*Nig. J. Anim. Prod. 2022, 49(2):299-306.https://doi.org/10.51791/njap.v49i2.3491* *Nigerian Journal of Animal Production*


# Grazing behaviour of West African dwarf sheep and goats co-grazed on natural pasture in the humid zone of Nigeria

[1]Adebayo, A. A., *[2]Adewuyi, P. A., [2]Akewusola, O. G. and [1]Babayemi, O. J
[1]*Department of Animal Science, University of Ibadan, Nigeria*
[2]*School of Agriculture and Environmental Sciences, University of The Gambia*
***Corresponding author:** paademola@utg.edu.gm

## Abstract

*Mono-species grazing of natural grazing land could results in under-utilisation of plant species whereas mixed-grazing of different livestock species enhances a better and maximum biomass nutrient uptake. Thus, this study was designed to observe grazing behavioural budget of West African Dwarf (WAD) sheep and goats grazing together in a natural heterogeneous grazing land. Grazing behavioural activity budgets of WAD sheep and goats in mixed grazing system on natural grazing land were determined chromatically by observation. Grazing activity budget (GAB; %), walking activity budget (WAB; %) and ruminating activity budget (RAB; %) by WAD sheep and goats as influenced by seasons, early dry season (EDS) and early wet season (EWS), time of the day, morning period (MP), afternoon period (AP) and evening period (EP), and ruminant species, sheep and goats, were determined by standard procedure. There were no differences ($p>0.05$) in GAB, WAB and RAB of WAD sheep and goats in the EDS and EWS. However, GAB had the least value of 52.79% at EDS and highest of 54.47% at EW. While WAD and RAP ranged from 10.23% (EW) to 11.21% (ED) and 20.06% during ED to 22.04% during EW, respectively. There was significant ($p<0.05$) difference in WAD sheep and goats behavioural budget as influenced by seasons. GAB during MP (74.02%) was significant greater than EP (49.07%) and AF with the least significant ($p>0.05$) of 37.67%. WAB had the highest of 11.52% during MP and the least of 10.55% during AP. There was significant ($p<0.05$) different between RAP during AP (29.63%) and EP (25.90%) but were significant ($p<0.05$) greater than 7.19% during MP. The GAB had no significant ($p>0.05$) difference between WAD sheep and goats. WAD sheep had the highest value of 54.57% and goats had least of 52.69% for GAB. Goats had WAB of 12.21% that was significantly ($p<0.05$) greater than 9.27% noted for sheep. However, there was no significant difference between RAP with 21.06% and 21.07% for sheep and goats, respectively. The grazing behavioural activity of WAD sheep and goats is similar and cyclical at early dry and early wet seasons. Budgeted time for other activities were similar but different for walking which revealed that forage selection was not overlapped due to forage resources partitioning because of different grazing niches they belong. It can be concluded that mixed grazing WAD sheep and goats could encourage optimum utilisation of forage plants.*

**Keywords:** Behaviour, mixed-grazing, West African dwarf sheep and goats, budget and pattern

# Comportement de pâturage des moutons et des chèvres nains d'Afrique de l'Ouest pâturée sur des pâturages naturels dans la zone humide du Nigéria

## Résumé

*Les mono-espèces le pâturage des pâturages naturels pourraient entraîner une sous-utilisation des espèces végétales alors que le pâturage mélangé de différentes espèces de bétail améliore une absorption de nutriments de biomasse supérieure et maximale. Ainsi,*

