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Review article

The influence of flock dynamics, reproductive performance and mortality on productivity of traditionally managed goats in Sub Saharan Africa

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ABSTRACT

The current goat production status and contribution to the total meat gross domestic product is still regarded as low in Sub Saharan Africa. Among some of the reasons given for unsatisfactory smallholder goat production contribution to household livelihoods is failure to understand the flock dynamics, production performance and reproductive capacity in smallholder farming sector. It is hoped that the understanding of flock dynamics, reproductive performance traits and production characteristics may assist in formulation of appropriate livestock intervention strategies to improve goat production in smallholder farming sector on the continent. Implementation of sound goat intervention stategies should be based on reproductive and productive performance monitoring data in smallholder livestock sector. However, it is acknowledged that this approach need to be complemented with other aspects of improved general goat management such as adequate nutrition and health management. The purpose of this discussion is to explore significance of understanding flock dynamics, reproduction and production characteristics in order to increase goat contribution to smallholder household livelihood.

1. Introduction

Livestock production in general is an avenue for realization of positive socio-economic change, through improved income and quality of life (Adesehinwa et al 2004). In Sub Saharan Africa, the smallholder sector, among the livestock species, small ruminants, especially goats have proved to be of utmost importance in the dry areas. This on the background that goats constitute a larger proportion of the livestock species widely kept by the rural farmers for their survival (Homann et al., 2007; Sebei, et al., 2004; Tolera, 1998). However, the role of various productive, reproductive and survival traits on the overall performance of smallholder goats is not well documented. Very little and no comprehensive studies have been carried on productive and reproductive traits of goats under smallholder arid and semi arid conditions in Sub Saharan Africa. This has result in information on these aspects beign scarce or lacking. It is suffice to suggest that improvingement in goat production requires a multidimensional approach involving criteria such as basic knowledge about the smallholder flock dynamics, performance characteristic and reproductive capacity of the animals demonstrated under local-specific farming conditions. It is hoped improvement in goat productivity in these areas will make a very valuable household contribution to the resource poor farmers. It is imperative that the significance of goats which has been underestimated and its extent of contribution to the livelihood of the poor is undervalued be revisited. The underevaluation has emanated from the fact that contribution of goat meat to the total national meat product is in most cases unknown, if there are any figures, they are probably an underestimate as goats slaughtered in rural areas are seldom recorded. Therefore, a detailed diagnosis of goat flock dynamics, production performance and reproductive capacity in smallholder farming systems will guide in any of livelihood intervention programs which takes into account the important socio-economic issues towards improving the standard of living of the rural poor on the continent. It is suffice to suggest that knowledge on smallholder goat population dynamics, productive and reproductive performance is essential component for accurate identification of opportunities to shape the future of goat production in Sub Saharan Africa. An understanding of flock dynamics, production and reproductive traits in smallholder goat farming sector is needed to improve the overall performance in this sector in order for goats to fulfill their agricultural, economic, cultural and even religious household roles. Documentation, communication and promotion of appropriate evidence based goat production intervention strategies for sustainable pro-poor smallholder goat production through understanding goat flock dynamics, production performance and reproductive capacity may improve goat productivity on the continent. The purpose of this discussion is to explore significance of understanding flock dynamics, reproduction and production characteristics in order to increase goat contribution to smallholder household livelihood.

2. Significance of goat production in sub saharan africa

Goat has emerged as a major livestock species that is enormously rising in number (Devendra, 2001; Delgado et al., 1999) and contributes to the livelihoods of millions of rural resource poor in most of the developing countries of Africa (Morand-Fehr and Boyazoglu, 1999). Africa's goat population increased by 75% between 1980 and 2005 and constitutes 30% of the world population (Simela and Merkel, 2008). Most of these goats are indigenous (Mason and Maule, 1960) and are kept by smallholder farmers in the drier ecologicall zones of Sub Saharan Africa. There is, nonetheless, all the available evidence suggests that goats are owned by a large proportion of the rural population in semi arid areas and their advantages over other livestock species in traditional farming systems is associated with small size, low initial costs, rapid turnover and efficient conversion of feed resources not directly eaten by man (Winrock International 1983). Consequently, any livestock intervention programme which target improving goat production by small-scale producers would be critical to achieving economic growth in rural communities and enhancing livelihoods in the marginal rainfall areas. It is suffice to mention that local goats are numerous hence their wider use can be expected to increase overall meat supply in both urban and rural areas where malnutrition is perenial (Van Rooyen et al., 2007). This is on the background that small ruminants, especially goats play an important role in the smallholder sector and most rural farmers in dry areas keep goats for immediate cash needs and home consumption (Hargreaves et al., 2004). This entails that goat production performance improvement becomes a major development interventions which can improve livelihoods for resource-poor farmers. The basis of smallholder goat production improvement intervention programmes lies on the understanding goat flock dynamics, reproductive performance and production characteristics as well as finding ways to reduce goat mortality in order to increase the potential for off-take and quality production.

Increased benefits from understanding of the aforementioned through monitoring and evalution need to be demonstrated under local-specific farming conditions.

