Growth and Reproductive performance of Ogaden cattle at Haramaya University, Ethiopia

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Abstract

The Ogaden Zebu in Ethiopia is also known in the literature as a Lowland Zebu. It is range-adapted and has good potential for beef production from the semi-arid rangelands. This study characterized growth and reproductive performance of the breeding herd maintained at Haramaya University. The mean birth weight was 21.0±0.31 kg for females and 22.0±0.33 kg for males, and the average weaning weight at six months was 87.9±1.95 kg for females and 95.4±1.92 kg for males. Males had average yearling weight of 145.±2.86 kg and it was 127.65±2.87 kg for females, and the 24-month weight was 214.80±4.30 kg for males and 186.59±4.08 kg for females. Average weight at first service was 245.7 kg which reached 269.1 kg at first calving at an average age of 49.2±4.43 months. The mean annual calving rate was 74.2±16.03 % with average lifetime calving of 2.17±0.12 per cow. The average breeding efficiency was 69.6%. Cows measured 150.11±8.20 cm on chest girth, 121.09 ± 7.18 cm on body length, 115.54 ± 5.17 cm on height at withers and
57.49 ± 4.33 cm on distance from ground to the abdomen. Qualitative characteristics were also described. The result indicated promising growth and reproductive performances of Ogaden breed, which is favourably comparable to other zebu cattle breeds of Ethiopia. Some of the physical traits of Ogaden cattle are similar to those of the Ethiopian Boran, but both cattle breeds are different in some other traits.

Keywords: Ogaden zebu cattle, Ethiopia, Phenotypic characterization, Growth, Reproduction.

Introduction

The indigenous cattle breeds of Ethiopia constitute an important asset for the present as well as future economic and social development of the country. However, characterization and inventory work on these resources is still at its early stage of development. Most of the 27 recognized indigenous cattle breeds only have a basic description of their typical features and their distribution (Aleber-

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ro and Haile-Mariam, 1982; Sisay Gezahegn, 1996; DAGRIS, 2007), but very limited comparative information is available on productive and reproductive performance, let alone specific adaptive attributes, viability and within-breed genetic diversity. Detailed on-station performance evaluation of indigenous cattle breeds have been carried out in relation to national smallholder dairy improvement programmes. Some of them are the Ethiopian Boran cattle and their crosses at Abernosa ranch (Azage Tegegn, 1981 and Mekonnen Haile-Mariam, 1987), Fogera cattle and their crosses at Andassa cattle breeding station (Asheber Sewalem 1992), and Arsi cattle at Assela livestock farm (Enyew Nigussie, 1992). Moreover, several new distinct indigenous cattle breed types have been reported recently. These are the Wollo Highland zebu, Raya Sanga and Afar Sanga (Dereje Tadesse et al., 2008) and Mahibere-Silassie (Zewdu Wuletaw et al., 2008). The present report is part of a bigger study which was targeted to characterize Ogaden cattle in terms of morphological traits as well as reproductive and growth performances at specific ages (Getinet Mekuriaw, 2005).

The Ogaden cattle are maintained by Somali pastoralists and agro-pastorals and inhabit most of the warm and arid rangelands of the Ogaden region in south-eastern Ethiopia (Figure 1). In this area mid-day temperature readings can soar to more than 40°C (CE, 2005). There are no official population estimates the breed. Alberro and Haile-Mariam (1982) classified the Ogaden zebu as similar to the Ethiopian Boran; however, Sisay Gezahegn (1996) provided genetic evidence based on protein polymorphism data that the Ogaden and Ethiopian Boran both have relatively very high heterozygosity values indicating separate and divergent long-term within-breed natural selection for adaptation to harsh environmental conditions towards formation of separate breed lines.

The breed is mainly used for meat and milk and they are considered to be drought-tolerant. The breed is regarded as suitable for profitable beef production from arid and semi-arid rangelands of south-eastern Ethiopia, and is being extensively used for both domestic and export markets. Thus they can effectively be used to generate more incomes for the large pastoral and agro-pastoral community in the Ogaden rangelands. Some typical features of the Ogaden cattle are the white to grey hair coat color, compact body conformation and short horns (Sisay Gezahegn, 1996). No attempt has been made to characterize performance of this breed. The present study provides the first *ex situ* on-station performance characterization of the breed using the experimental beef herd that has been maintained at the Beef Cattle Farm of the Haramaya

University since 1990 (Figure 1). Hence, the objectives of this report are to evaluate morphological characteristics of Ogaden cattle breed and to estimate average reproductive and growth performances of the herd.

Materials and Methods

The study area

Haramaya University (formerly known as Alemaya University of Agriculture) is situated at an altitude of 9º 20´ North of the Equator and 42º 03´ East of Meridian and at an altitude of 1980 m.a.s.l. in eastern Ethiopia, about 521 km on the easterly road from Addis Ababa. It lies within high potential agricultural plateau of the Hararghe highlands. It enjoys a moderate average temperature of 16ºC, with mean minimum temperature of 9.73ºC and mean maximum temperature of 24.02ºC. The annual rainfall ranges between 507 and 995 mm (Mengistu and Asnakech, 1986).

The foundation stock of this breeding herd was purchased from different places of Dagahabur Awraja of the previous Hararghe Administrative region which is the natural habitat of the breed, about 200 km south of the University in 1990. Ninety females and ten bulls were selected as foundation stock. From establishment up to August 2004, a total of 495 animals were born on the farm and a further 148 animals were purchased into the herd. All of these 743 animals were included in this study. The herd is kept on pasture without supplementary feeding. The pasture predominantly consists of *hyparrhenia* species, *Cynodon dactylon*, *Sporobolus Africanus* and *Pennisetun* species (Mengistu and Asnakech, 1986). Natural seasonal block mating was practiced, with an average mating ratio of one bull to twenty-five cows. Cows were not milked and calves were allowed to run with dams till weaning age of 180 days. Breeding bulls have been selected based on birth, weaning and yearling weights, good body conformation and size and condition of the testis, and they were allowed to graze with the cows during the breeding season which is usually 75-90 days.

