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Reproductive Potentials of West African Dwarf Sheep and Goat: A Review

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Abstract: The accelerating demands of a growing human population and the pressures of economic development are affecting the security and survival of many indigenous African small ruminant breeds. Until now, these breeds have been a stable part of their particular ecosystems for hundreds of years. There is an increasing tendency to introduce exotic germplasm and/or to concentrate on a narrow range of supposedly more profitable breeds. As a result, indigenous small ruminant breeds are threatened, even though they have been naturally selected for the local environments and are therefore best adapted. Problems preventing extensive utilization and improvement of African animal genetic resources need to be identified. Genetic improvement programs need to be renewed. Breeds already endangered need to be conserved as a matter of urgency even if their economic value is not presently apparent. Concurrently, information should be compiled on reproductive performance and adaptive characteristics of these Animal Genetic Resource (AGR) populations to aid the development of rational utilization and conservation programs.

Key words: Sheep, goats, ruminant, reproduction

INTRODUCTION

Increase in the human population and the scarcity of production resources exert severe pressure on the small-scale mixed farming system and threaten its existence (Peters and Laes-Fettback, 1995). Increasing demand for animal protein and the ever-increasing competition for land resources call for major structural changes in the agricultural sector, which is the major occupation, subsistence and income in the tropics. A major objective of such changes will be to increase productivity per animal and per unit area. With the threat of land degradation, rising demand in animal products should be met by an increase in animal productivity and by further increase in animal numbers, which means increased production per animal through changes in animal genotypes, better feeding and management (Opara *et al.*, 2005). Small ruminants have an increasing role to play in areas

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where the availability of land and fodder is insufficient (Horst, 1981). They can utilize fodder resources high in crude fibre and present the advantage of high productive performance and a small body size that makes it feasible to adapt to extreme environmental conditions (Peters, 1988).

By increasing small ruminant rearing and productivity, high degree of integration can be achieved in the existing farming systems in the Tropics. The high productivity and low capital investment demand of small ruminant production ensures easy access to animal protein supply, higher liquidity of the smallholder enterprise and a ready supply of easily applied manure. Small ruminant production is a further strengthening of the socio-cultural institutions through its cultural relevance and religious function. Kezie (1997) reported on the situation in Togo where sale of small ruminants (sheep and goats) is effected to meet family needs, especially before the harvest, at the beginning of the new school year and in case of illness and where the preference of sheep and goat as slaughter animals at religious purposes is more pronounced. Ngere (1973) and London (1993) have made similar reports pertaining to the situations in Ghana and the importance of indigenous small ruminant. In drought areas, small ruminants are increasingly playing the role of bridging the gap between good years and drought years, years of plenty and years of hunger. Besides being a means of supply of meat, milk and hides, sheep and goat production as a sector of small ruminant production could form a basis for major export trade as has been the case in Somalia, where big livestock (cattle and camels) and small ruminants (sheep and goats) have made up to 80% of the national export trade, with the latter numerically making up 75% of all animals (Mumin, 1986). West African Dwarf sheep and goats have their own specific roles within complex and diversified farming systems. The role of science is to bring this more to bear.

This study focuses on the reproductive status of indigenous West African Dwarf sheep and goats, as well as the constraints and potentials for improvements under small-scale production.

FLOCK STRUCTURE

According to Moll (1989), Prestige and status were terms used in derogatory manner, to describe the behavior of traditional ownership in relation to their animals. The reasons for keeping livestock are rational and are related to their particular needs in the long or short term. This is supported by the age and sex structure of the flocks. In rural areas, goats are generally more important than sheep for religious purposes (Moll, 1989). Nevertheless, goats and sheep do not arouse the same emotions in rural people as do cattle (Hunter, 1936). Whatever the major objective of keeping sheep and goats, there is always the preponderance of the female in the flock while minor differences in sex and age structure are maintained. The WAD sheep and goat are productive, whether production consists of giving birth to young, producing milk, or simply the process of growth to a size at which another product becomes the principal one.

The major management practice used to obtain stability of structure is the selling or slaughtering of the animals for home consumption and/ or performance of rituals, for ones not required for other production functions. There is usually one or two bucks retained in the flock for breeding.