3. Reproductive traits and productivity

Reproductive traits are under the influence of genetic and factors of the environment (Greyling 2000; Song et al., 2006), however, the genetic effect on each component of reproduction varies (Safari et al. 2005). The reproductive characteristics of goats are affected by various genetic and environmental factors (Chiboka et al., 1988). Reproductive goat traits, as stated by Sodiq et al. (2003), are the main traits which determine the productivity of goats, which especially relates to meat production. Reproduction is a complex composite trait influenced by many components including puberty, estrus, ovulation, fertilization, embryo implanta-tion, pregnancy, parturition, lactation, and mothering ability (Mia, et al., 2013). The reproductive performance like age at first service, body weight at first service, age at first kidding, body weight at first kidding, number of service(s) required per conception, gestation period, service period and kidding interval have been studied elsewhere, and directly and indirectly improve the production ability of the animal (Dhara et al., 2011). One of the most favorable attributes of goats as meat producing animals is their high rate of reproduction as determined by the number of progeny delivered in a given period of time (Greyling, 2000). Moaen-ud-Din et al. (2008) stated that reproductive efficiency of goats can be established based on parameters, number of live born kids, mass of kids at birth and weaning, kidding interval and duration of reproduction cycle, whereas Song et al. (2006) state that reproductive efficiency of goats is determined by age of goats at first kidding, kidding interval, type of birth, litter size and mass of kids at birth and weaning. The phenotypic variation of a complex trait such as reproduction is influenced by the level of variability among its component traits and their interactions (Snowder, 2008). Although component traits of reproduction are under the influence of many genes, a limited number of major genes associated with separate components of reproduction have been reported (Piper and Bindon, 1982; Bradford et al. 1986). Prolificacy has been reported to be the primary reproductive trait studied that was not directly influenced by management and was rather controlled by genetic and environmental factors (Wilson et al., 1989). Chikagwa-Malunga and Banda, (2006) reported an annual parturition rate of 82.6 with a prolificacy of 1.3 kids per parturition. This rate was lower than that obtained by Banda (1992) of 1.47 for local goats. However, Rischkowsky and Steinbach (1997) obtained even higher values of 2.0 for local Malawi goats when m ost kidding was taking place from October/November to March. The high prolificacy of Landim does has been well documented (Wilson et al., 1989) and was confirmed by observation in a study in Mozabique by van Niekerk and Pimentel (2004). The prolificacy of goats is partly attributed to the better management strategies, feeding does and targeting kids production for marketing (Talore, 2009). Akapa et al., (2010) observed a significant effect of breeding males and females on litter size as an indication of the genetic contribution of both the sire and dam to the performance of their offsprings, hence parents with high potential for twining or triplets may likely give birth to off-springs with high litter size potential, thus this trait can be improve through selection. However, Turner (1978) concluded that litter size seemed to be the most useful selection criterion for genetic improvement of meat production. Amoah and Gelaye, (1990) established that litter size was under significant influence of goat age and parity, whereas Awemu et al. (1999) stated parity, year and season as factors of importance for goat litter size. Reproductive performance in goats is a composite of several processes which are influenced by environmental, developmental, genetic, and managerial factors (Terrill and Foote, 1987). Significant variation among different litter size was observed in age at puberty, age at first conception and age at first kidding while in case of gestation period the variation was found to be non-significant (Zeshmarani et al., 2007). It was evident that age at puberty, age at conception and age at first kidding were earliest in single born goats in three different genetic groups studied. Alexandre et al. (1999) observed kidding interval of 8,5 months in Creole goats, whereas this interval in Chinese goat breeds established by Moaen-ud-Din et al.(2008) varied from 217 to 334 days, depending on the breed and parity. Elsewhere, Clarke (1972) cited selection for litter size being successful, although the rate of improvement has not been large, partly because the trait is only observable in females of reproductive age that do conceive and maintain their pregnancy. Different average flock size have been reported in various parts of Africa, 7.5 goats per flock in Nigeria (Francis, 1988), 5 goats in Cameroon (Ndamukong et al., 1989) and 8 goats in Ghana (Turkson, 1992). The flock size observed in our study is lower than the average flock size of 19.2 reported by FAO (2009) in Zaria and 15.5 reported by Akpa et al., (2010) in smallholder goat herds in Kano, Nigeria. A variation in flock size was attributted to quality of grazing and human population density. The smaller average flock size in general provides limited scope for a commercially

oriented approach to goat production. In the high populated areas the smaller flock size may be a result of overgrazing of grazing lands which could not sustain larger flock sizes. Age at first kidding, litter size, kidding interval and kidding rate was found to be 407.9 days, 1.16±0.04 kids, 1.46±0.03, and 307.9 days, respectively (Mengistie et al., 2013). The effect of type of birth and season of kidding on annual reproductive rate was significant that multiple bearing does and those kidded in the hot season had larger reproductive rate. Expressions of the genetic effects on repro-duction are affected by numerous environmental factors such as season, climatic conditions, management, health, nutrition, breeding ratio, age and weight of doe, and libido of buck and fertility, as a result of interaction of genetic and environmental factors achieving genetic improvement of reproduction is very complicated.

