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Growth Performance Evaluation of Doyogena Sheep under Community based Breeding Scheme in Doyogena Woreda

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Keywords: *breeding, community based, lamb, growthperformance, Doyogena sheep.*

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Keywords: breeding, community based, lamb, growth-performance, Doyogena sheep.

I. Introduction

Sheep is one of the most important livestock species in Ethiopia with an estimated number of 30.7 million (CSA, 2014) found in cool alpine climate of the mountains to the arid pastoral areas of the lowlands. Phenotypic characterization had categorized into 14 sheep breeds of Ethiopia (IBC, 2004; Workneh *et al.*, 2004) which later Solomon (2008) reduced it to 9 through molecular characterization.

In Ethiopia, the livelihood of smallholder households depends to a great extent on livestock production. Sheep contribute substantial amounts to income, food (meat and milk), and non-food products like manure, skins and wool. They also serve as a means of risk alleviation during crop failures, property security, monetary saving and investment in addition to many other socio economic and cultural functions (Markos, 2006; Adane and Girma, 2008). The indigenous sheep breeds have immense potential to contribute to the livelihood of low input smallholder farmers, and the pastoral community (Kosgey and Okeyo, 2007). Moreover, sheep play a great role in the economy of the country through generation of foreign currency (Berhanu *et al.*, 2006). Although their contribution is great importance, sheep productivity in the country is constrained by lack of technical capacity, feed scarcity, diseases, poor infrastructure and lack of market information, besides lack of planned breeding program and policies (Solomon *et al.*, 2013).

The genetic improvement program of sheep in developing countries is less successful than developed countries due to implementation of the program without taking consideration the needs of the farmer and insufficient participation, as well poor adaptability of exotic breed (Kosgay and Okeyo, 2007; Duguma *et al.*, 2009; Markos *et al.*, 2010).

Increasing urbanization and income level increase the demand for animal source food. However, with incompetent production or low supply in both quality and quantity it is unlikely to satisfy the ever increasing demand for mutton and cheavon (Negasa and Jabar, 2008). To meet such huge demand for animal protein, implementation of improvement options like pure-breeding essentially in the form of selection within breed is crucial (Haile *et al.*, 2014). A new approach that has recently stimulated global interest is a community-based breeding strategy. Programs that adopt this strategy take into account the farmers' needs, views, decisions, and active participation, from inception through the implementation, and their success is based upon proper consideration of farmers' breeding objectives, infrastructure, participation, and ownership (Mueller 1991; Sölkner *et al.* 1998; Wurzinger *et al.*, 2011; Merkina *et al.*, 2011). Designing a community-based breeding program is much more than genetic theories and increased productivity. It is a matter of infrastructure, community development, and an opportunity for improved livelihood of livestock owners through productive and adapted animals and markets for their products (Haile *et al.*, 2011).

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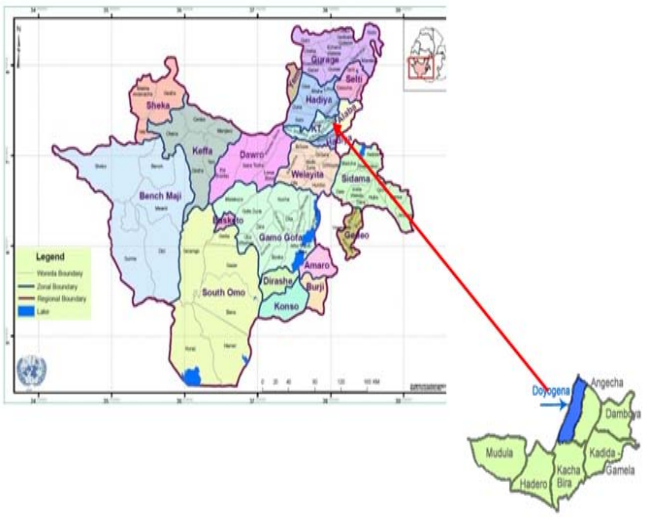
Doyogena sheep is one of the sheep types which have been considered for community based production in southern region. The sheep has high growth rate and prolificacy (Tsedeke, 2007; Deribe, 2009). Doyogena sheep is reared and characterized in the area where mixed crop-livestock production system exist(Tafesse, 2012).The breed has thick fat tailed and the male rams are usually horned. Great genetic diversity was observed within breed (Deribe, 2009). Thus, emphasis was given to explore the genetic potential of Doyogena sheep with respect to mutton production through undertaking performance testing.