The animal production system in the tropics is traditional, with the principal degree of dependence of the household or the production unit on livestock or livestock products for household income or for food supply. Where crop production is in association with the livestock production. The WAD sheep and goats are managed on free range, are allowed to

graze a distance away from home, sometimes under the supervision of the herdsman and are enclosed in a wooden hut at night. Daily movement of livestock from home to the grazing fields is recognized as an important aspect of management within the system. The enclosing of livestock in the huts is done mainly to protect them from theft and predation.

Ownership of WAD Sheep and Goats

The role of women in the various aspects of ownership of sheep and goats is typical in many African countries having similar cultural background. In most African countries, culture dictates that women are subordinates to men and hence are socially marginalized (Okali and Sumberg, 1985). Women mostly own goats and sheep but they do not have a room for decision making on how to utilize their animals, e.g., they are not allowed to sell goats in the absence of their husbands, who are migrant laborers, even though they are the ones, who own them. The various decision-making levels related to goat's ownership in the tropics depict a conspicuous gender imbalance, which is a product of strong cultural background bias against women.

Potentials for WAD Sheep and Goat Production

In animal production systems, the value of a species increases in relation to its adaptation, capacity to make socio-economic contributions, capacity to fill market opportunities and potential for increasing productivity (Maniabolo and Webb, 2005). There is a considerable potential for increased WAD sheep and goat production, if proper management is employed. Much will depend on recognition of their values as small domestic animals.

The WAD Sheep and goats are highly adaptable to a broad range of environments. They can utilize a wide variety of plant species and are thus complementary to cattle and camels. They generally do not compete directly with these species for feed. For example, a mixture of animal species on semi-arid rangelands makes it possible to change the stocking rate from 26 ha per Tropical Ruminant Livestock Unit (TRLU) (250 kg live weight equivalent) for cattle alone to 13 ha per TRLU when cattle and goats are reared together and to 10 ha per TRLU when camels are included (Shwartz, 1983). It is this complementary nature of the ruminant species that maintains the high animal biomass that characterize pastoral production systems.

Goats are more effective at grazing selectively than any other domestic livestock species (Winrock International, 1983) and they utilize poor quality forage and browse better than sheep. Goats also walk longer distances in search of food than do other domestic livestock (Wilson, 1991). Due to their short generation lengths and high reproductive rates, West African Dwarf sheep and goats have high production efficiency (Winrock International, 1992). In addition, the energetic efficiency of milk production may be higher in dairy goats than for other dairy animals (Winrock International, 1992). West African Dwarf sheep and goats are thought to be tolerant of trypanosomiasis and other diseases, allowing them to be grazed on land not available to other domestic livestock (Okoli *et al.*, 2005).

The WAD sheep and goat are useful to humans during periods of cyclical and unpredictable food shortages. They also help balance the energy and protein supply during normal variations between seasons and years. The small size and early maturity of WAD sheep and goats give them several distinct economic advantages in smallholder situations. They can efficiently utilize marginal and small plots of land; the risk on investment is reduced by smaller individual size, allowing more production units per unit of investment; and there is a faster turnover of capital because they mature early sexually and are younger at

slaughter. Smaller carcasses are also easier to market and can be consumed in a short period of time. This is important as most rural areas lack proper storage facilities. Their strong flocking instinct makes herding by younger and older members of the family possible, allowing labor to be used more efficiently.

They produce lower absolute quantities of milk than cattle. However, when their body weight is taken into account, their milk yield is higher than other species, with the possible exception of camels (Wilson, 1991). During difficult periods of the year, these minor levels of output become significant (Coppock *et al.*, 1982). It has been estimated that up to 40 years may be needed for cattle to attain the population and production levels existing prior to a drought (Wilson, 1991). Because of their shorter generation length and higher reproductive rate, WAD sheep and goats have a much shorter recovery period. For example, following a severe drought, goats conceive as soon as there is sufficient moisture for leaves and browse plants to grow. They kid five months later and consequently produce milk for human consumption at a very early phase of the recovery cycle (Wilson, 1991).

Although, regional variations exist, WAD sheep and goats appear to withstand drought better than cattle (Campbell, 1978). The droughts of the early 1980s, which affected Ethiopia and the Sahel, including Sudan, resulted in cattle losses of 80% or more. Small ruminant losses did not exceed 50% (Wilson, 1991). Shafie (1992) has summarized the physical and physiological characteristics, which enable WAD sheep and goats to survive in arid and saline environments. These include: body conformation (slim trunks and slender limbs), which provide a large proportional surface area, helping excess body heat dissipate through non-evaporative cooling and a respiratory system with a larger proportion of dead space to respiratory space, a structure which facilitates heat dissipation via respiratory water vaporization, without the need for severe panting. Due to their adaptation to the environment (including feeding behavior), small ruminants, particularly goats, are often the last to be affected by catastrophes.