*cette étude a été conçue pour observer le budget comportemental de pâturage des moutons de nain de l'Afrique de l'Ouest (NAO) et de la chèvre et des chèvres dans un atelier naturel hétérogène. Les budgets d'activité comportementale de pâturage des moutons de la femme et des chèvres dans un système de pâturage mixte sur des pâturages naturels ont été déterminés chromatiquement par observation. Budget d'activité de pâturage (BAP;%), budget d'activité de marche (BAM;%) et budget d'activité de rumination (BAR;%) de Moutons et de chèvres de NAO comme influencé par les saisons, la saison sèche précoce (SSP) et la saison des pluies anticipée (SPA), L'heure de la journée, la période du matin (député), la période d'après-midi (PA) et la période de soirée (PS) et les espèces de ruminants, des moutons et des chèvres, ont été déterminées par procédure standard. Il n'y avait aucune différence (p> 0,05) dans GAB, WAB et RAB de moutons et de chèvres de NAO dans les SSP et SPA. Cependant, BAP avait la moindre valeur de 52,79% à EDS et la plus élevée de 54,47% chez EW. Bien que le tissu et le PAP varient de 10,23% (SSP) à 11,21% (SPA) et de 20,06% au cours de 22,04% pendant 22,04% au cours de SPA, respectivement. Il y avait une différence significative (p <0,05) dans le budget comportemental des moutonset des chèvres de NAO comme influencé par les saisons. Le BAP pendant le député (74,02%) était significatif supérieur à celui du PE (49,07%) et de l'AF avec la moins importante (p> 0,05) de 37,67%. WAB avait le plus haut de 11,52% pendant le député et le moindre de 10,55% pendant AP. Il y avait une importance significative (p <0,05) différente entre le PAR pendant AP (29,63%) et le PE (25,90%) mais étaient importants (p <0,05) supérieur à 7,19% pendant le député. Le GAB n'avait aucune différence significative (p> 0,05) entre les moutons de la femme et les chèvres. Le mouton de NAO avait la valeur la plus élevée de 54,57% et des chèvres au moins 52,69% pour BAP. Les chèvres avaient atteint 12,21% de 12,21% (P <0,05) supérieures à 9,27% ont été notées pour les moutons. Cependant, il n'y avait aucune différence significative entre le rap de 21,06% et 21,07% pour les moutons et les chèvres, respectivement. L'activité comportementale de pâturage des moutons et des chèvres de la NAO est similaire et cyclique au début des saisons sèches et mouillées précoces. Le temps prévu pour d'autres activités était similaire mais différent de la marche, ce qui a révélé que la sélection de fourrage n'était pas recouverte de la partition des ressources fourragères en raison de différentes niches de pâturage qu'ils appartiennent. On peut en conclure que les moutons de pâturage mixtes et les chèvres pourraient encourager une utilisation optimale des plantes fourragères.*

**Mots-clés**: comportement, mixte-pâturage, moutons et chèvres de nains d'Afrique de l'Ouest, budget et modèle

## Introduction

Poor utilization of forage biomass in extensive production system characterized small-holders system that keeps mainly sheep and goats. Lower uptake per area of grazing land contributes to poor productivity of livestock in small-holder's system. Also, mono-species grazing of natural grazing land could cause unhealthy and unproductive grazing land by invasion of noxious and non-forage plant species. Thus, mixed-grazing of different livestock species could be a better means of maximum biomass harvest and nutrient uptake. For better utilization of extensive grazing land in smallholder practice, mixed grazing of sheep and goats is suggested. Sheep and goats are small ruminants known to that belong to different grazing niche, due to their unique grazing strategy. Sheep are categorised as grazer because they relish grasses, while goats are browser (Animut and Goetsch, 2008) and categorised as mixed or intermediate feeders because their diet consist of grasses and woody plants known as browse (NRC, 2007). Maximizing forage utilization in extensive grazing land, studying grazing pattern of

