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Review Article – Agriculture

Dorper sheep cross breeding with Indigenous sheep breed in Ethiopia

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Abstract

The objective of this review paper was to review dorper sheep cross breeding with indigenous sheep breed in Ethiopia. The paper reviewed and discussed the history of dorper breed introduction, research and development efforts in crossbreeding and their performance under on-station and on-farm management. Formal survey on farmers perception on Dorper cross sheep indicated that the crossbred dorper sheep have non selective feed behavior and excellent in meat production under farmer`s management. On other study showed that dorper sheep was not meet farmer interest in breeding sheep aspect because of black coat color. The performance of indigenous sheep and their crosses with Dorper varied as per the location, management, farming conditions and percentage of exotic blood level inheritance. Different research output by team of researchers on farm and on station performance evaluation of dorper indicated that crossbreds often outperformed their local contemporaries. Under on farm condition, body weight at different ages was significantly higher in 50% Dorper crosses as compared to their 25% and75% counter parts.On station birth weight of Dorper (3.39 3.8 kg) better than crossbreed (3.0 3.24 ± 0.04 kg) and local sheep (2.36 2.77 kg), respectively.While the mean weaning weight (14 16 kg) and yearling weight (26.95 32.43 ± 0.46 kg) of 50% Dorper crossbreed was better than indigenous sheep breeds. However, crossbred ewes and local sheep breeds did not differ in litter size. Dorper crosses with Afar under on station is not economically important due to lower weight in all aspects. Crossbreeding programs of dorper with indigenous sheep require strong research and development support from public service and non-governmental institutions for sustainable design, optimization, and implementation in clearly defined production environments.

Keywords: Dorper cross, Reproductive performance, Cross breeding

Introduction

The importance of sheep production as a source of meat in Ethiopia has been increasing from time to time.This sheep production has experienced changes regarding the use of introduced exotic breeds, in order to increase the growth rate of lambs.Thus, there is a great demand for improved sheep breed such as Dorper sheep to improve the growth performance of lambs, which is an important trait that determines the overall productivity of the flock. Farmers rear sheep mainly for sale and consumption. Sheep owners gain a vast range of products and services such as meat, milk, skin, wool, manure, gifts, religious rituals, etc. (Hirpa, 2008).Sheep are also a means of risk mitigation during crop failures, property security and monetary saving in addition to many other socio- economic and cultural functions (Gatenby, 2002). Sheep contributes 21% of the total ruminant livestock meat output of the country, with the annual national mutton production estimated to be at 77 thousand metric tons (Sebsibe, 2008).While contributing significantly to meat production of the country, productivity or output of per sheep is low (Tibbo, 2006). Thus, the productivity of indigenous sheep has to be improved and efficient sheep genetic improvement programs must be initiated to boost output and profitability of the producers (Kosgey, 2007). To improve sheep productivity, therefore, crossbreeding with exotic breeds is considered as the most rapid way of improving productivity of indigenous sheep breeds (Hassen, 2004). To accomplish the crossbreeding program, the Ethiopian Sheep and Goat Productivity Improvement Program (ESGPIP) took the responsibility for importation of improved genotypes, multiplication of purebreds, crossing with indigenous sheep and distribution of both crossbred and pure exotic animals to sheep producers. To carry out the activities, four nucleus and ten Breeding, Evaluation and Distribution (BED) sites were established in different regions of the country.

History of Dorper Sheep Introduction to Ethiopia

Dorper is a superior meat type sheep breed in South Africa developed through the long time effort of crossbreeding of Black headed Persian and the Dorset Horn in 1930 (Gavojdian *et al.,* 2013). To improve the productivity of indigenous sheep, crossbreeding with high yielding exotic Dorper sheep breed is valuable for market oriented meat production and for enhancing the benefits obtained from the local sheep (Helen *et al.,* 2015). The Ethiopian Sheep and goat productivity Improvement Program (ESGPIP) brings this sheep breed and began a crossbreeding Program at different breeding, evaluation and distribution sites of the country. Overview of Crossbreeding Effort with Dorper Sheep in Ethiopia.