REPRODUCTIVE POTENTIALS OF WAD SHEEP AND GOATS

Annual Reproductive Rate

The annual reproductive rates of WAD sheep and goats are composite parameters, which do not appear to be utilized as much as it should be (Wilson, 1989). The total number of young per breeding female per year has been calculated as the size of the litter and the number of days in a year divided by the kidding interval, that is (litter size x365/kidding interval). The annual reproductive rate for indigenous West African Dwarf sheep and goat was found to increase with age and peaks at 3 to 4 years of age, remain stable and then starts to decline (Table 1).

Breeding Season

The WAD sheep and goat is the most prolific of all the domesticated ruminants under tropical and subtropical conditions and are able to breed throughout the year (Hofmeyer *et al.*, 1965; Devendra and Burns, 1970; Casey *et al.*, 1988; Greyling, 1988). The

Table 1: The effect of age on prolificacy of WAD goats

Age (years)	Prolificacy (%)
2.5	56.1-77.3
3.5	7.3-98.2
4.5	133.4-183.7
5.5	106.2-146.3

Source from Mamabolo and Webb (2005)

indigenous goats breed throughout the year with the highest kidding in autumn which indicates summer breeding which coincides with optimum feed availability. The length of the breeding season is primarily the result of genetic and environmental interaction (Casey *et al.*, 1988) with the environment playing a major role. WAD sheep and goats have been reported to be polyestrous all year round, Devendra and McLeroy (1982) and Amoah *et al.* (1996) and it is believed that environmental factors other than the photoperiod (e.g., feed availability, rainfall, temperature and humidity variations) may affect the breeding season of WAD goats and sheep.

Gestation Period

The gestation period is usually defined as the period from conception to parturition. The gestation length for WAD sheep and goats is found to be 145 to 148 days; this is similar to the gestation period in Boer goat doe in South Africa (Greyling, 1988). The gestation period of 149 days is normal in the goat (Shelton, 1978), varying between 144 and 150.8 days. Whether the weight of the kids, type of birth (single or twins) and type of diet affect the gestation period was not evaluated in this review.

Age at First Kidding

Similar to the Boer goat does (Casey *et al.*, 1988; Greyling, 1988), the indigenous WAD sheep and goats are early breeders, reaching puberty at 6 to 7 months of age. The age at which they first kid is between 16 and 18 months. Other authors (Robinson *et al.*, 1977) reported similar results (16-17) for age at first kidding for West African Dwarf goats in Chad. This is longer compared to Togo, Sahel and Maradi goats (15 months, 13 Months and 14 months, respectively) (Wilson and Light, 1986) and for West African Dwarf goats in Nigeria (Ikwuegbu *et al.*, 1995). The effect of age at first kidding for the communal goats is shorter than that reported for Rwandan goats (Wilson, 1989). Compared to most breeds of indigenous small ruminants in the tropics the WAD sheep and goats are more prolific than most of other reports on age at first kidding in African traditional systems (Wilson and Dukin, 1983; Manjeli *et al.*, 1996; Ikwuegbu *et al.*, 1995). This situation is expected in traditional management systems where bucks run continuously with does.

Litter Size

Mamabolo and Webb (2005) reported that the litter size of WAD sheep and goat is 1.7. The most frequent litter size was twins (96 and 93% for both autumn and spring), respectively together accounting for 76% and lower twinning in winter (32%) accounting for 24% of births. In winter, 68% of kids were born as singles (Table 2).

Kidding Interval

Mamabolo and Webb (2005), reported that the kidding interval for indigenous goats in Mootse was 258 days. This interval is slightly shorter compared to those obtained from previous studies in West Africa for West African Dwarf goats and with other types of goats

Table 2: Seasonal type of birth for communal goats

Season	Single birth	Twin birth (%)	Proportion of total
Autumn	4	96	54
Winter	68	32	24
Spring	7	93	22
Summer	0	0	0

Source from Mamabolo and Webb (2005)

in other parts of Africa (Wilson *et al.*, 1984; Odubute *et al.*, 1992). The kidding interval of 250 days is similar to that found for West African Dwarf goats in Southern Nigeria (Ikwuegbu *et al.*, 1995). The shortest interval generally occurs in traditional systems where uncontrolled breeding is the norm. Thus in effect the WAD sheep and goats, under traditional village conditions kid three times in two years, in agreement with the findings. The kidding patterns indicate that the prolificacy of indigenous goats and sheep increases with age, reaching its peak at four years of age (Table 1).