sheep and goats grazing together could provide managerial solution to grazing land improvement and better livestock productivity. Forage selection by sheep and goats (Aminut *et al.*, 2005) reflects their uniqueness of grazing the niche they belong. Mixing sheep and goats to graze on the same grazing land could increase offtake of forage biomass. Due to grazing preference for different plant species and parts by sheep and goats, efficient utilization of forage could be achieved with better animal productivity and stability of vegetation dynamics when the two ruminant species are grazed together. The different dietary preference is of a great advantage for optimum utilization of available forages on extensive grazing lands, which are usually heterogeneous in vegetation composition (Alder *et al*., 2001), when sheep and goats are mixed to graze together. Grazing lands used by smallholder sheep and goat farmers are natural and communal lands characterized by heterogeneous forage species. There are reports of improved productivity elsewhere when different grazing stocks are mixed to graze heterogeneous land (Squires, 1982; El Aich and Waterhouse, 1999). However, there is limited information on the impact of different seasons on behavioural activity of mixed-grazing of West African Dwarf (WAD) sheep and goats on natural grazing land in Nigeria. Therefore, the study was designed to observe grazing behavioural budget and pattern of WAD sheep and goats grazed together on unimproved natural heterogeneous grazing land. It also aimed to inventory selectively grazes forage plants and parts by the animals.

## Materials and methods

### *Experimental site*

The experiment was carried out at the Teaching and Research Farm, University of Ibadan, Oyo State, Nigeria. The location falls within 7˚20'N, 3˚50'E at an altitude of 200-300 m above the sea level. The site of the experiment is of sub-humid type, having an annual rainfall of about 1250 mm and mean temperature of between 25 and 29 ˚C (Babayemi and Bamikole, 2006).

### *Experimental animal*

Fifteen female nulliparous, yearling WAD sheep and WAD goats of average body weights of (18±2 kg) and (14±2 kg) respectively were mixed for the study to negate the influence of sexual behaviour. Yearlings WAD sheep and goats were used for the study to prevent different age behaviour. The animals were offspring from flocks raised in the study environment to prevent non-familiarity to plant types on the study field.

### *Experimental grazing land*

The experimental grazing land was unsown natural heterogeneous land sward composition or mixture of grass (55%), legumes (15%), forbs (25%) and shrubs (5%). The grazing land was fenced and divided into four paddocks of equal size of approximately 38.11 m x 46.56 m each. There were several easily accessible water points in the paddocks for the animals.

### *Behavioural observation*

Five animals of each experimental species were randomly selected and marked for chromatical observation. Observation was done for three consecutive days per week making total of twelve days in a month. Animals were observed for two hours at different periods of the day, in the morning (08:00 - 10:00 hr.), afternoon (12:00 - 14:00 hr.) and evening (16:00 - 18:00 hr.), and seasons, early wet (April-June) and early dry (October-December) to draw-out grazing behavioural pattern of the animals. The animals were observed from distance of 15 m to avoid perturbation from their natural behaviour. Marked animals were observed visually for grazing behavioural activities for five minutes as described by Solanki (2000), using fixed interval time point sampling procedure (Martin and Bateson, 1985).Observed activities and terms used to describe them are indicated in Table 1.

**Table 1: Grazing behaviours and terms**

| Behaviours | Terms |
|---|---|
| Grazing | Grazing or browsing while walking or standing |
| Walking | Moving from one place to another without grazing or browsing |
| Drinking | Drinking of water from water trough |
| Resting | Simply standing, dozing or lying down without ruminating |
| Ruminating | Simply sitting or standing for chewing of the cud |

***Statistical analysis***

Data on the two species of ruminants and seasons of study were analysed using one way analysis (ANOVA) for paired *t* test at $p<0.05$, while data on the time of the day was analysed in a completely randomized design using SAS software (SAS, 1999). Duncan multiple range test was used for separate the significant means of data on the time of the day and significance was declared at $p<0.05$.