Currently, to improve the genetic potential of local sheep in Ethiopia, Dorper sheep were imported into Ethiopia, mainly for crossbreeding purposes. The most obvious and quickest means of greatly elevating meat sheep productivity in Ethiopia is to take advantage of the heterotic effects of crossbreeding. The South African Dorper sheep was chosen as a primary candidate for crossing with Ethiopian sheep breeds. Attributes of the Dorper sheep are well known and they include large size, considerable

muscling, high dressing percentage, and fast growth. Dorper sheep were placed at Fafen (Somali) and Werer (Afar) Research Centers. At the above (Nucleus) sites, purebred animals are being bred to produce pure offspring for multiplication and for the crossbreeding programs at the respective Breeding, Evaluation and Distribution (BED) sites (Tilahun, 2012).

Growth Performance of Dorper Cross Sheep

On station Performance

According to Tilahun (2012) who works at Sirinka bree ding,evaluation and distribution experimental site,body weight, average daily gain, total dry matter intake, gain efficiency and feed conversion efficiency of the three sheep breeds are presented in Table 1. Initial BW was greater (P< 0.001) for 25% Dorper x 75% CH(central highland) sheep (20.25 kg) compared to 50% Dorper x 50% CH sheep (17.9 kg); both were greater than CHS (14.41 kg). At the beginning of the experiment, the Dorper crossbreds had greater initial body weight (P< 0.001) compared to the CHS indicating that around similar age the crossbreds appears to have greater live weight. Meanwhile, 25% Dorper x 75% CH sheep had got greater initial body weight than 50% Dorper x 50% CH sheep at around similar age which was not expected, the reason behind this is that the 25% Dorper x 75% CH sheep were well managed at farmers field before the start of the experiment while 50% Dorper x 50% CH sheep suffer drought problem at the main station SARC(sirinka agricultural research center) farm before the start of experiment and 50% Dorper x 50% CH sheep did not get sufficient amount of feed during pre-weaning stage from mother's milk or additional supplemental feed. Widdowson(1980) reported that growth rate can be influenced by factors such as plane of nutrition, hormonal status, and environment resulting in a mature body size that is below the genetically determined maximum.

Both Dorper crossbred sheep genotypes were significantly (P< 0.01) higher in final body weight, average daily gain and gain efficiency than CHS. Average daily gain for 25% Dorper x 75% CH sheep and 50% Dorper x 50% CH sheep was 130.79 and 125.84 g day-1, respectively and both crossbreds gained more rapidly (*P< 0.01*) than CHS (91.39 g day-1). After 90 days of experimental trial sheep genotypes had gain a total of 8.19, 11.80 and 11.23 kg for CHS, 25% Dorper x 75% CH sheep and 50% Dorper x 50% CH sheep genotypes, respectively. Incomparable to this result, Genet (2012) reported that crossbreds of Black Head Ogaden × Dorper and Hararghe Highland × Dorper sheep supplemented with concentrate at either 0.9% or 1.5% of body weight and noted that high level of nutrition (1.5% body weight) resulted significantly higher value of average daily body weight gain for intact males 110±4.66; than animals maintained on low level of nutrition (0.9% body weight) 94±2.18 g day.

Table1. Effects of genotype on growth performance characters of CHS and their crosses with Dorper Sheep

Item	**Sheep genotypes**				
	CHS	25% Dorper Crossbred	50% Dorper crossbred	SEM	SL1
Initial BW (kg)	14.41^{c}	20.25^{a}	17.9^{b}	0.42	***
Final BW.(kg)	25.85^{b}	29.37^{a}	29.19^{a}	0.27	**
ADG(g/d/head)	91.39^{b}	130.79^{a}	125.84^{a}	2.94	**
Total DMI (kg)	83.02^{b}	91.72^{a}	87.66^{ab}	0.71	*
FE (g DMI/g gain)	9.17^{a}	7.35^{b}	7.23^{b}	0.18	**
GE (g gain/kg DMI)	107.71^{b}	138.72^{a}	139.50^{a}	2.58	**

Source (differ; **= (P<0.01); ***=(P<0.001); ns= non-significant; SEM= standard error of means; SL= significant level; FE =feed efficiency and GE= gain efficiency and 1the covariate was initial body weight for all variables

Table 2. Live body weight and daily body weight gain of the local and crossbred sheep.