Constraints to the Reproductive Potentials of West African Sheep and Goat

Livestock production efficiency is to a large extent dependent on reproductive performance. Reproductive performance is about five times more important than product quality (Nwaodu, 2008). The aim for animal production is the reproductive ability of such animal from which accounts the continuity of animal meat, milk, egg and other products are sure (Otuma *et al.*, 2005). However, in a subsistent extensive or nomadic production system common in the sahelian and tropical ecozones of Africa for example the overall viability of the system depend largely on reproductive efficiency, to replenish the herd that is often decimated by harsh environmental conditions and diseases (Okoli *et al.*, 2000, 2006). West African dwarf sheep and goat are very prolific, possessing high frequency of kidding and ability to survive under poor management, despite their poor genetic potentials for growth and milk production (Adebambo *et al.*, 1994). The remarkable reproductive potential in terms of young produced per female per year (Gall *et al.*, 1992; Wilson *et al.*, 1984) was found to follow the change in dry and rainy seasons and so influenced by temperature, humidity and nutritional status of the animal.

Constraints to increased WAD sheep and goat production in the Tropics and Subtropics are of a biological and environmental nature and relate to the available potential, survival in hot tropical environments and required efforts to increase production.

Potential productivity of WAD sheep and goat is constrained by poor understanding of the many values of these animals and of strategies for improved natural resource management in target environments. False perceptions (environmental degradation, biases, inadequate official support and resource) are the major believes of people to rule against WAD sheep and goat production. Until recently, there has been an official bias against goat as destroyer of vegetation. Because of this prejudice, efforts to exploit the full potential of this animal have been generally minimal compared to efforts in cattle (Bembridge, 1989). The controversy-surrounding goat is associated with the environmental and alleges resource degradation. Such criticisms are not unique and can apply to other herbivores, but with goats, the allegations are more severe because of their unique mouth parts, selection of feeds, ability to adapt to varying forage quality and capacity to use coarse grazing and shrubs to advantage.

Studies on small ruminants, particularly goats have been less numerous than cattle and major production constraint are less well known. Nutritional problems appear to be less acute than on cattle (Wilson, 1988). Theft, predation and poor hygiene in ascending order appears to be the most important problem limiting goat production (Mamabolo and Webb, 2005). Lack of understanding of economic and social values of small ruminants by developers and scientists undoubtedly restrict goat production and education program to overcome this could be of great benefit to rural people.

The WAD Sheep and goat production in the Tropics is also constrained by the following factors:

- Low genetic potential
- Seasonality of availability of feed and scarce water resources
- High ambient temperature
- Mortality

However, Okoli *et al.* (2000) and Odeyinka Okunade (2005) stated that; other constraints to indigenous small ruminant production in the tropics includes: diseases, accidents, seasonality of feed supply, theft, destructive habit of goat, lack of capital and land. Similar constraints have also been reported in literature (Gefu *et al.*, 1994; Doma *et al.*, 1999; Sumberg and Mack, 1985).

Low Genetic Potential

Most indigenous breeds of small ruminants in the Tropics have not been selected for high productivity. This implies low rates of growth and long time to reach physiological maturity (Bullerdiek, 1996). Low genetic potential of WAD sheep and goat is often quoted as a major constraint to meat and milk production in sub-Saharan Africa (SSA). The current fertility status of communal WAD sheep and goat is low. Poor production results mainly from kid mortality and inbreeding. In traditional livestock management does and bucks run together for the whole period of their lives, usually one or two bucks are left in the herd and can even be left for more than five years, consequently inbreeding occurs. Studies indicate that the performance of indigenous breeds of small ruminants could be improved through management. Additionally, estimates of genetic parameters point to considerable genetic variation within indigenous populations. This indicates the potential for genetic improvement through selection.