For this, on-farm data collection on economic importance traits that includes reproduction and production attributes, focusing on objective traits has been takes place since 2013. However, data was not analyzed to evaluate the different traits considered. The aim of this study was to evaluate the growth performance evaluation of Doyogena sheep under community based breeding scheme level.

II. Material and Methods

a) Description of study area

The study was conducted in Doyogena district. The district is located in Kembata Tembaro Zone in the Southern Nation, Nationalities, and Peoples' region. It is bordered on the south by Kacha Birra district; on the west and north sides by Hadiya zone; and on east by Angacha district. The altitude of Doyogena ranges from 1900 to 2300 meters above sea level (m.a.s.l.). Agro ecologically, the district is divided into mid-altitude (30%) and highland (70%). The mean average annual rainfall is between 1200 and 1600 mm with average mean temperature variation of 10 – 16°C. The major farming system is mixed crop-livestock production. Types of livestock reared and population in the study area include cattle (46,703), sheep (13,822), goats (1,444), horses (6,343) and poultry (27,253) (BoA, 2013). The district is purposely chosen for the study because the area is known as a center of distribution for sheep to neighboring markets (Ashenaf *et al.*, 2013). The existence of community based Doyogena sheep breeding program in the area is also another reason for choosing the district.



b) Breed Description and management

According to previous studies, sheep type found in Kembata-Tambaro zone is known by different names. For instance it is called Arsi-Bale breed (Markos, 2006) and it is categorized as under Adilo sheep types (Tsedeke, 2007; Solomon *et al.* 2011; Deribe *et al.*, 2013) and Wolaita sheep ecotype (Tsedeke,2007). According to Aberra *et al.* (2013) based on morphometric and qualitative traits studies it was stated that sheep population which are found in Kembat Tambaro zone significantly differ from those of sheep in Wolaita area. However the study conducted by Ashenaf *et al.* (2013) indicates that, Adilo is huge sheep marketing place where 65% of sheep including lambs, ewes and rams from Doyogena sheep market are transported to and purchased by big and small traders. Also small holder farmers found in and around Adilo area purchase sheep for fattening and breeding purpose from Doyogena origin. The sheep breed was characterized as being large in size, where twining is common, and are horned with long tick tail and possess different coat color.

In the study area natural pasture, enset and crop residues are used as major feed sources. Farmers keep their sheep together with other livestock species around homestead, farm land after harvesting crop and road side during the day time. Tethering is common management practice in the study area due to shortage of communal grazing land. Controlled mating system was practiced by all sheep keepers due to the policy of the community based breeding program (CBBP). They assured that this practice is being used after the start of CBBP. by holding of selected rams in the area. It was stated that a selected breeding ram was shared by organized household group in the proportion of one ram to twenty ewes.

c) *Source and management of Data*

Data were collected from the productive (birth, weaning and six month body weight and date) and reproductive traits (sex, birth type and parity) by Areka Agricultural Research center since 2013 G.C.

The data were analyzed using the General linear model (GLM) procedures of SPSS, version 16.0. Fixed effect were evaluated for the growth traits (year of birth, season of birth, sex and birth type) and for the growth of lambs. The Tukey test was used to separate least square means with more than two levels. The following model was developed.