Breed	Sex	Age categories (months)	Number of observation	Live body weight Mean±SE	Average daily weight gain (g/day) Mean ±SE
Cross breed	Male	0- 4	2	10 ± 1	162.5 ± 12.5
		5-9	3	27 ± 2	137.0 ± 24.1
		10-12	1	32 ± 0.0	88.9 ± 0.0
		> 12	5	45 ± 0.0	83.3 ± 0.0
	female	0- 4	7	13 ± 0.1	158.2 ± 9.7
		> 12	2	38 ± 0.0	111.1 ± 5.6
Local sheep (highland)	male	5-9	2	15 ± 0.2	63.5 ± 9.4
		10-12	1	17 ± 0.0	47.2 ± 0.0
		> 12	2	16 ± 6	33.6 ±19.7
	female	0- 4	1	3 ± 0.0	66.7± 0.
		> 12	1	22±0.0	30.6 ± 0.0
Total	27				

In agreement with this also Wildeus *et al.,*(2004) noted that, when forage-based diets were supplemented with concentrate feeds, growth rates increased to 67–165 g day^{-1}, dependent on forage quality and level of concentrate supplementation. In contrast to this, the average daily gain obtained by Teklebrhan (2011) for Dorper x Hararghe Highland breed fed different diet levels of grass hay *ad libitum* and concentrate mixture of wheat bran and noug cake during the growth periods reported average daily gain values (g day^{-1}) which were lower than Tilahun's study. These differences may be due to the effect of type of crossing between different sire and dam, which may show the effect of the hybrid vigor and may come from the effect of the plane of nutrition. But this result shows the potential of Dorper crosses to finish at early age with good quality feed supply. In addition, the 50% Awassi × Charollais and Awassi × Romanov F1 crossbred cross bred sheep showed better growth performance than purebred Awassiwhich may presumably indicate the effect of hybrid vigour in first generation crosses on half Charollais and Romanov blood

compared with pure Awassi (Shaker *et al.,*2002; Shaker *et al.,* 2010). The Central Highland sheep had scored higher average daily gain when compared to other works and comparable results of weight were reported for growing Ethiopian highland sheep (96 g day^{-1}) and Horro rams (90 g day^{-1}) when 35% and 50% of their ration were hay, respectively (Galal, 1979).

Another research result by Gebreyowhens *et al.* (2017) at mekele agricultural Research station shows comparison of local sheep and dorper crosses, as a result, the comparison of local and crossbred based on the live body weight is presented in Table 2. The average daily body weight gain for male crossbred at the age group of 0-4, 5-9, 10-12 and >12 months was 162.5 ± 12.5, 137.0 ± 24.1, 88.9 ± 0.0 and 83.3 ± 0.0 g, respectively. Whereas for the female crossbred, the average daily body weight gain at the age group of 0-4 months and >12 months was 158.2 ± 9.7 and 111.1 ± 5.6 gm. The average daily body weight gain for male local sheep at the age group of 5-9, 10-12 and >12 months was 63.5 ± 9.4, 47.2 ± 0.0 and 33.6 ±19.7, respectively. Whereas for the female local sheep, the average daily body weight gain at the age group of 0-4 and >12 months was 66.7± 0.0 and 30.6 ± 0.0 g, respectively.

The current study observed that the average body weight gain was higher for Dorper crossbred sheep under traditional management system. The male crossbred sheep reached marketable weight (27 kg at 5-9 months) as compared to the male local sheep (15 kg at 5-9 months). Dorper lambs can grow daily by 206 g/day post weaning supplemented with concentrated feeds (Cloetea *et al.,* 2000). According to Byrne *et al.,* (2009) Doper lambs have live body weight gain of 240 to 280 g/day tested at varied environmental conditions. The early weaning age (2 to 3 months) of the Doper lambs have a potential of enhancing post-weaning gains 180 to 200 g/day (Byrne *et al.,* 2009).