**Results**

Shown in Table 2 is the influence of day time on the time spent or budgeted by WAD sheep and goats for grazing behavioural activities in sub-humid heterogeneous grazing land of Oyo state, Nigeria. There was significant difference ($p<0.05$) among the time of the day for grazing behaviour of WAD sheep and goats. Morning session of the day time had highest percentage budgeted time mean value of 74.02% followed by evening session with 49.07% while afternoon had lowest budgeted time of 37.67% on grazing activity by WAD sheep and goats. No significant difference ($p>0.05$) was noted for time budgeted for walking activity for the day time by WAD sheep and goats. The animals spent more ($p<0.05$) time on drinking in the afternoon and evening than in the morning. Resting activity by WAD sheep and goats had different budgeted time of 18.63%, 10.93% and 5.42% that differed significantly ($p<0.05$) across the day time for afternoon, evening and morning, respectively. Ruminating activity by WAD sheep and goats in afternoon and evening day time was greater than time budgeted for the same activity in morning day time.

Table 3 shows the influence of livestock species on the behavioural activity budget by WAD sheep and goats mixed grazed on heterogeneous landscape in sub-humid zone of Ibadan, Nigeria. Percentage time budgeted for grazing activity by WAD sheep was similar ($p>0.05$) to that goats. WAD goats had a greater ($p>0.05$) time budget for walking activity than sheep. There was no ($p>0.05$) difference in percentage time budgeted for drinking, resting and ruminating activities by WAD sheep and goats.

Shown in Table 4 is the influence of season on the time budget by WAD sheep and goats on mean daily percentage of grazing activities in the early wet and early dry season of the year. Grazing, walking, resting and ruminating activities of the animals were not ($p>0.05$) affected by the season of the year. However, the mean percentage of time spent on drinking activity was higher ($p<0.05$) for the early dry season than for early wet season.

**Table 2: Effect of day time on grazing behavioural activities of West African dwarf sheep and goats**

| Activities (%) | Day Time | | | SEM |
|---|---|---|---|---|
| | Morning | Afternoon | Evening | |
| Grazing | 74.02[a] | 37.67[c] | 49.07[b] | 3.39 |
| Walking | 11.52 | 10.55 | 10.60 | 0.75 |
| Drinking | 1.84[b] | 4.13[a] | 3.40[a] | 0.73 |
| Resting | 5.42[c] | 18.63[a] | 10.93[b] | 1.47 |
| Ruminating | 7.19[b] | 29.63[a] | 25.90[a] | 3.25 |

[abc] Means on the same row with different superscripts differ significantly P<0.05

**Table 3: Influence of species on grazing behavioural activities of West Afr ican dwarf sheep and goats**

| Activities (%) | Species | | SEM |
|---|---|---|---|
| | Sheep | Goats | |
| Grazing | 54.57 | 52.69 | 0.79 |
| Walking | 9.27[b] | 12.21[a] | 0.39 |
| Drinking | 2.67 | 3.24 | 0.33 |
| Resting | 12.39 | 10.77 | 0.52 |
| Ruminating | 21.06 | 21.07 | 0.68 |

[ab] Means in the same row with different superscripts differ significantly P<0.05

**Table 4: Influence of season on grazing behavioural activities of Wes t African dwarf sheep and goats**

| Activities (%) | Season | | SEM |
|---|---|---|---|
| | Early Dry | Early Wet | |
| Grazing | 52.79 | 54.47 | 0.80 |
| Walking | 11.21 | 10.23 | 0.39 |
| Drinking | 4.62[a] | 1.34[b] | 0.33 |
| Resting | 11.27 | 1.19 | 0.52 |
| Ruminating | 20.06 | 22.04 | 0.68 |

[ab] Means on the same row with different superscripts differ significantly P<0.05

**Discussion**

The period of the day influenced grazing behaviour of both WAD sheep and goats. It was observed that the animals have different patterns of grazing behavioural activities, with peak in the morning and evening period. The longest duration of grazing was in the morning followed by the evening. These pattern of behavioural grazing are in line with previous studies in inner Mongolian steppe (Lin *et al*., 2011) and semi-arid area (Shinde *et al*., 1997), and could be as a result of heat stress which is at the peak during the afternoon and lowers in the other periods of the day. This is in agreement with Gregorini (2012), that ruminant avoid grazing at hottest part of day. At afternoon, the animals exhibited resting behaviour than other time of day. They sought shade under trees or beside