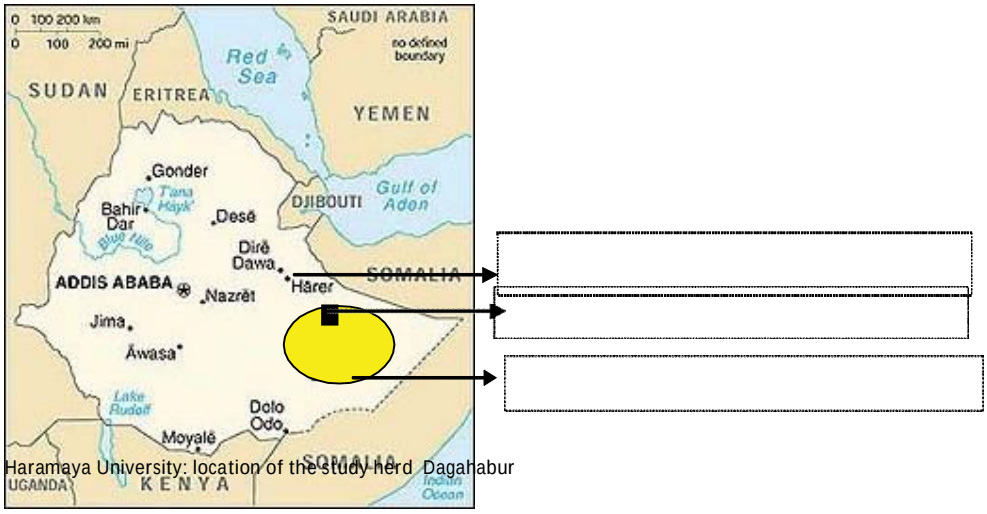

Figure 1. Natural habitat of the Ogaden breed

Data collection and management

Data on the growth and reproduction of the herd between 1990 and August 2004 were collected from individual and herd record cards of the farm for the purposes of this study. Substantial data cleanup and checking was made before transcription into computer. Morphometric data were collected from randomly selected adult animals, whose age is greater than or equal to three years, on site by the researcher.

Cows were identified by origin, as some belonged to the foundation stock (or brought in recently as replacements) and others were born in the farm. Birth, weaning (at six months) as well as bi-monthly live body weights were used to evaluate growth and weight gains. Weight records were checked through calculated fortnightly weight gains and records suggesting average daily gains (ADG) or losses above one kilogram were considered unrealistic and hence excluded from the analysis. Because body weight records were not taken on exactly 15 days intervals, only those records within ±6 days to the weaning, yearling and other fixed age weights were included in the analysis. Using the average daily weight gain which the animal achieved within the interval of consecutive fixed ages, data were projected through linear interpolation to the required fixed age of each individual animal. .

Based on the breeding plan of the farm, Ogaden heifers were made available for mating for the first time when they re ach 24 months of age and have attained a body weight of around 200-250 kg. Annual calving rate (CR) was calculated as percent annualized calving interval (Wilson, 1986), i.e.:
$CR(\%) = (\frac{S}{CI} x 365) x 100$, where, S=Litter size, and CI = Calving interval. Similarly, the breeding efficiency (BE) was calculated as the average number of calves born per annum during reproductive life of the cow (Wilcox *et al*., 1957), i.e. $BE = \frac{365(N-1)}{Days\ from\ first\ to\ last\ calving}$, where N = the number of calvings during the reproductive life of the cow. For morphological and morphometeric descriptions, both qualitative and quantitative variables were recorded from existing adult male and female stock (FAO, 1986), and cows and heifers above three years of age were used. But for males the relatively very small number of males in the herd meant that all the available males, including young bulls less than four years of age had to be used.

Statistical Analysis

Quantitative data were subjected to the General Linear Model (GLM) procedure of SAS (SAS, 1999). Descriptive statistics was used to analyze qualitative variables. Missing body weight and age data limited options for analyzing interactions between variables. Depending on the trait, fixed effects such as birth year, birth season, birth weight, origin of dam, sex of the calf and parity of the dam were used in the statistical models. These factors were included on the basis of their direct influence on the coefficient of determination (R^2) and the overall number of observations per trait.

The following statistical models were used:

Growth performance traits:

$Y_{amdjsl} = \mu + B_a + H_m + P_d + S_j + X_s + e_{amdjsl}$ Reproductive

performance traits:

1. Age at first calving: $Y_{ajl} = \mu + B_a + S_j + e_{ajl}$
2. Gestation length: $Y_{abjsl} = \mu + B_a + W_{b(Cov)} + S_j + X_s + e_{abjsl}$
3. Calving interval: $Y_{mdinl} = \mu + H_m + P_d + R_i + Z_n + e_{mdinl}$

Where; Y_{amdjsl} = the dependent variable B_a=

effect of a^{th} birth year

H_m = effect of m^{th} source of dam herd P_d = effect of d^{th} parity of the dam
R_i = effect of i^{th} calving year S_j = effect of j^{th} birth season
W_b = effect of b^{th} birth weight of the calf X_s = effect of s^{th} sex of the calf
W_b (birth weight) was considered as a covariate for gestation length.
For morphological traits, breeding efficiency and weight at first service, only descriptive statistics was be applied.

Results

Growth Performance

The overall least squares means of birth weight was 21.50±0.29 kg, with 20.98±0.31 kg for females and 22.03±0.33 kg for males (Table 1). The calves had adjusted mean 3 months weight of 62.85±0.46 kg and ADG from birth to 3 months of age of 462 g with coefficient of variation 31.05% (Table 2).

