lambing Interval (LI) of sheep were 2.46±0.24 years and 15.91±0.38 months, respectively (Table 3). The mean LI in this study agrees with the finding of Yisehak *et al*. [20], who has reported average lambing interval of 15.80±0.23 months in Jimma zone. The current finding is higher than the finding of Belay *et al*. [22], who has reported 12.64±5.29 and 7.37±0.77 months of AFL and LI in Dandi district of Oromia region.

The mean Age at First Kidding (AFK) and Kidding Interval (KI) of goats were significantly different ($p<0.05$) between the study areas. The overall mean age at first kidding and kidding intervals were 2.05±0.04 years and 15.45±0.30 months respectively. The highest mean AFK was observed in Omo Nada 2.12±0.04 years followed by Kersa 2.06±0.04 years and the minimum AFK was observed in Tiro Afeta district 1.97±0.05 years. The mean KI in the current study is in agreement with the finding of Yisehak *et al.* [20], who has reported average KI of 15.48±0.2 months in Jimma zone. However the mean AFK and KI in the current study are higher than the finding of Belay *et al*. [22], who has reported mean AFK and KI of 10.90±3.14 and 6.56±1.42 months respectively in Dandi district of Oromia region.

Table 4: Change in body condition of ruminant livestock in dry season and wet season and reason for change

	Districts % respondents				
Seasons & reasons	Kersa	Omo Nada	Tiro Afeta	Overall	P
Dry season					ns
Poor	93.33	88.89	83.33	88.52	
Fair	2.22	5.56	8.89	5.56	
Good	4.44	5.56	7.78	5.93	
Reason if poor					ns
Feed shortage-disease Occurrence	91.11	94.44	92.22	92.59	
unknown	8.89	5.56	7.78	7.41	
Wet season					ns
Good	68.89	71.11	62.22	67.41	
Fair	16.67	10.00	16.67	14.44	
Poor	14.44	18.89	21.11	18.15	
Reason if Poor					ns
Feed-disease problem	80.00	74.44	76.67	77.04	
Unknown	20.00	25.56	23.33	22.96	

ns: non-significant difference ($p>0.05$)

Change in Body Condition in Wet and Dry Season: In the current study the body condition of ruminants are mainly dependent on season of the year (Table 4). About 88.52% of the respondents reported that the body condition of their livestock is poor in dry season. According to discussion with key informants the dry period in the current study area extends from mid of November to beginning of May. In this long dry period there is no livestock feed supply either from irrigation or from agro-industrial by products. Hence, feed shortage coupled with disease occurrence were the main reasons for poor body condition of their animal according to 92.52% of respondent households in the study area. On the other hand, 67.41% of the surveyed household explained the body condition of their livestock is good during the wet season. Discussion with key informants revealed mid of May to the beginning of November is the long rainy season in the study area. So these months are relatively good for livestock since grass, weeds, crop thinning and crop residues from the cropping system are used as sources of livestock feeds. As majority of farmers perceived feed supply shortage is the main hindrance for low productive and reproductive performances of livestock in the study area, animals are producing under

their genetic potential. According to Yisehak and Geert [29], the estimated values of feed DM, CP and ME supply could not yet satisfy the normal maintenance requirements of livestock in Jimma zone.

CONCLUSION

From the current study it is possible to deduce that livestock performances in the current study area are very minimal. Fluctuation in feed supply in quantity and quality throughout the year are the main determinant factors for low productive and reproductive performances of animals in the study area. Besides, prevalence of livestock disease mainly in critical feed shortage period is also another factor which constrains animal performances.

Low lactation milk yield, long calving interval and long age at first calving of cattle are the productive and reproductive performances which needs much more immediate attention. Hence, improvement of the existing indigenous cattle through selection and cross breeding and improvement on management systems mainly on feeding needs argent response.

In general, technical and institutional intervention would be very crucial to alleviate the prevailing low productive and reproductive performances of livestock in the study area.

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