Yijkm = μ+ Si + Bj + Ck + Dm +Pn (B*D) jm + eijkm,
Where:
Yijkm = Weight at different ages and ADG of individual lamb
μ = overall mean
Si = fixed effect of sex of lamb (i = male, female)
Bj = fixed effect of birth type (j = single, twin, triplet)
Ck = fixed effect of season of birth (k = Big rainy season (June-August), Small rainy season (May and September-November), dry (December-April))
Dm = fixed effect of year of birth (m = 2013, 2014, 2015)
Pn = Fixed effect of nth parity of dam (n=1……≥5)
(B*D) jm = interaction between birth type and year
eijkm = residual effect

III. Result

a) *Productive performance of Doyogena sheep*

i. *The effect of fixed factors on birth, weaning and six month weights of sheep*

Coefficient of variance (CV %) was in the range of 15.5% for weaning weight to 20.4% for six month weight. Body weights at birth, weaning and six months of age are presented in Table 1. There was significant difference (P<0.001) between birth types along all ages of weight (at birth, weaning and six month). Single born lambs were significantly (P<0.001) heavier than those from multiple births (twins and triplets). Furthermore significant (P<0.001) variation in body weight among multiple birth was observed where twins were greater over triplets (P<0.001). The interaction between birth type by year was significant (P<0.05) on birth weight of lambs. The male lambs had heavier weight than those of the female lambs at birth (3.0 vs. 2.7), weaning weight (12.8 vs. 11.3) and at six month of age (20.3 vs. 17.4). Year of birth had significant (P<0.001) effect on the three studied traits. However, season of birth had no significant (P>0.05) effects at all stage of weights (at birth, weaning and six month age).

Parity had significant (P<0.05) effect on birth weight only.

Table 1: Least squares means (±SE) for effects of birth type, sex, year, season and parity on body weights

Source of Variation	BW(Kg)		WW(Kg)		WSM(Kg)	
	N	LSM ±SE	N	LSM ± SE	N	LSM ± SE
Overall	584	2.9 ± 0.02	352	12.1 ± 0.1	166	18.9 ± 0.3
CV%	-	16.6		15.5	-	20.4
Birth type		***		***		***
Single	195	3.2 ± 0.04^{a}	132	13.9± 0.2^{a}	75	20.9 ± 0.4^{a}
Twin	362	2.9 ± 0.03^{b}	202	12.0 ± 0.2^{b}	85	18.7 ± 0.4^{b}
Triplet	27	2.4 ± 0.08^{c}	18	9.4 ± 0.5^{c}	6	14.5 ± 1.1^{c}
Sex		**		**		***
Male	370	3.0 ± 0.03^{a}	240	12.8 ± 0.2^{a}	124	20.3 ± 0.3^{a}
Female	214	2.7 ± 0.04^{b}	112	11.3 ± 0.3^{b}	42	17.4 ± 0.5^{b}
Year		***		***		***
2013	125	2.7 ± 0.05^{c}	105	11.7 ± 0.2^{c}	57	17.2 ± 0.4^{b}
2014	375	3.0 ± 0.04^{b}	203	13.1 ± 0.2^{b}	96	20.7 ± 0.3^{a}
2015	84	3.2 ± 0.05^{a}	44	14.0 ± 0.3^{a}	13	20.7±0.8^{a}
Season		Ns		Ns		Ns
Big rainy	80	3.1 ± 0.06	70	13.4 ± 0.3	31	20.3 ± 0.6
Small rainy	207	2.9 ± 0.04	125	12.8 ± 0.2	76	18.5 ± 0.4
Dry	297	2.9 ± 0.04	157	12.6 ± 0.3	59	20.4 ± 0.5
Parity		*		Ns		Ns
1	18	2.7 ± 0.09^{c}	17	13.1 ± 0.6	12	18.6 ± 1.1
2	24	2.9 ± 0.08^{a}	24	12.9 ± 0.5	20	18.1 ± 0.8
3	18	2.82 ± 0.09^{b}	16	11.6 ± 0.6	7	18.7 ± 1.4
4	26	2.91 ± 0.07a	24	12.3 ± 0.5	16	17.2 ± 0.9
≥ 5	27	2.80 ± 0.1^{b}	26	12.9 ± 0.5	15	18.3 ± 0.8
Birth type x year	-	*	-	NS		NS

*abcd = means with different superscripts in the same column within the same subclass group differ significantly,*p< 0.05,**P<0.01,***P<0.001, Ns = Not significant, SE = Standard error, BW = Birth weight, WW=weaning weight, WSM= weight at six month, Kg=kilogram, N=observation number.*

b) The effect of fixed factors on average daily gain (ADG) of Doyogena sheep

Overall average pre- and post-weaning daily weight gain of lambs was 103.6 and 67.3 g/day respectively. It was shown that the mean pre-weaning growth rate was more (36.3 g/day) than the post weaning growth rate. Lamb growth from birth to weaning depend more on dam's milk whereas after weaning depends the type of feeds they graze since they are exposed to environment influence.