Attempts have been made (Ayele *et al.,* 2015) in order to evaluate the growth performance of Dorper and its F1 crossbreds at DebreBirhan Agricultural Research Center (DBARC). In his study the overall birth weight, weaning weight and yearling weight of pure Dorper and Dorper x Local 50% cross breed lambs were 3.04±0.04kg, 14.32±0.23 kg and 32.43±0.46 kg respectively. The author investigated that pure Dorper lambs were heavier at birth than the F1 crosses with Afar and Menz breeds with the mean birth weight of 3.39vs 2.57 and 2.77 kg, respectively. Furthermore, he found that pure Durper lambs were significantly heavier at 90 days compared to the Dorper x Afar50% and Dorper x Menz 50% lambs and they were 71 and 31 % heavier at the age, respectively. Similar to this, heavier birth weight of pure Dorper (3.5 kg) as compared to crossed (3kg) was reported by Gavojdian *et al.* (2013). Lakew *et al.,* (2014) mentioned that weaning, six months and yearling weights of 50% Dorper crossbreds were much higher with values of 14.95, 20.43 and 31.37 kg, respectively; as compared to the corresponding values for local breed in North Wollo lowland areas of Ethiopia with values of 8.53, 11.92 and 22.38 kg, respectively. In contrast, a study on response to feeding trial (Tilahun *et al.,* 2014) identified that initial weight for local, 25% Dorper and 50 % Dorper at about 7 months were 14.8, 20.3 and 17.9, respectively; Final weight after 90 days were 22.8, 32.2 and 29.3 kg, respectively. He underlines that 25% Dorper performed well with final body weight under on station condition. On the other hand, a recent study carried out by Ayele *et al.,* (2015) found that the adjusted yearling weight of lambs in DebreBirhan research center was 32.43±0.46 kg; as yearling weight for 50% Dorper x Menz sheep (31.33 kg) was superior to the 50 (26.95 kg) and 75% Dorper x Local sheep (29.13 kg) (Mekonnen *et al.,*2012). However, the estimated birth weight of Dorper lambs under intensive condition was 3.8±0.8 kg (Mellado *et al.,* 2016) and yearling weight reached an average weight of 55.0 kg at 18 months of age (Gavojdian *et al.,* 2013). In other cases Lakew *et al.,* (2014) at Sirinka Agricultural Research Center found that the local sheep and their Dorper crosses mean birth weight and weight at weaning was 2.36±0.05 kg, 3.24±0.04 kg; 8.53±0.14 and 14.95±0.21kg, respectively. On station representative's of productive performance of indigenous and their cross with Dorper sheep are summarized in Table 3. The body weight performances of the Dorper crossbred have got premium result in improving the local sheep worldwide (Lakew *et al.,* 2014). The current suggested that Dorper sheep is an appropriate technology for producing crossbred lambs with better growth rates under Smallholder farmers.

Table 3.on station growth performance of dorper sheep and their crosses in Ethiopia

Genotype	BWT(kg)	WWT(kg)	YWT(kg)	References
Local	2.36±0.05	8.57	22.38	Lakew *et al.,* 2014
Dorperx local	3.24±0.04	14.95	31.37	Lakew *et al.,* 2014
Pure dorper	3.39±0.08	16.18±0.35	34.43±0.79	Ayele *et al.,* 2015
dorperxAfar(50%)	2.57±0.06	9.45±0.87	24.96±3.77	Ayele *et al.,* 2015
Dorperx Menze	2.77±0.04	12.34±0.25	31.33±0.56	Ayele *et al.,* 2015

Table 4. On station reproductive performance of dorper sheep and their crosses in Ethiopia

Genotype	Reproductive performance traits			
	AFL	WFL	LI	references
local	469±8.45 days	22.8±0.43	287±2.38	Lakew *et al.,*2014
Local X dorper	556±6.25 days	32.7±0.63	306±4.62	Lakew *et al.,*2014
Pure dorper	12 month	NA	NA	Flourie *et al.,*2009