The kidding interval and service period for the rainy season kidders were shorter than cool dry season kidders. Litter size significantly affected kidding interval and service period, whereas the triplet kidders recorded longer days to second parturition and service period followed by twin and single kidders (Bushara et al., 2013). Majele-Sibanda et al. (2000) showed that season affect the litter size, since the litter size have a major impact on the kidding interval (Karua, 1989).Season of parturition influence the duration of postpartum anoestrus, and also reproduction efficiency of goats (Awemu et al., 1999). However, season of birth did not affect significantly service period and kidding interval, the despite longer kidding interval was notice in the cool dry season (Alexandre et al. (2000). Odubote (1996) observed the significant effects of parity, season and year on kidding interval in West African Dwarf goats. Kidding interval appeared to decrease with increase in age of dam while the kidding rate increased with age. The optimal kidding rate was obtained between the ages of 36 and 48 months. This finding contradicts results in Devendra & McLeroy (1982) who say that the optimal reproductive performance in tropical goats is attained between five and six years. The differences in kidding interval may be related to availability of feed from pasture during the rainy and dry seasons, which have direct influence on ovulation rate and fertility, since the nutritional stress appears to be a prime probable cause of cyclicity and long kidding interval in the goats, body weight changes support this hypothesis. Increasing management components improved goats reproductive characteristics to the level of a combination of shelters, feed and mineral supplementation (Ogebe, et al., 1995).

Local goat breeds are reputed to have low production (Simela et al 1999) as reflected in high proportion of non carcass components (Mahgoub, 1997). Livestock production in many tropical environments is constrained by low feed resources availability (Bartholomew et al., 2003) and low feed quality during a prolonged dry season (Leng, 1984; 1990) which may fail to sustain growth hence low adult mature weight at slaughter. Elsewhere increase in live weight from 18.5 to 24.5 kg caused significant increase in the percentage of lean meat in indigenous black goats in Iraqi (Tahir et al., 1994). Mediterranean countries live weight for kids goats is lower than in Arabian or Africa and logically, increasing live weight could increase a farmer's profit margin (Marichal et al, 2003). Aduku et al (1999) reported offals constituting 33% of gross value of goats in Nigeria. Offals weight showed a tendency to decrease with increase in adult mature weight at slaughter and a similar pattern have been described by Mourad et al., (2001). Noticeable was the effect of high proportion of weight of offals (particularly intestines plus rumen, internal organs-liver, lungs, kidney, heart) in reducing the proportion of edible carcass components in goats on range which may presumably limit the potential of local goats for meat production under feedlot condition. The proportion of non carcass components of goats managed extensively in the tropics and sub tropics have been general high to those in temperate environment mostly under intensive management (Mahgoub, 1997). The dressing percentage increased with increasing adult mature weight at slaughter and were usually within the range cited by Naude and Hofmeyr, (1981) which normally varies between 44 and 55% in goats and the DP estimates also correspond with the reports of Nsoso et al., (2004) and Warmington and Kirton (1990) in goats. The apparent decline in dressing percentage with increased selected adult mature weight at slaughter indicate a possible negative association of live weight for age and dressing percent and a similar trend was observed by El-Hag and El-Sharg, (1992). However generally the roles of nutrition and stage of maturity in determining dresiing percentage, level and distribution of fat are poorly understood in goats (Warmington and Kirton, (1990). The level of intake and diet composition has proved to influence goat carcass composition (Legesse and Abebe, 2008). However, appropriate fat distribution in goats can be achieved by slaughtering goats at appropriate adult mature weight for age a non genetic factors which influence growth and carcass traits of goats (Biswas and Koul, 1989) and may differ in early and late maturing goat breeds. Goats of diverse mature sizes (large vs small) are compared at similar harvest weights, larger genotypes tend to be younger (because of faster growth rates), less mature (because of slower maturing rates and younger ages) and leaner (because of tendency to fatten

at relatively heavier weights) a trend which was observed in cattle which would also reasonably apply to other livestock (Koch et al 1972, 1982).