Table 1. Least square means and standard errors (LSM±SE) of birth weight

Factors	N	LSM±SE (kg)
Overall	378	21.50±0.29
Dams herd		* 21.91±0.37[a]
Farm born dam	167	
Purchased dams Parity	211	21.10±0.33[b]
of dam		**
1	189	20.29±0.34[d]
2	67	21.53±0.39[abc]
3	41	21.79±0.50[abc]
4	35	21.94±0.54[ab]
5	46	21.98±0.53[a]
Year of birth		**
1991	77	24.68±0.54[b]
1993	18	20.65±0.80[cdefgh]
1994	16	20.26±0.81[efghijk]
1995	24	20.26±0.64[efghij]
1996	21	20.89±0.66[cdefgh]
1997	15	22.43±0.79[c]
1998	19	19.70±0.70[efghijkl]

Factors	N	LSM±SE (kg)
1999	34	21.43±0.62^{cdef}
2000	1	20.58^{cdefghi}
2001	38	25.09±0.55^{a}
2002	41	21.66±0.48^{cde}
2003	41	19.67±0.59^{efghijkl}
2004	33	22.24±0.53^{cd} NS
Season of birth		21.01±0.37
Kiremt	165	
Meher	130	22.35±0.49
Belg	83	21.15±0.49
Sex of calf		**
Male	176	22.03±0.33^{a}
Female	202	20.98±0.31^{b}

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-significant

Table 2. Least square means and standard errors (LSM±SE) of adjusted weight at three months of age and average daily weight gain from birth to three months.

Factors		LSM±SE (kg)	
	N	ADJ3Wt	ADG0-3
Overall	159	62.85±0.46	0.462±0.02
Dams herd		NS	NS
Farm born dams	104	66.72±1.37	0.495±0.02
Purchased dams	55	63.66±1.77	0.472±0.02
Parity of dam		*	*
1	61	63.29±1.66^{abcd}	0.478±0.02^{abc}
2	33	67.30±2.07^{abc}	0.521±0.03^{a}
3	17	69.11±2.92^{a}	0.513±0.04^{ab}
4	20	67.32±2.73^{ab}	0.494±0.03^{abc}
5	28	58.93±2.36^{d}	0.408±0.03^{d}
Season of birth		** 66.50±2.03^{a}	*
Kiremt	39		0.472±0.03^{a}
Meher	95	61.07±1.28^{b}	0.445±0.02^{b}
Belg Sex of	25	68.00±2.49^{a}	0.533±0.03^{a}
calf		** 61.42±1.40^{b}	**
Female	88		0.440±0.02^{b}
Male	71	68.95±1.69^{a}	0.520±0.02^{a}

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-signifi-cant, ADJ3Wt = adjusted weight at three months age and ADG0-3 = average daily weight gain from birth to three months

The least squares means of live weights of calves at weaning and 9 months were 91.65±1.67 kg and 111.1±2.16 kg, respectively, with 95.42±1.92 kg and 116.64±2.49 kg for males and 87.88±1.95 kg and 105.50±2.37 kg for females. The estimated ADG from 3 months to weaning age was 0.389 kg with 0.407±0.01 kg for males and 0.370±0.01 kg for females and it was 0.336 kg for the period from weaning to 9 months of ages with 0.355±0.01 kg for males and 0.317±0.01 kg for females (Tables 3&4).

Table 3. Least square means and standard errors (LSM±SE) of adjusted weight at six months of age and average daily weight gain from 3-6 months.

Factors	N	LSM±SE (kg)	
		ADJ6Wt	ADG3-6
Overall	210	91.65±1.67	0.389±0.01
Dams herd		NS	NS
Farm born dam	133	93.48±2.11	0.395±0.01
Purchased dam	77	89.82±1.91	0.383±0.01
Parity of dam		* 91.44±2.02^{abc}	* 0.397±0.01^{abc}
1	79		
2	39	93.66±2.50^{ab}	0.400±0.01^{ab}
3	28	95.69±2.92^{a}	0.411±0.02^{a}
4	26	92.33±3.09^{abc}	0.388±0.02^{abc}
5	38	85.13±2.87^{d}	0.348±0.02^{d}
Year of birth		**	**
1991	3	96.46±8.52^{b}	0.390±0.05^{bcd}
1992	-	-	-
1993	-	-	-
1994	12	93.19±4.77^{bcd}	0.407±0.03^{bc}
1995	5	124.36±6.19^{a}	0.574±0.03^{a}
1996	16	88.07±3.89^{bcdefg}	0.368±0.02^{bcdefgh}
1997	10	93.37±5.13^{bc}	0.389±0.03^{bcde}
1998	12	81.03±4.71^{bcdefghij}	0.338±0.03^{cdefghij}
1999	24	92.27±3.72^{bcde}	0.409±0.02^{b}
2000	-	-	-
2001	35	92.18±3.54^{bcdef}	0.369±0.02^{bcdefg}
2002	38	76.55±2.92^{jk}	0.304±0.02^{defghijk}
2003	39	84.73±3.35^{bcdefghi}	0.370±0.02^{bcdef}
2004	16	85.94±3.93^{bcdefgh}	0.358±0.02^{bcdefghi}
Season of birth		NS	NS
Kiremt	94	95.49±2.44	0.418±0.01

Factors	N	LSM±SE (kg)	
		ADJ6Wt	ADG3-6
Meher	97	90.19±2.66	0.370±0.02
Belg	19	89.27±4.27	0.378±0.02
Sex of calf		**	**
Males	105	95.42±1.92a	0.407±0.01a
Females	105	87.88±1.95b	0.370±0.01b

LSM with different letters within a factor differ significantly. ** = P<0.01, * = P<0.05 and NS = Non-signifi-cant
ADJ6Wt = Adjusted weight gain at six months ADG3-6 = Average daily weight gain from three to six months

Table 4. Least square means and standard errors (LSM±SE) of adjusted weight at nine months of age and average daily weight gain from 6-9 months.