Factors influencing pre and post-weaning average daily weight gain are indicated in Table 2. Birth type had significant ($P<0.001$) effect only on pre-weaning average daily gain of sheep. Thus the highest ($P<0.001$) growth rate was attained in single birth followed by twin birth. However the post-weaning growth rate was not significantly different among the different birth types. This was due to environmental factor and growth shock after weaning. Both pre- and post-weaning average daily gain of lambs was significantly affected by sex of lambs. Pre-weaning growth weight for male lambs (109.8g/day) was significantly higher ($P<0.001$) than female lambs (98.4g/day). Post-weaning average gain of ram lambs (72.7g/day) was also significantly higher ($P<0.05$) than ewe lambs (61.0g/day).

The result further indicated that birth year had significant effect on daily gain of lambs both pre- and post-weaning growth periods. Pre-weaning ADG was higher ($P<0.01$) in the year 2015 and 2014, whereas lower during 2013 period. The difference, however, was insignificant between birth year of 2014 and 2015. Season and parity did not significantly affect ($P>0.05$) growth rate of Doyogena sheep in the study area.

Table 2: LSM (±SE) and tests of significance of factors affecting pre and post- weaning average daily gain of Doyogena sheep

Source of variation		Birth to weaning		weaning to six month)	
		N	ADG(g/day)	N	ADG(g/day)
Overall		352	103.6 ± 1.7	166	67.3 ± 1.9
CV%		-	30		36.3
Birth type			***		Ns
	Single	132	119.0 ± 2.6[a]	75	71.6 ± 3.9
	Twin	202	105.6 ± 2.0[b]	85	68.4 ± 3.6
	Triplet	18	81.5 ± 5.6[c]	6	62.9 ± 10.6
Sex			**		*
	Male	241	109.8 ± 2.5[a]	124	72.7 ± 3.0[a]
	female	113	98.4 ± 3.6[b]	42	61.0 ± 4.4[b]
Year			**		*
	2013	105	101.4 ± 2.8[c]	57	57.5 ± 4.3[b]
	2014	203	111.1 ± 2.5[b]	96	76.2 ± 3.5[a]
	2015	44	120.6 ± 4.2[a]	13	73.9 ± 7.8[a]
Season			Ns		Ns
	Big rainy	70	114.9 ± 3.8	31	68.9 ± 5.9
	Small rainy	125	110.4 ± 2.4	76	62.4 ± 3.7
	Dry	157	106.2 ± 2.9	59	79.3 ± 4.6
Parity			Ns		Ns
	1	17	115.7 ± 6.6	12	55.1 ± 7.0
	2	24	112.6 ± 5.6	20	58.0 ± 5.49
	3	16	98.8 ± 6.8	7	62.9 ± 9.2
	4	24	105.6 ± 5.6	16	62.1 ± 6.1
	≥5	26	111.5 ± 9.1	8	64.0 ± 5.7

*abc = means with different superscripts in the same column within the same subclass group differ significantly, *p< 0.05, **P<0.01, ***P<0.001, Ns = Not significant, LSM=least square mean ,SE = Standard error, ADG = Average Daily Gain, N=observation number, g/day=gram per day.*

IV. Discussion

Growth performance

The birth weight of Doyogena sheep recorded under the current study is about 2.9kg. This is higher than birth weight reported by Deribe *et al.*, (2013) for Adilo sheep (2.3kg) reared under traditional management and Horro sheep reported as 2.4kg by Markos (2006) and 2.6kg by Solomon (2002) which was managed under on-station management. This finding is also higher than that report by Haile *et al.* (2014) for Menz sheep (2.25kg) under community based breeding management. The observed differences may be attributed to breed and management condition. The current finding however is lower than the birth weight (3.55kg) reported by Momoh et al (2013) for Balami breed in a semi-arid region of Nigeria and Bonga sheep (3.4kg) which is also under community based breeding