AFL-age at first lambing; I-lambing interval

On farm Performance

On-farm performance assessment concerned with the whole farm environment provides information in location specific production conditions that could lead to breed improvement options that are appropriate to the system (Getahun, 2008).However, unlike on station experiments, on-farm study is influenced by many factors which could not be controlled. Sisay (2002) identified that under on farm condition variation exists between indigenous and exotic sheep breeds for body weight traits. The trend of varied productivity performances of Crossbred sheep across

locations implies the importance of G x E interaction due to differences in feed supply and farmers' management capability (Getachew *et al.,* 2016). The mean birth weight of 3 and 3.5 kg for crossed and pure Dorper sheep (Gavojdaian *et al.,* 2013) concurs well with the birth weight of 3.3-3.9 kg of Dorper lambs that found by Neser *et al.* (2001) and Hinojosa-Cuéllar *et al.,* (2013) under pasture conditions. Besides, Snyman and Olivier (2002) reported 4.06, 30.0 and 64.4 kg for birth weight, weaning weight and yearling weight of Dorper sheep breed under extensive management condition.

Although Cloete *et al.,* (2000) estimated mean weaning weight of 18.2 kg for Dorper sheep breed. However, Belete *et al.,* (2015) reported that the means of birth weight (kg), weaning weight (kg), weaning age (month), market age (month) and market weight (kg) of Dorper sheep crosses in Wolita and Silte Zone was 2.25, 17.30, 3.16, 12.66 and 30.66 kg, respectively. The mean market weight (30.68 kg) and market age (12.66 months) of Dorper sheep breed (Ermias, 2014) was significantly lower than the report of 36 for female crossed and 70 for male pure Dorper sheep (Fourie *et al.,* 2009). On farm evaluation study carried out in the highlands of Ethiopia confirmed that body weight at different ages was significantly higher in 50% Dorper crosses as compared to their 25% counter parts (Ayele *et al.,* 2015). Despite this, Belete *et al.,* (2015) found that birth weight was higher for 25 % crosses, but weaning and marketing weights were found higher for 50% crosses, while litter size was higher in 25% crosses (1.96) than 50% crosses (1.88).

Table 5. Reproductive performance of Dorper crosses

Blood level	AFL(months)	LI (months)	Litter size	References
50% Dorper	11.07±0.53	N/A	1.88±0.27	Belete *et al.,* 2015
25% Dorper	12.50±0.65	N/A	1.96±0.26	Belete *et al.,* 2015

WT = birth weight, WWT = weaning weight, YWT = yearling weight, AFL = age at first lambing, LI = lambing interval, N/A = not attend
Adopted from Destaw *et al.* (2017)

Besides, Lakew *et al.,* (2014) addressed that the local sheep attained faster age at first lambing than the crossbred ewe lambs (469±8.45 vs 555±6.25 days), while the crossbred ewes weighed more than the local sheep ewes at the age of first lambing (32.7±0.63 vs. 22.8±0.43 kg) in Sirinka Agricultural Research Center, Ethiopia. He confirmed that the crossbred and local ewes were comparable in their litter size for local (1.18±0.02) and for Dorper crosses (1.17±0.00), despite the fact that the lambing interval of crossbred ewes was longer than the local ewes (306±4.62 vs. 287±2.38 days). Furthermore, the local ewes had higher annual reproductive rate than that of the crossbred sheep ewes (1.49±0.02 vs. 1.37±0.01 lambs) under the same environmental conditions (Lakew *et al.,* 2014). As a result he outlined that the local sheep were faster to attain the age at first lambing and have shorter lambing interval than the crossbred ewes, whereas the crossbreds were heavier at first lambing than the local sheep. Moreover, the local sheep had higher reproductive rate, while litter size and mortality rate were comparable for both breeds. In contrast to (Budai *et al.,* 2013) there was no significant difference between lambing interval of pure Dorper (8 months) and Dorper crosses (8months), respectively.

On farm Performance

Astudy which was conducted by Belete *et al.,* (2015) shows that Dorper cross with Adilo indigenous sheep show a Mean birth weight, weaning weight, weaning age, market age, market weight, litter size, age at first lambing and sexual maturity for Dorper sheep were 2.25±1.72 kg, 17.30±0.98 kg, 3.16±0.55 months, 12.66±1.39 months, 30.66±3.26 kg, 1.48±0.71, 11.81±1.37 months and 5±0.74 months, respectively. Location, season, birth type, parity, sex and blood group had significantly ($P<0.05$) affected weaning weight. Season had influence on weaning age. Pre-weaning mortality rate of Dorper sheep was 2.93% and lower in Wolaita than Siltie zone.