4. Mortality and productivity

One of the most important production factors that adversely affect goats' production is high pre-weaning mortality of young kids (Devendra and Burns, 1970). Rearing of goats under communal farming conditions is characterised by high kid mortality and low weaning percentages (Mhlangabezi et al., 2014). Peacock, (1996) implicated various predisposing on kid mortality factors which include lack of colostrum, poor mothering, poor nutrition of the doe leading to low milk production, hygiene lack allowing build-up of infective agents and contaminated water. Kyomo (1978), Mchau (1979) and Sarmah et al (1981) reported that mortality was high in the preweaning period. Younger animals seem less able to withstand attack by both physical and biological agents due to their lack of immunity. This makes them more susceptible to enteric and respiratory infections (Ndamukong, 1985). Losses in the preweaning period can be minimised by providing proper shelter, prophylaxis and better nutrition. The traditional system of goat management is mainly characterised by low survivability and high mortalities of kids, which result in low weaning percentages (Sebei et al., 2004). The low mortality rate contrasts with the higher mortality of 40 to 50% reported in the humid zone (Reynolds et al, 1988). This may in part be due to the small veterinary package provided in this study which improved flock survival. High mortality among kids and slow growth among those that survive are the major constraints to production. Goat mortality has been found to be the most important constraint. Farmers with few goats are unable to sustain their flocks, whereas those with larger flocks do not realize the potential benefi ts from goats due to high mortality rates (Homann et al., 2007). Poor access to animal health support, dry season feed shortages and inadequate housing are the most important immediate factors contributing to high mortalities and can generally be ascribed to a lack of information and poor service structures. The lack of feed and mineral supplementation and poor housing resulted in high mortality rates due to lack of protection against heat and rainfall (Assan, 2014). Mortality rate is generally higher in kids than in adults (Ndamukong et al., 1989). These results were in agreement with Halpin (1975) who pointed out that the age of the animal has a great effect on its ability to withstand attack by both physical and biological agents. Thus younger animals are particularly susceptible to certain enteric and respiratory infections since they lack immunity. This age group therefore requires greater protection from the harshness of the environment through provision of adequate nutrition, housing and management. Environmental conditions on the communal farms were most favourable for the survival of free-living forms of intestinal parasites during the summer and autumn months and most adverse during spring and early summer which increases mortality rates. Hailu (2006) reported that lower survival rate for Borana and Arsi-Bale kids, which is born in the dry season than those born in the wet season. El-Abid and Abu Nikhaila (2009) also observed similar effect of season on kids' mortality rate. Kids born during the wet season had a higher mortality rate than those born in the dry season (Chawla et al, 1982). The higher mortality rate in the rainy season was associated with high rainfall and high relative humidity (Mazumdar et al, 1980), both of which are known to promote disease and parasitic infection. This might be because of different management level provided by the farmers to his flock special to overcome the effect of cold stress and feed shortage in wet and dry season of the year. Well-fed animals are more resistant to the negative effect of parasitosis than debilitated malnourished animals (Radostits et al. 1994). Other factors that may be implicated in the survival rate of kids include birth weight of the kid, genetics, mothering ability and milk production of the dam, adverse environmental or feeding conditions, diseases and predators (Snyman, 2010). Relatively low birth weight, slow growth rate and insufficient milk production by does, were identified as the major constraints directly associated with higher kid mortality and this responsible for reduction of the total productivity (Hunsain, 1993). Twins were more likely to die than were singles this observation was made by Wilson and Murayi (1988), this is because twins tended to have lower birth weights. Curtis (1969) concluded that animals with low birth weights had lower energy reserves and were therefore less able to withstand harsh environments; also if the dam has a poor milk yield, she may be unable to provide adequate nutrition for twins, thus increasing their susceptibility to disease. The birth weight of the kid had an influence on pre and post-weaning mortality rates, Mazumdar et al (1980) reported mortality rates of 100% for kids weighing 1.0 to 1.5 kg and 32.2% for kids weighing from 2.0 to 2.5 kg. Lower pre-weaning and post-weaning mortality rates are experienced when disease prevention and feed provision are good. However, inconsistent management contributed to higher mortality rates (Chawla et al., 1982; Wilson and Murayi, 1988). The standard of flock hygiene and disease monitoring needs improvement in order to

lower mortality rates. Kid mortality was reduced from 22.2 to 8.16% with the parity. Reproductive and productive performances of Black Bengal goat were better in 3rd parity than that of the 1st and 2nd parity (Hossain et al., 2004). Awemu et al. (1999) reported linear increase in survival rate with parity at the highest parity (parity 6), which may agree with Chowdhury et al. (2002) who observed that kid mortality decrease linearly with increase in parity. Any management strategies implemented to ensure survival of kids is bound to increase productivity and economic returns (Ademosun, 1987; Lebbie & Manzini, 1989). Mortality of kids may be reduced by control of internal and external parasites, feeding of the dam, vaccination and improved housing (Morand-Fehr et al., 1984; Boomker et al., 1997; Payne & Wilson, 1999). High kids mortality rate can seriously affect the economic viability of small ruminant farming, jeopardize the beneficial impact of fecundity and litter size of the flocks (Girma et al., 2011).

5. Implications

It has been clearly noted that variation in flock size is attributted to the reproductive capacity of local goat breed in question, however the quality of grazing and human population density also have a role to play in limiting the flock size. Expression of the genetic effect on repro-duction is affected by numerous environmental factors such as season, climatic conditions, management, health, nutrition, breeding ratio, age and weight of doe, and libido of buck and fertility, as a result of interaction of genetic and environmental factors achieving genetic improvement of reproduction is very complicated. On the other hand, any management strategies implemented to ensure survival of kids is bound to increase productivity and economic returns. There is need to improve birth weight, growth rate and milk production by dams as these are major constraints directly associated with higher kid mortality and this responsible for reduction of the total productivity. Litter size seemed to be the most useful selection criterion for genetic improvement in goat meat production, however records should be adjusted for age of dam and parity, for accurate ranking of animals.