There has been a tendency to over-emphasize the low productivity of indigenous breeds without due consideration of some important characteristics of these breeds. When the small size of these breeds and the harsh environmental conditions under which they are raised are taken into account, their productivity is impressive. Comparative studies of indigenous and exotic breeds to determine their feed utilisation efficiency have not been conclusive. However, it is known that breeds with high maintenance requirements tend to lose the most weight and have the highest mortality rates under stress conditions such as drought (Frisch, 1984). Most breed comparison studies have concentrated on quantifying performance (e.g., live weights and milk production) but not inputs. Indeed, the high-performing temperate breeds cannot survive under traditional management in most African environments. Although, the performance of indigenous breeds under improved management has not been adequately assessed, there are indications that they respond to improved husbandry. For example, Kolff and Wilson (1985) have reported that indigenous small ruminants were able to double their daily weight gain rate with only minimal improvements in nutrition and management. The ability to survive under adverse environmental conditions with low inputs makes indigenous breeds a low-risk choice. The low-risk factor of resistant breeds is important where market prices are unstable or where the probability of death from environmental stress is high (Frisch, 1984). In some cases low productivity is an adaptive mechanism. For example, delayed age at first parturition and extended parturition intervals in semi-arid environments are mechanisms for coping with seasonal and often unreliable feed availability. In such environments some flock owners deliberately delay first breeding (Wilson *et al.*, 1984). Poor nutrition increases the animals' susceptibility to diseases. Animals that have low maintenance requirements and the ability to make efficient use of poor quality forages are therefore at an advantage. There is a need

for comparative evaluation of indigenous and exotic breeds in African environments, taking input costs and output prices into account.

Most imported (temperate) breeds are raised on high potential agricultural land where crop farming is practiced. The critical role of indigenous breeds is in providing the only means of using areas where other forms of agriculture are not practical. It may not be possible to improve some of these environments, especially in the arid zone, to accommodate exotic breeds. However, the strategy will most probably be some kind of crossbreeding to take advantage of breed complementarity and/or upgrading to allow gradual improvement in husbandry. Additionally, recent developments in biotechnology indicate that direct transfer of genes may become a routine method for germplasm improvement. Thus there is need to keep a reservoir of these exceptional genes. Indigenous breeds are crucially important today and will continue to be valuable in the future.

Seasonality of Availability of Feed and Scarce Water Resources

Indigenous small ruminant have been reported to have a remarkable reproductive potential in terms of number of young produced per female per annum (Wilson, 1991), because day length is relatively constant in the tropical locations. However, reproductive activities do follow the change of dry and rainy season and are influenced by temperature and humidity. Climatic factors have been observed to influence greatly the productivity of WAD sheep and goat under traditional system of management through their effect, principally on forage and water availability, thermal stress and photoperiod which are reflected in seasonal trends in growth, reproduction and morbidity (Butswaat, 1994).

To be able to survive in hot climates, animals should demonstrate the ability to consume and digest feed stuffs high in crude fibre content and to survive under conditions of seasonal feed availability, water scarcity, high heat and radiation while still retaining the ability to utilise the range (Horst and Peters, 1983). Feed production, quality and availability are dictated by weather changes and thus take a seasonal pattern. Low productivity of tropical WAD sheep and goat and seasonal availability of feed do not therefore offer the best combination for increased production. Only fast growing strains with a higher rate of growth from birth to weaning could utilise seasonally available feed resources including crop by-products more efficiently. The natural ability of the animal to regain weight lost due to feed scarcity upon realimentation provides the possibility for compensatory growth and recovery and efficient utilisation of scarce feed resources characterised by the same seasonal pattern.

Conditions of rearing that are free from thermal stress also generally yield the highest economic returns such that it would be in the interest of the producers to be aware of them and to take any necessary steps to provide the necessary climate in the shed and to select breeds or individuals of animals best suited to a given climatic area (Rege, 1992) The tropical environment might pose problems of a thermoregulatory nature and of survival for temperate strains (Bianca, 1976) of small ruminant which have mostly been selected for higher productivity over a long period of time. The tropical climate and weather are both characterised by high ambient temperatures especially during the day. Cold nights and winds are a common feature in the dry part of the Tropics.

According to (Ademosun, 1992) knowledge in the area of bioclimatology of the farm animal needs to be extended to include the effects of such factors as age, sex, breed, level of feeding and level of performance to be adequate. It would then be possible to link theory with practice provided the behaviour of the animals under variable climatic conditions are studied and properly interpreted to solve related problems in the animal production sector.

Unlike field studies, experiments in the climate chamber have the advantage of reducing to a minimum the number of effective climatic factors as well as bringing under control or eliminating altogether non-climatic factors such as nutrition and husbandry and thus making it possible to identify causes and interpret results for practical use (Ademosun, 1992).