(Haile *et al.*,2014). The variation from these findings could be due to the length of time selection has been operating in the reported cases. Similar birth weights however, have been reported by Haile *et al.*, (2014) for Horro sheep (3.1kg) under community based breeding management; and Surafel *et al.* (2012) for Simein sheep (2.97kg) under traditional management. The current result figure out that the resulted birth weights is due to well planed, careful selection and breeding combined with good management can enable animals to express their genetic potential and thereby improving the productivity and reproductive potential of a given breed. This also is the best option for genetic improvement than depending on the exotic breeds which were also not successful under the Ethiopian condition (Duguma *et al.*, 2009; Markos *et al.*, 2010).

The weaning weight of lambs is an indicator of efficiency of maternal ability. The milking ability of the dam and maternal factors (high prolific, easy lambing and high milk production) are the most determinant elements in pre-weaning growth of lambs. The weaning weight recorded under the current study is greater than the report of Belete (2009) and Deribe *et al.* (2013) for Bonga and Adilo sheep respectively. The reason for this could be lambs with heavier birth weight will have possibility of having higher pre-weaning growth and weaning weight. Besides, Doyogena sheep is one of the fast growth sheep types in the country and the current community based breeding program should be another reason for recording higher weights. The finding of the current study however is more or less comparable with that of Getahun (2008) for Horro sheep under on-station management (12kg), Mengiste (2009) for Washira sheep (11.9kg), and Surafel *et al.* (2012) for Simien sheep (11.7).

The overall pre-weaning ADG found in the present study is higher than that reported by Haile *et al.* (2014) for Horro (90g/day) and Menz (80 g/day) sheep under community based breeding practices, Mengistie (2009) for Washira (59.1 g/day) and Surafel *et al.* (2012) for Simien sheep under traditional management. The pre-weaning ADG of Belami sheep breed (70g/day) in a semi-arid region of Nigeria was lower than the current finding (Momoh et al, 2013). However, finding of the current study was lower than the result obtained by Haile *et al.* (2014) for Bonga breed under community based breeding. Bonga sheep have been under the community based breeding program over the last 8 years where as Doyogena sheep stayed only for 3 years in the selection program. The intensity of selection that was operating in Bonga sheep over the extended period should be reason for the recoded higher weight. The result of the current study is an additional proof for the efficiency of the community based breeding in improving the productivity of the indigenous breeds as also have been observed in Bonga sheep (Metshafe, 2015; Haile *et al.*,2014)and Menz and Horro sheep (Haile *et al.*, 2014).

V. Effects of Non - Genetic Factor on Growth Traits

a) Effect of Birth type

The effect of type of birth on body weight of sheep observed in this study is similar to earlier findings of Haile *et al.* (2014) and Metsafe (2015) for Bonga sheep and Momoha et al (2013) for Balami sheep, who reported significant effect of births on lamb's birth, weaning and six months of age weight. Similarly Haile *et al.* (2014) for Horro sheep and Surafel *et al.* (2012) for Simien sheep indicated significant effect of birth type on lamb weight at birth and weaning. The finding of current study(Table 1) also concurs with other studies although different values were reported (Ghangaboche *et al.*, 2006; Yilmaz *et al.*, 2007; Deribe *et al.*, 2013). The reason for this could be, when the fetus is still in the womb single births enjoy the available space and nutrition. After birth also, when the offspring depend on the dam's milk, single births enjoy milk without any completion while multiple births have to share and therefore single births weigh heavier than the multiple as also indicated by Markos (2006).