References

Ademosun, A.A., 1987. Appropriate management systems for the West African dwarf goat in the humid tropics. In Goat production in the humid tropics. Eds. Smith, O.B. & Bosman, H.G., Proc. Workshop at the University of Ife, Ile-Ife, Nigeria. pp. 21-28.

Adesehinwa, A.O.K., Okunola, J.O., Adewumi, M.K., 2004. Socio-economic characteristics of ruminant livestock farmers and their production constraints in some parts of South-western Nigeria. Livest. Res. Rur. Dev., Volume 16(61).

Aduku, A.O., Aganga, A.A., Okoh, A.N., Ingawa, S.A., Phillip, D.O.A., 1999. Contribution of offals to the gross value of goat carcasses in Nigeria. Small Rum. Res., (1-2) 179-184.

Ahamed, J., 1992. Reproductive pattern of Black Bengal, Recent advances in Goat Production in Goat Production. Proc. Inter. Confer. Goats., New Delhi P 1215 – 1220.

Akapa, G.N., Alphonsus, C., Dalha, S.Y., Garba, Y., 2010. Goat breeding structure and repeatability of litter size in smallholder goat herds in Kano, Nigeria. Anim. Res. Inter., 7(3) 1274 – 1280.

Alexandre, G., Aumont, G., Fleury, J., Arquet, R., 2000. Reproductive performance of Creole goats of Guadeloupe. Proc. Inter. confer. goat., 15-21 May2000, France P.1039.

Amoah, E.A., Gelaye, S., 1990. Reproductive performance of female goats in South Pacific countries. Small Rum. Res., 3257-267.

Assan, N., Sibanda, M., 2014. Goat production in the smallholder section in the Matobo district in semi arid areas of Zimbabwe. Agric. Adv., August, Volume 3, Issue 8, pages 218- 228.

Awemu, E.M., Nwakolar, L.N., Abubakar, B.Y., 1999. Environmental influences on pre-weaning mortality and reproductive performance of Red Sokoto doe. J. Small rum. Res., 34161-165.

Banda, J.W., 1992. Genotypic and seasonal influences on milk yield and milk composition of sheep and goats in Malawi. PhD Thesis, Justus-Liebig-University of Giessen, Germany.

Bartholomew, P.W., Ly, R., Doumbia, M., Khibe, T., Kone, N'g., Traore, B., Ba, S., 2003. Agro-industrial by-products cowpea residues and urea treatment of hay for supplementary dry season feeding of mature Zebu oxen in Mali. Liv. Res. Rural Dev., 15(2) 1-2.

Biswas, J.C., Koul, G.L., 1989. Age difference of certain carcass traits and carcass composition in male Cheghu goats. Indian J. Anim. Sci., 59 (6)754 -756.

Boomker, J., Kiwanuka, K., Bester, J., Kotze, A., Mosupi, H., Green, E., Motsabi, H., Kyozaire, J., 1997. Goats and Sheep. Res. needs anim. owners at Jericho., Ed. Stewart, C.G.

Bradford, G.E., Quirke, J.F., Sitorus, P., Inounu, I., Tiesnamurti, B., Bell, F.L., Fletcher, I.C., Torell, D.T., 1986. Reproduction in Javanese sheep evidence for a gene with large effect on ovulation rate and litter size. J. Anim. Sci., 63, 418-431.

Bushara, I., Abdelhadi, O.M.A., Elemam, M.B., Idris, A.O., Mekki, D.M., 2013. Effect of Season of Birth and Litter Size on Taggar Goat's Production in Western Sudan. Wudpecker J. Agric. Res., 2 128-133.

Central Statistical Office (CSO)., 2000. Agric. Livest. Surveys in Communal Lands. Central Statistical Office, Causeway, Harare, Zimbabwe.

Chawla, D.S., Bhatnagar, D.S., Mishra, R.R., 1982. Factors affecting kid mortality in dairy goats. Indian J. Anim. Sci., 52166-171.

Chiboka, O., Somade, B., Montsma, G., 1988. Reproduction of West African Dwarf goats – A summary of research work at Ile–Ife, Nigeria. In Proc. Int. Workshop on Goat Production in the Humid Tropics. University of Ife. July, 20-24, 1987. Eds. Smith, O.B. & Bosman, H.G., Wageningen. pp. 125-137.

Chikagwa-Malunga, S.K., Banda, J.W., 2006. Productivity and survival ability of goats in smallholder crop/livestock farming systems in Malawi. Livest. Res. Rur. Dev., 18 (1).

Chowdhury, S.A., Bhuiyan, M.S.A., Faruk, S., 2002. Rearing BlackBengal Goat under semi-intensive management 1. Physiological and reproductive performances. Asian-Australasian J. Anim. Sci., 15(4) 477-484.

Clarke, J.N., 1972. Current levels of performance in the Ruakura fertility flock of Romney sheep. Proceeding of New Zealand Soc. Anim. Product., 32 99 – 111.