Factors	N	LSM±SE (kg)	
		ADJ9Wt	ADG6-9
Overall	240	111.07±2.16	0.336±0.01
Parity of dam		*	*
1	93	109.05±2.63^{bcd}	0.334±0.01^{abcd}
2	48	112.36±2.86^{abc}	0.341±0.01^{ab}
3	33	116.85±3.44^{a}	0.357±0.01^{a}
4	26	112.65±3.89^{ab}	0.339±0.01^{abc}
5	40	104.43±3.43^{de}	0.309±0.01^{cde}
Year of birth		**	**
1991	19	118.84±5.19^{bc}	0.347±0.02^{bcde}
1992	-	-	-
1993	4	124.36±8.99^{ab}	0.384±0.03^{ab}
1994	12	116.53±6.01^{bcde}	0.369±0.02^{bcd}
1995	18	134.50±4.67^{a}	0.432±0.02^{a}
1996	19	101.40±4.69^{efghi}	0.286±0.02^{fghi}
1997	12	108.12±5.93^{bcdef}	0.317±0.02^{bcdefg}
1998	14	90.21±5.56^{ijk}	0.262±0.02^{ijk}
1999	36	118.13±4.05^{bcd}	0.380±0.01^{bc}
2000	-	-	-
2001	35	98.09±4.36^{fghi}	0.269±0.02^{ij}
2002	35	104.25±3.74^{efgh}	0.307±0.01^{fgh}
2003	36	107.33±4.34^{bcdefg}	0.341±0.02^{bcdef}
2004	-	-	-
Season of birth		NS 114.94±2.64	* 0.353±0.01^{a}
Kiremt	119		

Factors	N	LSM±SE (kg)	
		ADJ9Wt	ADG6-9
Meher	103	107.45±3.43	0.306±0.01[bc]
Belg	18	110.81±5.83	0.349±0.02[ab]
Sex of calf		** 116.64±2.49[a]	** 0.355±0.01[a]
Males	119		
Females	121	105.50±2.37[b]	0.317±0.01[b]

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-significant ADJ9Wt = Adjusted weight at nine months of age, ADG6-9 = Average daily weight gain from six to nine months of age

The overall least squares means yearling and 18 months weights were 136.30±2.36 kg and 163.32±2.51 kg, respectively with 144.96±2.86 kg and 171.92±3.1 kg for males and 127.65±2.87 kg and 154.72 kg for females. The difference was highly significant between males and females at the specified ages (Table 5). The ADG from 9 months to yearling age was 322 g with coefficient of variation 21.52%, and that from yearling to 18 months of age was 226g. The overall least square means weight at 24 and 30 months of ages were 200.7±3.43, and 234.79±3.67 kg, respectively, which meet the minimum weight for the age of export beef animals (Table 6). ADG from 18 to 24 months of age was 227.0 g and from 24 to 30 months of age was 222 g per day. The Ogaden cattle reached 267.63± 4.44 kg and
298.7±5.48 kg of overall mean adjusted weight at 36 and 42 months of age, respectively, with 217g and 212 g ADG from 30 to 36 and from 36 to 42 months of age, respectively (Table 7).

Table 5. Least square means and standard errors (LSM±SE) of adjusted weight at yearling age and 18 months age, and average daily weight gain from 9 to 12 months and from 12 to 18 months.

Factors	LSM±SE (kg)			LSM±SE (kg)		
	N	ADJ12Wt	ADG9-12	N	ADJ18Wt	ADG12-18
Overall	240	136.30±2.36	0.322±0.01	237	163.32±2.51	0.226±0.00
Dams herd		*	**		**	**
Farm born dam	130	132.08±2.90[b]	0.309±0.01[b]	91	157.85±3.41[b]	0.218±0.01[b]
Purchased dam	110	140.53±2.84[a]	0.334±0.01[a]	146	168.79±2.73[a]	0.234±0.00[a]
Parity of dam		**	**		*	**
1	93	140.19±3.06[abc]	0.337±0.01[ab]	134	166.55±2.37[abcd]	0.233±0.00[abc]
2	48	142.29±3.74[a]	0.339±0.01[a]	44	167.82±3.91[abc]	0.234±0.01[a]
3	33	142.03±4.49[ab]	0.336±0.01[abc]	26	168.53±5.01[a]	0.234±0.01[ab]
4	26	136.81±5.16[abc]	0.322±0.01[abc]	13	167.85±7.20[ab]	233±0.01[abcd]
5	40	120.21±4.45[d]	0.275±0.01[d]	20	145.85±5.94[e]	0.197±0.01[e]

Factors	N	LSM±SE (kg)		N	LSM±SE (kg)	
		ADJ12Wt	ADG9-12		ADJ18Wt	ADG12-18
Season of birth		NS	NS		NS	NS
Kiremt	119	136.54±2.44	0.318±0.01	131	159.71±2.61	0.220±0.00
Meher	103	140.72±2.51	0.333±0.01	49	160.62±3.83	0.222±0.01
Belg	18	131.65±5.97	0.314±0.02	57	169.63±4.33	0.235±0.01
Sex of calf		**	**		**	**
Male	119	144.96±2.86[a]	0.345±0.01[a]	111	171.92±3.10[a]	0.239±0.01[a]
Female	121	127.65±2.87[b]	0.298±0.01[b]	126	154.72±2.92[b]	0.213±0.00[b]

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-signifi-cant, ADG12Wt = Adjusted weight at 12 months of age, ADG9-12 = Average daily weight gain from nine to 12 months of age, ADJ18Wt = Adjusted weight at 18 months of age, ADG12-18 = Average daily weight gain from 12 to 18 months of age.