Thermoregulation covers all changes taking place in a given animal in response to thermal stress which enables the animal to maintain body temperature within normal limits for its species when exposed to cold or heat (Bianca, 1976). Such changes are functional (e.g., shivering or sweating), structural (e.g., vlies type) or behavioural such as the search for a less hot micro-climate. Behavioural changes normally form the first pattern of response followed by physiological ones. In view of the long time it would take to select for high productivity within the local tropical breeds of small ruminant and regarding the existing big gap between demand and supply of animal protein, the production of crosses of temperate and tropical breeds becomes all the more relevant in an effort to increase productivity while retaining the ability of the animal to apply adequate thermoregulatory function.

High Ambient Temperature

High ambient temperature has a negative effect on productivity. This negative effect is direct in the form of stress suffered by the animal and the diversion of energy from the purpose of production to regulation of body temperature and indirectly by affecting the availability of feed resources upon which production is dependent. The availability of feed resources has a seasonal pattern implying that they are quantitatively and qualitatively inadequate during some seasons of the year. All this raises the question of the feasibility of rearing cross breeds with regard to both survival and maintenance of high productivity. Whereas measurement of productive adaptability needs a long period of time to quantify, basic indication of the ability to survive can be deduced from the physiological reaction of animals subjected to high ambient temperature in a climate chamber.

Effect of High Ambient Temperature on Feed Intake and Digestibility

Feed and water intake: Feed intake forms the basis of production such that a thermostatic regulation of intake (increase and reduction of appetite in the cold and heat, respectively) under extreme climatic conditions becomes an important point for animal production (Ademosun, 1992). High productivity is associated with a high metabolic rate and hence high heat production (Bianca, 1976). Heat induced reduction in appetite is therefore useful as a mechanism of thermoregulation with the disadvantage that this implies loss in production. High ambient temperature is known to cause reduction in feed intake (Stelk, 1987; Kaiser, 1992) but increased digestibility due to reduced rate of passage (Blaxter and Wainman, 1961; Mc-Dowell *et al.*, 1969; Faichney and Barry, 1986; Stein, 1991) and therefore reduction in energy lost in faeces (Graham *et al.*, 1959); as well as increase in water consumption (Mc-Dowell *et al.*, 1969; Klein, 1984; Faichney and Barry, 1986) and frequency of consumption (Miescke, 1977). On the other hand, low ambient temperature has been known to increase feed intake (Klein, 1984) followed by reduction in digestibility (Kennedy and Milligan, 1978; Kennedy *et al.*, 1982) and N-balance (Bailey, 1964). A combination of low ambient temperature and high fibre ration has been associated with a negative balance of both N and energy (Kaiser, 1992). Further, sheep and goat are said to be able to better tolerate high ambient temperature than cattle with regard to loss of appetite due to low metabolism per unit surface area (Blaxter and Wainman, 1961). The effect of ambient temperature on digestibility has not been found to be lineal (Stein, 1991).

Table 3: Effect of increasing ambient temperature (°C) on DM and raw fibre intake

Temperature at 60% RH		DM intake (%)		
From	To	Ration 1	Ration 2	Ration 3
Concentrate roughage		95:5	20:80	10:90
15°C	30°C	-10.81	-	-4.98
30°C	35°C	-11.30	-12.85	-4.44
20°C	30°C	-	-2.95	-
20°C	35°C	-	-15.42	-
15°C	35°C	-20.89	-	-9.20
Raw fibre intake (%)				
15°C	30°C	-15.26	-	-10.00
30°C	35°C	-14.91	-13.33	-1.59
20°C	30°C	-	-8.16	-
20°C	35°C	-	-20.41	-
15°C	35°C	-27.90	-	-11.43

Source: Based on Kaiser (1992)

Table 3 shows that both DM and raw fibre intake were negatively affected by high temperature, the reduction in intake of raw fibre was generally higher than for DM. The reduction in intake of both nutrients was lower for Ration 3 than for 1 and 2.

Effect of High Ambient Temperature on Production

High ambient temperature has been associated with a reduction in growth rate and milk yield, which affect the survivability of the young once. Data on growth performance of lambs under high ambient temperature experiments in the climatic chamber is limited in terms of how it affects various genotypes. Data on milk performance has largely been concerned with dairy cattle. The physiological reaction of cattle in this case could be comparable to that of sheep and goat subjected to similar conditions. From 15°C/60%RH to 30°C/60%RH constant ambient temperature, 55% reduction in ADG has been reported and associated with 38% reduction in energy intake. In this case, two-thirds of the lambs reared at 30°C /60%RH were prematurely removed from the experiment for failing to meet the minimum growth requirement of 50 g Average Daily Gain. The same lambs recorded an average of 0.4°C higher rectal temperature than those retained.