their pen house and were found either lying down or standing idle. This may be a way of reducing metabolic activities and hence internal heat generation as a means of attaining homeostasis equilibrium for cooling of the body. The WAD sheep and goats were found to budget the least time on drinking activity. The animals spent few minutes drinking on few occasions. However, the frequency of drinking by the animals was noted to be higher in afternoon and evening day time. This is probably a mechanism of osmotic balance to replenish water loss due to higher environmental temperature at this time of the day.. This could cause dehydration and osmotic imbalance within the animals system, and the animals had to ameliorate these effects by obtaining extra water from drinking water. However, the amount and frequency of water an animal consumed was influenced by water content of the grazed forages. If the forages are lush, less drinking activity is generally observed in animals. This was observed in the grazing behavioural pattern of the animals in the morning time of day; the animals spent little or no time drinking because of the available forages were lush as result of dew. These observations support the reports of Markwick (2007) that both pasture quality and ambient temperature influence animal water intake. Ruminating activity by the animals was higher in the afternoon and evening time. It was observed that rumination was pronounced when the animals were not perturbed and idle. This activity often interjects with resting activity. Since rumination is a response to ruminal fill, therefore the animals had greater budget time in the morning for grazing activity to fill their rumen. Consistent walking activity budget time across the time of the day is a reflection of even distribution of energy expenditure as a strategy in the search of forages that are spatially distributed in the pasture by the animals. The similar total time budgeted for grazing, drinking, resting and ruminating, and the varied time for walking between the WAD sheep and goats (sheep vs goats) in current the study is consistent with the previous observations for sheep and goats co-grazed on pasture of grass and forbs (Animut 2005; 2007). These parallel patterns of behavioural activities (grazing, drinking, resting and ruminating) implies that both WAD sheep and goats had similar time budget for these activities. The WAD sheep budgeted less time for walking activity than the WAD goats due to difference in diet selection. sheep are grazer (Celaya *et al*., 2007) and graze grasses and forbs that are evenly distributed and enough in the pasture while goats are browsers (Animut and Goetsch, 2008) and exploit the paddock in search of browse forages which are spatially distributed, thus accounting for more time budget for walking. Since walking activity is a proxy to energy expenditure of the animals, the result indicates that the goats spent more energy in search of forage than the sheep. Walking activity on pasture is determined by pasture distribution and abundance, when the pasture are scattered over a large area of land and of lower population density, the walking activities increases but when the pasture are of higher density are concentrated within a smaller area of land , the walking activities reduces. This was supported by Schlect *et al*. (2006) that walking was an indicator of spatio-temporal use of forage. The result of time budgeted for walking by WAD sheep and goats in the present study contradicts earlier findings of Pokoram *et al*. (2013) who reported goats spent less time on walking than sheep while on the pasture. This variation in results is probably due to invasion of the pasture land of the study area by shrubs which made the goats had access to enough shrubs, thus reducing the time for walking in search of fodder.

It is expected that grazing time should be shorter in early dry season since forages are expected to be relatively more available and animals will not need to search for forages unlike in the early wet season when forages are just emerging after the late dry season, but because of global warming that results in uncertainty in rainfall pattern and seasonal pasture growth or availability, both WAD sheep and goats spent more time grazing at early dry and early wet seasons to meet their daily dry matter intake for body weight gain. In order to circumvent the problem of seasonal nutrients and energy deficits as a result of poor quantity and quality forages off-seasons, which are important limiting factors in livestock production (Olafadehan and Adewumi, 2010), the animals engaged in grazing as their major activity and thus spent a chunk of their time grazing. Whereas goats compensated for this limitation by browsing twigs and leaves of some woody shrub species in the grazing conferment, sheep switched to grazing more of forbs than grasses that were dry and lignified. This behavioural pattern of sheep and goats is similar to the reports of Hejemanova *et al*. (2015), who stated that sheep graze selectively more on forbs than old grasses and shrubs, and Gurung *et al*. (1994), who reported that goats showed preference more for woody species and specific browse forages parts. Grazing pattern of sheep and goats at both seasons did not overlap despite similarity in time budget for other behavioural activities. Goats were observed to budget more time on walking activity due to their innate behaviour of exploitation for choice dietary forages. This pattern of grazing resulted in complementary rather than competitive use of available feed resources by mixed grazing livestock species. This was noted in improvements in the performance of multiple animal species mixed together to graze heterogeneous grazing land (d'Alexis *et al.,* 2014). Also, these animals are physiologically different in osmotic and thermal balance and this was evident with high budgeted time of WAD sheep on drinking water. This observation was supported by findings of Redding (1981) that sheep are more susceptible to heat and therefore drink more water.