Table 6. Least square means and standard errors (LSM±SE) of adjusted weight at 24 and 30 months of age, and average daily weight gain from 18 to 24 and from 24 to30 months.

Factors	N	LSM±SE (kg)		N	LSM±SE (kg)	
		ADJ24Wt	ADG18-24		ADJ30Wt	ADG24-30
Overall	195	200.68±3.43	0.227±0.00	174	234.79±3.67	0.222±0.00
Dams herd		**	**		**	**
Farm born dam	72	192.04±4.72b	0.216±0.01b	64	225.43±5.27b	0.213±0.01b
Purchased dam	123	209.32±3.75a	0.238±0.00a	110	244.16±3.88a	0.232±0.00a
Parity of dam		*	**		**	**
1	109	200.32±3.30bcd	0.229±0.00abc	92	240.47±3.62ab	0.230±0.00ab
2	36	213.93±5.55a	0.245±0.01a	32	247.38±5.97a	0.237±0.01a
3	16	203.14±8.22ab	0.230±0.01ab	15	241.54±8.66abc	0.229±0.01abc
4	13	202.84±9.21abc	0.228±0.01abcd	11	235.63±10.18abc	0.222±0.01abc
5	21	183.18±7.59d	0.203±0.01d	24	208.94±7.50d	0.194±0.01d
Season of birth		**	**		NS	NS
Kiremt	104	193.87±3.80b	0.218±0.00b	91	238.94±4.21	0.226±0.00
Meher	49	221.13±4.96a	0.254±0.01a	46	229.23±5.12	0.217±0.01
Belg	42	187.04±6.16b	0.209±0.01b	37	236.21±6.73	0.224±0.01
Sex of calf		**	**		**	**
Male	87	214.80±4.30a	0.245±0.01a	70	253.36±4.68a	0.242±0.00a
Female	108	186.59±4.08b	0.210±0.01b	104	216.22±4.41b	0.203±0.00b

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-signifi-cant, ADJ24Wt = Adjusted weight at 24 months of age, ADG18-24 = Average daily weight gain from 18 to 24 months of age, ADJ30Wt = Adjusted weight at 30 months of age, ADG24-30 = Average daily weight gain from 24 to 30 months of age

Table 7. Least square means and standard errors (LSM±SE) of adjusted weight at 36 and 42 months age, and average daily weight gain from 30 to 36 and from 36 to 42 months.

		LSM±SE (kg)			LSM±SE (kg)	
Factors	N	**ADJ36Wt**	**ADG30-36**	**N**	**ADJ42Wt**	**ADG36-42**
Overall	137	267.63± 4.44	0.2165±0.0040	109	298.70±5.48	0.212±0.0041
Dam herd		**	**		*	*
Farm born dam	47	255.58±6.12^{b}	0.206±0.01^{b}	30	288.25±8.39^{b}	0.204±0.01^{b}
Introduced dam	90	279.69±4.57^{a}	0.227±0.00^{a}	79	309.15±4.99^{a}	0.219±0.00^{a}
Dam parity		NS	NS		*	*
1	78	270.51±4.06	0.221±0.00	62	308.69±5.05^{ab}	0.219±0.00^{ab}
2	28	281.98±6.34	0.231±0.01	18	313.64±8.94^{a}	0.224±0.01^{a}
3	11	264.37±10.23	0.213±0.01	11	302.66±10.91^{abcd}	0.215±0.01^{abcd}
4	10	263.28±10.92	0.212±0.01	10	307.29±11.74^{abc}	0.217±0.01^{abc}
5	10	258.04±10.96	0.206±0.01	8	261.20±13.54^{e}	0.184±0.01^{e}
Birth season		*	NS		* 303.26±6.07^{a}	* 0.213±0.00a
Kiremt	64	273.88±5.61^{a}	0.221±0.01	59		
Meher	44	273.46±5.49^{a}	0.222±0.00	29	283.00±6.95^{b}	0.200±0.01^{b}
Belg	29	255.57±7.47 ^{b}	0.206±0.01	21	309.83±9.77^{a}	0.220±0.01^{a}
Calf sex		**	**		**	**
Male	44	306.53±6.18^{a}	0.251±0.00^{a}	37	341.94±6.99^{a}	0.245±0.00^{a}
Female	93	228.74±4.68^{b}	0.182±0.01^{b}	72	255.46±6.26^{b}	0.179±0.01^{b}

Note: LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-significant, ADJ36Wt = Adjusted weight at 36 months of age, ADG30-36 = Average daily weight gain from 30 to 36 months of age, ADJ42Wt = Adjusted weight at 42 months of age, ADG36-42 = Average daily weight gain from 36 to 42 months of age

The overall adjusted mean body weight at 48 months age and ADG from 42 to 48 months were estimated 295.11±12.59 kg and 0.184±0.01 kg, respectively (Table 8). Even though calves born to farm-born dams had significantly higher birth weight than those born to purchased dams (Tables 1), their weight at three and, six months of age and rate of gain during these periods were similar (Tables 2&3). However, from one year of age to 42 months of age progeny of the purchased dams performed significantly better than calves born to farm-born cows (Tables 5, 6&7). As expected males calves always had significantly higher body weight than their counterpart females, especially more so as the animals approached maturity.

Table 8. Least square means and standard errors (LSM±SE) of adjusted weight at 48 months of age, and average daily weight gain from 42 to 48 months.