Curtis, H.J., 1969. Aging. In Hafez E S E and Dyer I A (eds), Animal growth and nutrition. Lea and Fibger. Philadelphia., USA. pp. 165-174.

Dadi, H., Guru, M., Alemayehu, N., Dawo, F., Duguma, G. 2006. The effect of environmental factors on preweaning survival rate of borana and Arsi-Bale kids. Small Rumin. Res., 66291-294.

Delgado, C.M., Rosegrant, H., Steinfeld, H., Ehui, S., Courbois, C., 1999. Livestock 2020 The next food revolution. Discussion Paper 28. Inter. Food Policy Center., Washington DC, USA.

Department of Veterinary Services, Province livestock statistics., 2005. Bulawayo and Gwanda, Zimbabwe.

Devendra, C., Burns, M., 1970. Goat production in the troics. C.A.B., Farnham royal,Buells, UK.

Devendra, C., McLeroy, G.B., 1982. Goat and sheep production in the tropics. Intermediate tropical agriculture series. Longman Group, U.K. 271 pp.

Dhara, K.C., Bandopadhyay, P.K., Goswami, A., 2011.Influence of gastro-intestinal parasites on productive and reproductive performance of black Bengal goat under field condition. Inter. Sci. Nature., 2(3) 638- 647.

El-Hag, M.G., El-Shargi, K.M., 1996. Feedlot performance and carcass characteristics of local (Dhofari) and exotic (Cashmere) goat fed on a high fiber by products diet supplemented with Sardine fish. AJAS 9(4) 389- 396.

Francis, P.A., 1988. Livestock and farming systems in Southeast Nigeria. In Proc. Int. Workshop on Goat Production in the Humid Tropics. University of Ife. July, 20-24, 1987. Eds. Smith, O.B. & Bosman, H.G., Wageningen. pp. 125-137.

Girma, D., Duguma, M., Hundessa, F., 2011. Effect of Different Factors on mortality rate of Arsi- Bale Kids in Mid Rift Valley of Ethiopia. Global Veter., 6 (1) 56-60.

Girma, D., Duguma, M., Hundessa, F., Messele, F., Kebede, T., Negash, M., 2013. Study on major causes of kid mortality in Adami Tulu Jido Kombolcha District of Oromia. Ethiopia Agric. Biol. J. North Amer., 4(2)110- 115.

Greyling, J.P.C., 2000. Reproduction traits on the Boer goat doe. Small Rum. Res., 36171-177.

Hargreaves, S.K., Bruce, D., Beffa, L.M., 2004. Disaster mitigation options for livestock production in communal farming systems in Zimbabwe. 1. Background information and literature review. Inter. Crop. Res. Inst. Semi-Arid Trop., Bulawayo, Zimbabwe.

Homann, S., van Rooyen, A.F., Moyo, T., Nengomahsa, Z., 2007. Goat production and marketing Baseline information for semi-arid Zimbabwe. P.O. Box 776. Bulawayo. Zimbabwe Inter. Crop. Res. Inst. Semi-Arid Trop., 84pp.

Hossain, S.M.J., Sultana, N., Alam, M.R., Hasnath, M.R., 2004. Reproductive and Productive Performance of Black Bengal Goat under Semi-intensive Management. J. Biolog. Sci., 4 537-541.

Husain, S.S., 1993. A study on the reproductive performance and genetic potentials of Black Bengal goats. Ph.D Dissertation. Department of animal breeding and genetics. Bangladesh Agric. Univ., Mymensingh.

Karua, S.K., 1989. Some performance indicators of Malawi indigenous goats under village and ranch condition. In. African Small Rum. Res. Dev., Proceedings of conference Held in 18-25 Jan, 1989, Bamenda, Cameroon.

Koch, R.M., Dikeman, M.E., Lipsey, R.J., Allen, D.M., Crouse, J.D., 1979. Characterization of biological types of cattle. II III. Carcass composition, quality and palatability. J. Anim. Sci., 49448- 460.

Kyomo, M.L., 1978. Meat from goats in Tanzania. PhD thesis, University of Dar es Salaam, Tanzania., 292 pp.

Lebbie, S.H., Manzini, A.T., 1989. The productivity of indigenous goats under traditional management in Swaziland. African Small Rum. Res. Dev., Eds. Wilson, R.T., Melaku, A.

Legesse, G., Abebe, G., 2008. The effect of breed type and feeding system of yields of edible and saleable components of Somalia and Arsi- Bale goats. Liv. Res. Rur. Dev., 20(6) 1-6.

Leng, R.A., 1990. Factors affecting the utilization of poor quality forages by ruminants particulary under tropical conditions. Nutr. Res. Rev., 3277- 303.

Mahgoub, O., 1997. Meat production characteristics of Omani Dhofari goat. 1. Live weight, growth and carcass and non carcass characteristics. Intern. J. Anim. Sci., 1225-34.