## Conclusion

The grazing activity pattern of WAD sheep and goats was similar and cyclical at early dry and early wet seasons. Budgeted times were similar but differed for walking and drinking activities, revealing that forage selection was not overlapped due to forage resources partitioning because of different grazing niches they belong. This enhanced efficient utilization of forage resource diversity and better animal production per unit area of grazing land. It can therefore be concluded that mixed grazing WAD sheep and goats could improve utilisation of forage resources of a given pasture land.

## References

**Aminut, G., Goetsch, A. L., Aiken, G .E., Puchela, R., Detweiler G. and Krehbiel, C. R. Merkel, R. C., Sahlu, T., Dawson, L.J., Johsua, Z. B and Gipson, T. A 2005**. Grazing behavior and energy by sheep and goats co-grazing grass and forbs pasture at three stocking rate. *Small Ruminant Research 59, (191-201).*

**Aich, E. l,and Waterhouse, A. 1999**. Small ruminant in environment conversation. Small Ruminant Research : 34, 271-287.

**d'Alexis, S., Periacarpin, F., Jackson, F and Boval, M. 2014.** Mixed grazing systems of goats with cattle in tropical conditions: an alternatives to improving animal production in the pasture. *Animal (2014): 8:8, 1282-1289.*

**Gregorini, P. 2012**. Diurnal grazing

pattern: its physiological basis and strategic management. *Animal Production Science 52, 416-430.*

**Gurung, N. K., Jallow, O. A., McGregor, B. A., Watson, M. J., Mcllroy, B. K. M. H. 1994**. Complementary selection and intake of annual pastures by sheep and goats. *Small Ruminant Research, 14, 185-192*.

**Markwick, G. 2007.** Water requirements for sheep and cattle. Primefact 326 (Replace AGFACT AO. 5.4). www.dpi.nsw.gov.au.

**NRC. 2007.**. Nutrient requirements of small ruminants. Natural Academy of Science .Washington, DC, 243 pp.

**Olafadehan, O. A. and Adewumi, M. K. 2010**. Livestock management and production system of agropastoralist in the derived savanna of south-west Nigeria . *Tropical and Sub-tropical Agroecosystem 12(3)*

**Redding, R.W. 1981**. Decision making in the subsistence herding of sheep and goats in the Middle East. Ph.D thesis, university of Michigan.

**SAS. 1999**. SAS user guide. SAS Inc.Cary,North Caroline. 1999 edition.

**Shinde, A.K., Karim, S.A., Patrayak, B. C. and Mann, J.S. 1997**. Dietary preference and grazing behaviour of sheep on *Cenhrus ciliaris* pasture in semi-arid region of India. Small Ruminant Research. 26: 119-122.

**Solanki, G. S. 2000.** Grazing behavior and foraging strategy of goats in semi-arid in India. Tropical Ecology 41 (2), 2000.

**Squires, V. 1982.** Behaviour of free-ranging livestock on native grasslands and shrublands. *Tropical Grasslands 16, 161-170.*

***Received: 19th October, 2021***
***Accepted: 17th February, 2022***