Factors	N	LSM±SE (kg)	
		ADJ48Wt	ADG42-48
Overall	118	295.11±12.59	0.184±0.01
Dams herd		NS	NS
Farm born dam	27	294.63±19.32	0.184±0.01
Introduced dam	91	295.59±11.12	0.184±0.01
Dam parity		NS	NS
1	71	278.34±10.28	0.173±0.01
2	22	313.64±18.84	0.198±0.01
3	10	300.12±24.98	0.187±0.01
4	7	307.17±30.43	0.191±0.02
5	8	276.29±29.01	0.172±0.01
Birth season		**	**
Kiremt	58	299.94±14.53^{b}	0.188±0.01^{b}
Meher	34	337.19±14.46^{a}	0.212±0.01^{a}
Belg	26	248.21±21.66^{c}	0.152±0.01^{c}
Calf sex		**	**
Male	50	316.27±15.38^{a}	0.198±0.01^{a}
Female	68	273.95±13.65^{b}	0.170±0.01^{b}

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-signifi-cant, ADJ48Wt = Adjusted weight at 48 months of age, ADG42-48 = Average daily weight gain from 42 to 48 months of age

Birth weights were significantly affected by parity, with calves belonging to the first parity being lighter (20.29±0.34 kg) at birth than those born at later parities (Table 1). The heaviest average birth weight (21.98 kg) was recorded for the fifth and later parities. However, the growth rates of calves were less affected by parity. Season of birth did not affect birth weight, but weight at three months of age was significantly (P < 0.01) influenced whereby calves born during the wet season had heavier weights at three months of age.

The average observed weight at first service at the age of about 34 months was 245.7 kg (N=73). As stated above, heifers are considered ready for mating from about 24 months of age or about 200kg body weight. Similarly the average postpartum weight after first calving was 266.0 kg with coefficient of variation 12.9 %.

Reproductve Performance

The average age at first service was 34.4±2.28 months (N=52), with minimum and maximum values of 22.6 and 51.5 months, respectively. About 26% of them had service age of below 24 months. The overall mean age at first calving was 49.2±4.43 months (Table 9).

Table 9. Least square means and standard errors (LSM±SE) of age at first calving

Effects	N	LSM±SE (Months)
Overall	81	49.18±4.43
Birth year		**
1994	9	37.18±4.23^{gh}
1995	5	50.17±4.59^{bcdef}
1996	11	48.21±3.30^{bcdefg}
1997	4	57.15±5.53^{ab}
1998	4	52.33±5.53^{abcde}
1999	9	44.43±4.23^{bcdefgh}
2001	9	56.75±4.16^{abc}
2002	11	61.96±3.52^{a}
2003	3	54.63±6.25^{abcd}
2004	16	42.15±2.84^{defgh} NS
Birth season		46.65±2.51
Kiremt	33	
Meher	30	55.26±2.79
Belg	18	49.57±3.67

LSM with different letters within a factor differ significantly, * = P<0.05 and NS = Non-significant

The mean gestation length was 284.9±1.07 days with coefficient of variation of 2.20% (Table 10). Calf birth weight had highly significant effect (P<0.01) on gestation length. As the calf birth weight increased the gestation length was decreased. The average calving interval was 492.9±13.23 days with coefficient of variation of 23.5%. Parity of the dam and calving year had significant influences on calving interval; it was not affected by origin of dam and calving season (Table 11).

Table 10. Least square means and standard errors (LSM±SE) of gestation length in days.

Factors	N	LSM±SE (days)
Overall	318	284.89±1.07
Birth year		**
1991	74	286.35±1.42^{bcd}
1993	14	290.73±2.22^{a}
1994	17	282.39±2.21^{dcghij}
1995	15	280.33±2.10^{efghijk}
1996	25	284.76±1.69^{cdef}
1997	15	284.10±2.06^{cdefg}
1998	12	290.25±2.24^{ab}
1999	25	282.60±2.03^{defghi}
2001	26	284.78±1.74^{cde}
2002	30	288.06±1.56^{abc}
2003	38	280.26±1.90^{efghijk}
2004	27	283.18±1.49^{defgh}
Birth season		NS 282.67±1.19
Kiremt	132	
Meher	102	287.28±1.43
Belg	84	284.67±1.50
Calf sex		*
Female	165	284.01±0.95^{a}
Male	153	285.62±0.98^{b}
Birth weight	380	**

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-significant

Table 11. Least squares means and standard errors (LSM±SE) of calving interval in days

Factors	N	LSM±SE
Overall	176	492.86±13.23
Dam herd		NS 503.41±18.50
Farm born dam	83	
Introduced dam Dam parity	93	482.32±16.71 *
1	57	554.42±18.27^{a}
2	41	533.06±20.88^{ab}
3	33	476.07±23.69^{bc}
4	19	445.62±30.50^{cd}
5	26	455.13±28.58^{cd}
Calving year		**
1991	26	570.14±29.73^{a}
1992	3	429.47±73.06^{cdefghijk}
1993	10	516.87±44.56^{abcdef}
1994	5	498.36±60.67^{abcdefgh}
1995	6	557.49±51.04^{abc}
1996	10	535.28±41.03^{abcd}
1997	17	566.30±36.12^{ab}
1998	14	529.89±37.99^{abcde}
1999	7	356.41±54.25^{hijkl}
2000	-	-
2001	12	450.07±40.20^{cdefghij}
2002	25	504.20±28.37^{abcdefg}
2003	22	452.71±37.77^{bcdefghi}
2004	19	440.01±31.42^{cdefghijk}
Calving season		NS
Kiremt	89	474.98±21.06
Meher	52	520.75±25.58
Belg	35	482.85±29.81

LSM with different letters within a factor differ significantly, ** = P<0.01, * = P<0.05 and NS = Non-significant

The average annual calving rate for this herd was calculated to be 74.2±16.03 % (N=78).