Majele - Sibanda L, Bryant MJ, Ndlovu LR., 2000. Live weight and body condition changes of Matebele does during their breeding cycle in a semi-arid environment. J. Small Rum. Res., 35(3) 271-275.

Marichal, A., Castro, N., Capote, J., Zamorano, M.J., Arguello, A., 2003. Effects of live weight at slaughter (6, 10 and 25-29 kg) on kid carcass and meat quality. Liv. Prod. Sci., 83 (2-3) 247 256.

Mason, I.L., Maule, J.R., 1960. The indigenous livestock of eastern and southern Africa. CAB Tech. Commun. No 14Farmham Roy., Buckingham, England.

Mazumdar, N.H., Mazumdar, A., Goswami, K.K., 1980. Studies on some factors affecting mortality and survival rates in Pashmina kids. Indian J. Anim. Sci., 50251-255.

Mchau, K.W., 1979. Influence of Boer goats for crossing with Tanzanian goats. MSc thesis, University of Dar es Salaam, Tanzania. 92 pp.

Mengistie, T., Belay, D., Mussie, H., Melekot., 2013. Reproductive Performance of Central Highland Goats under Traditional Management in Sekota District, Ethiopia. Asian J. Biolog. Sci., 6 271-276.

Mhlangabezi, S., Maphosa, V., Fayemi, O.P., Mapfumo, L., 2014. Farmers' perceptions of goat kid mortality under communal farming in Eastern Cape, South Africa. Trop. Anim. Health Prod., 46 (7) 1209-1215.

Mia, M.M., Khandoker, M.Y., Husain, S.S., Faruque, M.O., Notter, D.R., 2013. Estimation of Genetic and Phenotypic Parameters of Some Reproductive Traits of Black Bengal Does. Iranian J. Appl. Anim. Sci., 3(4)829- 837.

Moaeen-ud-din, M., Yanf, L.G., Chen, S.L., Zhang, Z.R., Xiao, O.Z. Wen, Q.Y., Dai, M., 2008. Reproductive performance of Matou goat under sub-tropical monsoonal climate of Central China. Trop. Anim. Helth. Prod., 4017-23.

Moll, E.J., 1983. Trees of Southern Africa. C. Struik publishers, Cape Town, South Africa.

Morand-Fehr, P., Boyazoglu, J., 1999. Present state and future outlook of the small ruminant sector. Small Rum. Res., 34, 259-269.

Morand-Fehr, P., Villette, Y., Chemineau, P., 1984. Influence des conditions de milieu sur la mortalite des chevreaux. Les maladies de la chevre goat diseases. INRA Publishers, France. p. 28.

Mourad, M., Gbanamou, G., Balde, I.B., 2001. Carcass characteristics of West African Dwarf goats under extensive system. Small Rum. Res., 42(1) 81- 85.

Naude´, R.T., Hofmeyr, H.S., 1981. Meat production. In C. Gall (Ed.), Goat production (pp. 285–307). London Academ. Press.

Ndamukong, K.J.N., Sewell, M.M.H., Asanji, M.F., 1989. Management and productivity of small ruminants in the North west province of Cameroon. Trop. Anim. Health Prod., 21, 109-119.

Nsoso, S.J., Mannathoko, G.G., Tadubana, T.T., Malela, L., 2004. The effect of methods of castration on live weight, dressing percentage and linear body measurements of indigenous Tswana goats raised under semi-intensive management in South East Botswana. Livest. Res. Rur. Dev., 16 # 2. retrieved November 2, 2004.

Odubote, I.K., 1996. Genetic parameters for litter size at birth and kidding interval in the West African Dwarf goats. Small Rum. Res., 20 261-265.

Ogebe, P.O., Ogunmodede, B.K., McDowell, L.R., 1995. Growth and reproductive characteristics of nigerian southern goats raised by varying management systems. Livest. Res. Rur. Dev., 7(1).

Payne, W.J.A., Wilson, T.R., 1999. An introduction to animal husbandry in the tropics. Fifth ed., Blackwell Science Ltd. United Kingdom., pp. 447-481.

Peacock, C., 1996. Improving Goat Production in the Tropics. Manual for development workers An Oxfarm/Farm-Africa Publication, UK and Ireland., pp. 46-63, 153-161, 204-205.

Piper, L.R., Bindon, B.M., 1982. Genetic segregation for fe-cundity in Booroola Merino sheep. Pp. 159-168 in Genetics of Reproduction in Sheep. R.A. Barton and D.W. Robinson Eds. Butterworths, London.

Radostits, O.M., Blood, D.C., Gay, C.C., 1994. Diseases caused by helminth parasites. In Veterinary Medicine a textbook of diseases of cattle, sheep, pigs, goats and horses, 8th edition. London, Balliere Tindall., Pp 1223–1230.

Reynolds, L, Atta-Krah, A.N., Francis, P.A., 1988. A strategy for improving goat productivity under village production systems in the humid tropics. In Smith O B and Bossman H G (eds), Goat production in the humid tropics. Proceedings of a workshop held at the University of Ife, Ile-Ife, Nigeria, 20-24 July 1987. Pudoc (Centre Agric. Publish. Documentat.), Wageningen, The Netherlands. pp. 29-37.