High ambient temperature has been associated with decline in milk yield (Johnson *et al.*, 1960; Scott and Moody, 1960; Wayman *et al.*, 1962; Miescke, 1977; Rodriguez *et al.*, 1985; Klein, 1984) especially in late lactation (Johnson *et al.*, 1960). Decline in milk yield was the result of reduced feed intake (Wayman *et al.*, 1962; Miescke, 1977) and reduced efficiency of utilisation (Wayman *et al.*, 1962) and could be accompanied by loss in weight and reduction in fat content. At high ambient temperature, interaction with feeding level was increased with regard to milk yield and quality and the physiological reaction of dairy cattle (Scott and Moody, 1960; Leighton and Rupel, 1956; Wayman *et al.*, 1962). At ambient temperature of between 15°C and about 22°C, milk yield was less sensitive to variation (Cummins, 1992).

High milk yield under high ambient temperature conditions was associated with low body temperature and high sweating rate (Klein, 1984). At about 40°C, high productivity was associated more with high energy deposition in the form of fat due to heavier body weight and higher chronological age (Charring *et al.*, 1992). Earlier, Johnson *et al.* (1960) noted that potentially high and average milk yielding dairy cattle may demonstrate similar performance at an extreme ambient temperature level of 90°F/50%RH.

Mortality

Mamabolo and Webb (2005) reported that the mortality rate of goats in Mootse South Africa ranged between 3.75 and 40.1%. Similar rate of mortalities were reported in other

parts of Africa for goats (Bembridge, 1989; Manjeli *et al.*, 1996; Wilson *et al.*, 1984; Ikwuegbu *et al.*, 1995; Gall, 1981; Devendra and Burns, 1970). Unlike the West African Dwarf goats where the major causes of mortality were mainly Stillbirth or abortion, the mortality rates of WAD sheep and goats in emanates mainly from poor hygiene (coccidiosis), trypanosomosis, peste des petit ruminants (PPR) and bronchopneumonia, theft and predation (Okoli, 2001, 2003). The major causes of pre-weaning deaths in kids according to Opara *et al.* (2006) were starvation (24.27%), pneumonia (16.50%), helminthiasis (20.38%), bacterial infection (6.80%), diarrhoea (5.8%) and heartwater (4.85%). About 21% of the mortalities occurred during the neonatal period (0-7 days) (Okoli, 2003). These causes of mortality could be controlled if proper management practices are instituted (Etuk *et al.*, 2005).

CONCLUSIONS

Indigenous West African dwarf sheep and goat breeds constitute over 95% of the small ruminant population of Africa. They are owned by the majority of smallholder rural farmers for whom this resource is critical for nutrition and income. They are also an important and secure form of investment. They provide the only practical means of using vast areas of natural grasslands in regions where crop production is impracticable. Low genetic potential is often quoted as a major constraint to meat and milk production in Sub-Saharan Africa (SSA). Consequently, most livestock improvement programmes in the region have resorted to crossbreeding with imported exotic breeds or directly replacing the indigenous genotypes. This trend continues as the human population and the demand for animal products increases. As previously isolated communities intermingle, indigenous animal populations can interbreed. This, combined with increasing animal movements through trade, presents additional pressures on these populations. In some regions of Africa, the effects of drought and famine, compounded by prolonged civil wars, have also taken their toll. Consequently, indigenous African breeds are at risk. However, sustainable livestock improvement cannot be guaranteed for some environments without the adaptive traits of these genetic resources. The rate of developments in biotechnology also suggests that it will soon be possible to identify and manipulate genes, including those that confer disease resistance and physiological adaptation to other environmental stresses. The potential global contribution of the genetic resources of indigenous small ruminants is tremendous. It would be tragic if unique genetic resources resulting from centuries of natural and artificial selection were lost. The rate of erosion of indigenous animal genetic resources therefore threatens prospects of providing the livelihood of present and future human generations. African policy makers and other development agencies need to recognize the role these resources play in today's production systems. Programmes should be set up to conserve and develop these resources in step with the evolving agricultural systems.

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