The overall mean lifetime calving obtained per cow was 2.17± 0.12 (N=114). The breeding efficiency was calculated to be 69.6% with very high coefficient of variation of 42.36%.

Morphometric characteristics

On chest girth females measured 150.1±8.20 cm compared to 148.2±14.31 cm for males (Table 12). The average chest depth was 57.8 and 57.20 cm for females and males. The average distance from the ground to the abdomen was 57.5 cm and 58.4 cm for females and males. The average body length was 121.1 cm for females and 120.4 cm for males. The average height at wither was 115.5 cm for both females and males. Females and males have average horn lengths of 8.0 cm and 5.9 cm, ear lengths of 19.7 cm and 19.6 cm, and tail lengths of 71.6 cm and 71.9 cm, respectively. However, the results obtained for males were lower than that of females which seem contrary to the reality. The reason was, since more number of male animals were not allowed to stay in the farm, relatively very small number of males in the herd meant that all the available males, including young bulls under four years of age had to be used (Table 12).

Table 12. Linear measurements of male and female Ogaden cattle

Variable (cm)	Sex	N	Mean ±SD	Minimum	Maximum
Chest girth	Female	107	150.1± 8.20	131.0	170.0
	Male	20	148.2 ± 14.31	134.0	180.0
Chest depth	Female	107	57.8 ± 4.01	47.0	69.0
	Male	20	57.2 ± 4.79	51.0	73.0
Body length	Female	107	121.1 ± 7.18	120.0	147.0
	Male	20	120.4 ±7.27	110.0	140.0
Height at wither	Female	106	115.5 ± 5.17	104.0	131.0
	Male	19	115.5 ± 7.71	102.0	138.0
DGA	Female	106	57.5 ± 4.33	50.0	80.0
	Male	20	58.4 ± 2.16	55.0	63.0
Horn length	Female	91	8.0 ± 4.83	1.0	22.0
	Male	19	5.9 ± 3.26	1.0	12.0
Ear length	Female	107	19.7 ± 1.69	12.0	23.0
	Male	20	19.6 ± 1.05	17.0	22.0
Tail length	Female	107	71.6 ± 5.04	55.0	80.0
	Male	20	71.9± 5.15	62.0	85.0

DGA = Distance from the ground to the abdomen

Qualitative characteristics

Majority of females have short glossy hair, but not very shiny, with some females and all males having dull course hair. Over 80% of Ogaden cattle have white grey coat color with straight top line of same color (Figures 2 and 3). The facial profile is straight with flat forehead and level head. The eyelid and eyelashes are grey to white grey. The horns are grey and straight firm at base, and not thick. The ears are medium in size and horizontal in orientation. The muzzle color is grey for most of the animals. They have pyramidal hump, which is small in females and large in males. The dewlap is either small or medium. The naval flap is absent. The tail and switch are long and the black switch ends at pastern region (Figures 2&3). The hooves are medium sized, oval in shape and grey in color. The udder is small with cylindrical teats, which are pointed at tip.

Source: Getinet Mekuriaw, 2005

Figure 2. Herd of Ogaden cows

Source: Workneh Ayalew and Rowlands, 2004 Figure 3.
Ogaden Bulls

Source: Workneh Ayalew and Rowlands, 2004
Figure 4. Ethiopian Boran bull

Discussion

Growth Performance

The birth weight recorded in the present study is less than those reported for various Boran calves in Ethiopia: 23.3 kg by Beyene Kebede and Galal (1982), 23.9±0.08 kg by Kassa Mersha and Arnason (1986), 25.2 kg by Mekonnen Haile-Mariam (1987), 26.6 kg by Yohannes Gojjam *et al.* (2001b) and 23.7 kg by Amsalu Sisay (2003). The cooler and wetter agro-ecology of the study area is markedly different from the arid to semi-arid agro-pastoral characteristics

of the natural habitat of the Ogaden zebu breed, and this is expected to affect growth performance of the breed.

The live weights at weaning and 9 months of age are comparable to earlier reports for Boran calves (Amsalu Sisay, 2003), much better than similar reports on Boran calves by Yohannes Gojjam *et al*. (2001b), but less than those reported by Beyene Kebede and Galal (1982) for Barka, Boran and Horro breeds. The estimated ADG from 3 months to weaning age (389 g) was comparable with
382.3 g reported by Addisu Bitew (1999) for Fogera cattle and 390.0±21 g for Boran breed reported by Amsalu Sisay (2003).

The overall least squares mean yearling live weight (136.30±2.36 kg) was higher than 130.1± 4.9 kg for Boran reported by Amsalu Sisay (2003), but lower than the 179±5 kg for Boran reported by Mekonnen Haile-Mariam (1987) at Abernossa ranch, and 145.2±0.9 kg for Fogera cattle by Giday Yifter (2001). The rate of gain from 9 months to yearling age (322g) is very much higher than the reported 199±16 g rate of gain from 6 to 12 months for Boran cattle by Amsalu Sisay (2003), but lower than 424.8±13 g for Boran at Abernosa reported by Mekonnen Haile-Mariam (1987). Like other indigenous cattle breeds mentioned above, the Ogaden cattle has also comparative and encouraging live weight and rate of gain and realize as the breed can have better weight if the management practice is improved.

The overall least squares mean weight at 24 months (200.7±3.43 kg) is comparable to 201.5±4.26 kg for Fogera cattle reported by Addisu Bitew (1999) at this age, but lower than 269 kg of Boran cattle reported by Mekonnen Haile-Mariam (1987). Addisu Bitew (1999) reported 177.84 g per day for Fogera cattle from 18 to 24 months of age, which was very much lower than results (227.0 g) of this study. The overall adjusted mean body weight at 48 months of age (289.6 kg) is better than 267.0 kg of White Gudali at Shika station in Nigeria (Oni *et al.,* 1988) but less than the 300.0 kg of White Fulani cattle in Nigeria (Tawah and Rege, 1996). The better performance of the calves born from purchased cows than those from farm-born might be due to differences in genotype of the dam groups as they were not selected from the same original herd.