Rischkowsky, B., Steinbach, J., 1997. Goat's milk for smallholders in Malawi - A way of improving the nutrition of the rural population. Anim. Res. Dev., 46 55-62.

Safari, E., Fogarty, N.M., Gilmour, A.R., 2005. A review of genetic parameter estimates for wool, growth, meat and repro-duction traits in sheep. Livest. Prod. Sci., 92, 271-289.

Sarmah, P.C., Thakuria, K., Sarma, H.K., Borah, H.P., Mohan, M., Pant, K.P., 1981. Note on kid mortality in Assam local breed. Indian J. Anim. Sci., 51248-249.

Sebei, P.J., McCrindle, C.M.E., Webb, E.C., 2004. Factors influencing weaning percentages of indigenous goats on communal grazing. South African J. Anim. Sci., 2004, 34130- 133.

Sibanda, R., 2005. Livestock development in southern Africa future research and investment priorities. Zimbabwe country report. Inter. Crops Res. Inst. Semi-Arid Tropics, Bulawayo, Zimbabwe.

Simela, L., Merkel, R., 2008. The contribution of chevon from Africa to global meat production. Meat Sci. Rev., 80(1) 101- 109.

Simela, L., Ndlovu, L.R., Sibanda, L.M., 1999. Carcass characteristics of marketed Matebele goats from south western Zimbabwe. S. Rum. Res., 32(2) 173- 179.

Snedecor, G.W., Cochran, W.G., 1980. Statistical Methods. 7th Edition. The Iowa State University Press. Iowa, USA.

Snowder, G.D. 2008. Genetic improvement of overall reproduc-tive success in sheep a review. Asoc. Latinoamericana de Prod. Anim., 16(1), 32-40.

Snyman, M.A., 2010. Factors affecting pre-weaning kid mortality in South African Angora goats. South African J. Anim. Sci., 2010, 40 (1).

Sodiq, A., Adjisoedarmo, S., Tawfik, E.S., 2003. Reproduction rate of Kacang and Peranakan Etawah goats under village production systems in Indonesia. International Research on Food Security, Natural Res. Manag. Rur. Dev., Deutscher Tropentag-Göttingen, 1-7.

Song, H.B., Jo, I.H., Sol, H.S., 2006. Reproductive performance of Korean native goats under natural and intensive conditions. Small Rum. Res., 65284-287.

Tahir, M.A., Al-Jassim, A.F., Abdulla, A.H., 1994. Influence of live weight and castration on distribution of meat, fat and bone in the carcass of goats. S. Rum. Res., 14(3), 219- 223.

Terrill, C.E., Foote, W.C., 1987. Estimating reproductive per-formance in goats. Pp. 577-583 in Proc. 4th Int. Conf. Goats, Brasilia, Brasil.

Tolera, A., 1998. Production situation and some productivity and physical characters of traditionally managed sheep and goats in Kochore Woreda, southern Ethiopia. J. Appl. Anim. Res., 13(1-2) 49-59.

Turkson, P.K., 1992. The practices and problems of rural women involved in small ruminant.production. In Proc. West African Commonwealth Veterinary Association / Ghana.Veterinary Medical Association conference. 7-12 September. Eds. Amanfu, W. and.Koney, E.B.M., Ghana. pp. 135-140.

Turner, H.N., 1978. Selection for reproduction rate in Australian Merino Sheep direct responses. Australian J. Agric. Res., 29 327 – 350.

UNDP, P.R.F., IDS., 1998. Human development report Zimbabwe. United Nations Development Programme, Poverty Reduction Forum. Inst. Dev. stud. Zimbabwe.

Van Niekerk, W.A., Pimentel, P.L., 2004. Goat production in the smallholder section in the Boane district in Southern Mozambique South African J. Anim. Sci., 34 (Supplement 1)123-125.

Warmington, B.G., Kirton, A.H., 1990. Genetic and non-genetic influences on growth and carcass traits of goats. Small Rum. Res., 3147-165.

Wildeus, S., 1996. Reproductive management for meat goat production. Proceed. Southeast Reg. Meat Prod. Sympos., Feb 24, 1996, Tallahassee, Florida.

Wilson, R.T., Murayi, T., 1988. Productivity of the Small East African goat and its crosses with Anglonubian and the Alpine in Rwanda. Trop. Anim. Health Prod., 20219-228.

Wilson, R.T., Murayi, T.H., Rocha, A., 1989. Indigenous African small ruminant strains with potentially high reproductive performance. Small Rumin. Res., 2, 107-117.

Winrock International., 1983. Sheep and goats in developing countries. Their present and potential roles. The World Bank, Washington, D.C. U.S.A. pp 116.

Zeshmarani, S., Dhara, K.C., Samanta, A.K., Samanta, R., Majumder, S.C., 2007. Reproductive performance of goats in Eastern and North-eastern India. Livest. Res. Rur. Dev., 19 (8).