Reproductive Performance and Lamb Mortality

Onstation Performance

According to Fourie *et al.,* (2009), Dorper ewes in South Africa had age at first lambing of 346 days (11.5months), in contrast to, a well-managed ewes can lamb at the age of 13-15 months (Gavojdian *et al.,* 2013). Age at first lambing and lambing interval of 12 and 8 months was reported for pure Dorper sheep breed (Budai *et al.,* 2013), while age at first lambing of 12 and 13 months for pure Dorper and Dorper crossbred in South Africa (Fourie *et al.,* 2009).

According to Helen *et al.* (2015) the age at first lambing and lambing interval of indigenous sheep in eastern Ethiopia were 13.8±0.14 and 8.58±0.14 months, respectively. In contrast, age at first lambing of local sheep breed of 17.01 months (Samuel, 2005), 20.7 in pastoral and agro--pastoral system of Southern Ethiopia (Adugna and Aster, 2007), 14.6 for Adilo sheep (Getahun, 2008), 470.10 days for Menz sheep (Tesfaye, 2008), 12.43 months (Solomon, 2007; Zewdu, 2008; Deribe, 2009) and 12.88 months of Dawuro sheep (Amelmal, 2011). However, the least square means of age at first lambing of Dorper sheep of 11.81 (Belete *et al.,* 2015) and 11.5 months (Fourie *et al.,* 2009) was comparable with the report of 12 months (Teklebrhan, 2011) in Ethiopia. Dorper sheep crosses had better reproductive performance than indigenous sheep breed of Adilo especially in weaning weight and market weight even though it has similar sexual maturity and litter size (Belete *et al.,* 2015).

Farmer's Perception to Dorper Cross Sheep

Informal interview of the smallholder farmer indicated that the crossbred have non-selective feed behavior and excellent in meat production under farmer`s management. Farmers are highly interested and demanding introduction of additional rams. Some of the beneficiaries have earned up to 2200 Birr form the sale of adult crossbreds (Gebreyowhens *et al.,* 2017). On the contrary a study by Kebede H/giorgis and Zekarias Bassa (2017) showed that Dorper sheep was not meet farmer interest in breeding sheep aspect because of black coat color. It is suggested that to achieve upsetting farmer breeding ram interest which is increasing time to time further increasing of breeding ram producer cooperative workshould be considered.

Conclusion and Recommendation

Ethiopia has a diverse indigenous sheep population, estimated about 28.89 million, out of which about 72.84

percent are females, and about 27.16 percent are males. Sheep production in Ethiopia is based on indigenous breeds except for less than 1% exotic sheep group of mainly Dorper crossbred. However, comparing the presence of large sheep population similar to other tropical countries, present production levels are far below their potential and productivity per sheep is very low mainly due to low genetic potential as compared to improved tropical breeds. The productive and reproductive performance of sheep in Ethiopia showed variation among breeds / types, locations and differences. Besides, under farm and station condition variation exists between indigenous and exotic sheep breeds for productive and reproductive traits. The evidence from this review paper points towards the idea that productive and reproductive performance of indigenous and its crossbred with Dorper found to vary under on farm and on station conditions. It was revealed that on station performance of Horro out performed well in birth, weaning and yearling weight than other local breeds of Ethiopia, with minimum birth weight of 2.3 and maximum of 2.6 kg, respectively. With consideration of crossbreed, under on farm conditions body weight at different ages was significantly higher in 50% Dorper crosses as compared to their 25% and 75% counter parts. On station birth weight of pure Dorper out performed well than that of cross and local contemporaries, while Dorper Crossbreed (50%) is better than local breeds in terms of mean birth weight; ranges from 2.6 3.8 kg, weaning weight; ranges from 13 16 kg and yearling weight; ranges from 24 35 kg. Dorper crosses with Afar under station condition is not economically important due to lower body weights in all aspects. However, researches regarding on farm performance of indigenous and their crosses with Dorper and Awassi sheep breeds are not well grounded due to the reason that many researcher has tended to focus onstation performance evaluation rather than on farm condition. Indeed future research on On-farm performance evaluation of indigenous and their crosses with Dorper sheep breeds with different blood level inheritance should be encouraged.

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