Calves born during the wet season had heavier weights at three months of age, perhaps due to the better quality and quantity of pasture and hence milk yield of dams during later parts of the wet season.

The average weight at first service (245.7 kg) and the average postpartum weight after first calving (266.0 kg) are considered too low to support reproduc-

tion of the animals. Low weights at calving are closely related to calving difficulties and subsequent reproductive disorders (Ugarte, 1986).

Reproductve Performance

The age at first calving of Oganden cattle (49.2±4.43 months), is considered too late compared to reports of 45.2 months (Kassa Mersha and Arnason, 1986) and 45 months (Mukasa-Mugerwa, 1989) for Ethiopian Boran cattle. The study herd has been under seasonal mating, and those heifers which failed to come to heat during the breeding season had their next mating delayed until the next mating season, and this is expected to have contributed to the late average age at first calving. The mean gestation length (284.9±1.07 days) is close to 281.0 (Azage Tegegn, 1981) and 281.4 days (Ababu Dekeba, 2002) observed for other Ethiopian Boran herds at Abernossa ranch and 280 days for Barka cattle(Azage Tegegn, 1981) but higher than 276.2 days estimated for Arsi cattle (Enyew Negussie, 1992). The earliest as well as late gestation length is highly associated with the birth weight of the calves. It is biologically true that calves which are carried for longer time are higher in birth weight. It might be due to this fact that Ogaden has relatively higher gestation length and birth weight than Arsi cattle.

The average calving interval (492.9±13.23 days) is much lower than 780 days of traditionally managed Ethiopian highland zebu (Mukasa-Mugerwa *et al.,* 1989) and 534.3±17.64 days of the other Ethiopian Boran herd maintained at Abernossa ranch (Ababu Dekeba, 2002). But, the present estimate is higher than 479.9 days for Boran cows at Abernosa ranch (Azage Tegegn, 1981), 477±0.3 days for Boran cows at Mkwaja ranch of Tanzania (ILCA, 1985), and 465± 4 days for Boran cows in Abernosa ranch (Mekonnen Haile-Mariam, 1987).

The average annual calving rate for this herd (74.2±16.03%) is much lower than 97 and 91% reported for Horro cattle and their crosses at Bako station in Ethiopia (Gebre-Egziabher Gebre-yohannes and Mulugeta Kebede, 1996). However, it is better than the estimated 46% for Ethiopian Highland Zebu cattle (Mukasa-Mugerwa, 1989), 40% for Boran cows at Abernosa ranch (Million Tadesse and Alemayehu Reda, 2002). Environments like nutritional requirement and other management practices which are provided for the animals are determinant factors in affecting the performance of reproductive traits like calving rate, gestation length, calving interval and others than the genotypic influence. Therefore, the above mentioned figures at the respective traits are

good indicatives to revisit how the overall management practices were going on at farm level.

The overall mean lifetime calving obtained per cow (2.17± 0.12) is a lot less than 4.8 observed for Boran cows at Abernossa ranch (Mekonnen Haile-Mar-iam, 1987) and 3.34± 0.1 for Fogera cattle at Metekel ranch (Giday Yifter, 2001). The prolonged age at first calving and longer calving intervals can partly explain the low calf production. The low breeding efficiency (69.6%) indicates limitations of the routine husbandry practices of the study herd and that significant improvements in reproductive management can be achieved at the farm.

Morphometric characteristics

The average chest depth (57.8 and 57.20 cm) for females and males are similar to those of the Ethiopian Boran known for their deep chest (Rege *et al*., 2001). The relatively long height from the ground to the abdomen (57.5 cm and 58.4 cm for females and males) is explained by the relatively long legs, which are useful to improve walkability and keep the body far above the ground to adapt to hot tropical environment of the Ogaden lowlands. The horn length is similar to those of the Ethiopian Boran cattle and the Somali Short-horned Boran (Rege *et al*., 2001).

Qualitative characteristics

The white grey coat color which constitutes over 80% of the body is suitable to adapt to the hot climate by reflecting sunrays and the large dewlap size increases surface area for body heat dissipation (Maule, 1990). Similarly, the long tail and switch size are used to protect them from biting flies (Figure 3). Though some of the physical traits of Ogaden cattle are similar to the Ethiopian Boran, they differ from Ethiopian Boran in other traits which would indicate that Boran and Ogaden cattle are distinct breeds. Such performance differences have also been observed in growth as well as reproductive traits which strengthen their distinctiveness. The Ogaden have white grey to white coat color whereas the Ethiopian Boran coat color is light grey or fawn and some of them have patches. Horns of Ethiopian Boran are thick at base whereas horns of the Ogaden cattle have narrower base. The hump of Ogaden bulls is pyramidal in shape where as Ethiopian Boran bulls have humps hanging over one side. Ethiopian Borans have more pendulous sheath whereas the Ogaden breed has tied up sheath (Figure 4).

Conclusion

The result of this study indicated the promising growth (birth weight, weaning weight, yearling weight and later age weights) and reproductive (gestation length and calving rate) performances of the Ogaden breed as a beef type breed, which is comparable and even better to other zebu cattle of Ethiopia. Though some of the physical traits of Ogaden cattle are similar to those of the Ethiopian Boran, they differ in other traits. It was interesting to note that those dams procured from outside mostly performed better than those born in the farm, which is contrary to the breeding objective of improving herd performance in the station. Obviously, the herd is maintained outside its natural habitat; yet under station research management it is generally expected that the herd performs better than on-farm condition. This is an indication that the level of care provided to the breeding herd is unsatisfactory.

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