b) Sex effect

The current study shows male lambs have heavier weight than female lambs at birth, weaning and six month age. The difference in sexual chromosome, probably of in the position of gene, physiological characteristics and difference in endocrinal system must have led to variation in animal growth. Estrogen hormone has limited effect on the growth of long bones in females. The higher the surface area of the bone, the more space availability for muscle attachment and therefore, heavier weights. That could be one of the reasons in which females have lighter body weight than males (Rashidi *et al.*, 2008). Previous reports have confirmed similar results (Mousa, 2010, Gbangboche *et al.*, 2006, Momoh, 2013). In contrary to the current finding, non-significant effect of sex of lamb on the trait was reported by Getahun (2008) for Adilo and Hassen, (2002) for lambs in the cool highlands of Ethiopia.

c) Effect of birth year

Effect of year on body weight at different age was significant which is in agreement with reports from various studies (Gbanboche *et al.*, 2006; Akhtar *et al.*, 2012; Momoh *et al.*, 2013; Rahimi *et al.*, 2014). In addition to this, year of birth had significant effect on weaning weight. However, Berhanu and Aynalem (2009) reported that a non-significant effect of year on birth weight. Under the current study the effect of year could be due to selection effect that was operating over the three years while for the other studies, management and the other variables together with year might be the possible reasons. Similar reports have been given by Abbasi *et al.*, (2012), Akhtar (2012), Momoh (2013) and Mousa, (2013).

d) Effect of parity

There was a declining trend in birth weight after fourth parity, indicating the maximum productive periods might be before the fifth party in the Doyogena sheep situations. This indicates that the dams should stay in a flock until the 4th parity and should then be culled. As the younger ewes are still growing, there is a competition between the fetus and the dam for nutrients, which has negative influence on birth weight (Gemeda *et al.*, 2002a, Deribe, 2009). Heavier birth weight could be obtained at late parities due to heavier dam weight and larger size (Kassahun, 2000) and physiological imprint in the uterus during the first pregnancy which will facilitate relatively greater foetal growth in the subsequent pregnancies (Gardner *et al.*, 2007). Markos (2006) also reported significant increment of birth weight from beyond first parity, which was similar to the current findings, and then with increment at a decreasing rate beyond parity four. Several reports are in agreement with the current study (Markos 2006; Gardner *et al.*, 2007; Taye *et al.*, 2010).

e) Average daily gain

The higher average daily gain from birth to weaning for single born lambs over their multiple counter parts found in the current study agrees with other reports for Horro (Gemeda *et al.*, 2002), Washira (Taye *et al.*, 2010) and Menz sheep breed (Markos, 2006). Similar findings with the current study have also been reported for other breeds (Getahun, 2008; Deribe *et al.*, 2013; Senou, 2009; Haile *et al.*, 2014, surafel *et al.*, 2014). However non significant variation of birth type on post weaning growth was observed. The reason for this could be lambs after weaning, whether single or multiple, will be equally exposed to the environmental effect.

Sex of lamb had significant effect on pre and post-weaning growth of Doyogena sheep which is in agreement with reported by Haile *et al.* (2014) for Bonga sheep. Differences in sexual chromosomes, probably in the position of genes related growth, physiological characteristics in endocrinal system (type and measure of hormone) lead to differences in animal growth. This could be one of the reasons in which females have smaller body and lighter weight than males (Rashidi *et al.*, 2008; Momoha, 2013). Studies have reported significant effect of birth year on pre- and post-weaning average daily gain for Horro, Bonga and Menz sheep under community based sheep breeding cooperatives in different production system, which is similar with present study (Haile *et al*., 2014).

VI. Conclusion & Recommendation

From the study, it is concluded that growth performance of Doyogena sheep is fairly encouraging. There was higher within breed variability in growth traits which were significantly influenced by non-genetic factors at one or the other stage. The higher variation within the breed indicates that there is a great possibility for genetic improvement through selection among the Doyogena rams and ewes. The established community based breeding program has given encouraging results. Therefore, further selection among the flock for desired reproductive and productive traits to achieve higher lamb crop with superior growth performance should be continued extensively. Effects of non-genetic factors need to be corrected for mixed model approaches and values are to be used for breeding value evaluation in Doyogena lambs. Selection of rams and ewes for multiple births should also be initiated and genes responsible for this should be identified. Molecular level of characterization is needed to identify its distinctiveness and prolificacy testing to confirm the potential of the breed.

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