Nig. J. Anim. Prod. 2019, 46(3):339 - 352
© Nigerian Society for Animal Production
Nigerian Journal of Animal Production

Cattle grazing behavior and activity pattern under agropastoral system

[1]Adebayo, A. A., , [2]Fashae, O. A. and [1]Babayemi, O. J.
[1]Department of Animal Science, University of Ibadan, Nigeria
[2]Department of Geography, University of Ibadan, Nigeria
***Corresponding author**: ojyemi@yahoo.co.uk; +2348023430684

Abstract

Poor knowledge of grazing behavior activity of cattle in traditional system pose a limitation to grazing land condition improvement and cattle productivity. Cattle grazing behavior is an effective tool for sustaining grazing land and improve cattle production performance in Agro-pastoral System (AS). However, information on grazing activities of cattle under AS in derived savannah agro-ecological zone of Oyo state was studied. Ido Local Government Area was purposively selected for the study. Behavioural activity budget of cattle (n=120): Grazing Activity Budget (GAB), Walking Activity Budget (WAB) and Ruminating Activity Budget (RAB) were determined using visual observation. Activity pattern: Grazing Activity Pattern (GAP), Walking Activity Pattern (WAP) and Ruminating Activity Pattern (RAP) as influenced by time of day; period 1 (P1, 7:00hr to 9:59hr), period 2 (P2, 10:00hr to 12:59hr), period 3 (P3, 13:00hr to 15:59hr) and period 4 (P4, 16:00hr to 18:59hr) and seasons; (Early Wet-EW), (Late Wet-LW), (Early Dry-ED) and (Late Dry-LD) were determined in a 2x4 factorial arrangement. Forages selectively grazed by cattle were assessed for Dry Matter-DM and Crude Protein-CP, Crude Fibre-CF and Neutral Detergent Fibre-NDF contents using near infra-red spectroscopy. Data were analysed using descriptive statistics, canonical correlation and ANOVA at $\alpha_{0.05}$. The highest behavioural activity budget of cattle was recorded for GAB (42.49%), WAB (23.67%) and RAB (22.98%) for LW, EW and ED, respectively. Activity pattern: GAP, WAP and RAP ranged 29.54% (LD) to 48.39% (LW), 13.02% (ED) to 20.56%% (EW) and 8.70% (EW) to 22.56% (ED), respectively. While, for time of day ranged 23.46% (P4) to 53.33% (P1), 8.06% (P2) to 25.98% (P4) and 5.21% (P2) to 21.14% (P4) for GAP, WAP and RAP, respectively. Significant differences ($p<0.05$) was observed for season and time of day interaction effects. Strong relationship was observed between forage quality and grazing behavioural activity for Ido Local Government Area in wet seasons (r=0.79) and dry seasons (0.77).Better knowledge of cattle grazing behavior decision gives information on biotic and abiotic factors interplay. The interplay allows for a better choice of sustainable intervention in selecting grazing land and time-specific tool to adjust cattle activity budget and pattern.

Keywords: Agropastoral System, Derived Savanna, Cattle Behaviour, Activity Budget, Activity Pattern

Introduction

Exacerbating human population in Nigeria with improving economy and better human nutrition awareness, request for more animal protein (beef and milk), which greater supply comes from cattle. Cattle reliance on pasture as an inexpensive feed source is a long standing sustainable production argument. Extensively, cattle are raised on open native grazing land that is characterized by forage heterogeneity in traditional livestock system in Nigeria. To manage the grazing land, the pastors rely on some strategies to sustain the pastoral ecosystem and mutually maximize the production performance of the grazing livestock. There is no thorough knowledge of cattle grazing behaviour in Nigeria under agro-pastoral system causing improper grazing land management, improper

grazing systems and poor cattle performance in traditional livestock system. Cattle grazing behaviour is an expression of forage quality (Chilibroste *et al*., 2005; Bailey, 2005) and grazing environment (Butt, 2010) in which livestock relies (Kassahun *et al*., 2007). Grazing behaviour knowledge is coping strategy use to manage nutritional requirement of cattle on pasture in relation to available forage quality. Grazing behaviour expression as an adopted tool for forage management on grazing land and an acquired art over age long experience by the pastors. Grazing behaviour is influenced by forage factors such as quality, composition, abundance, distribution and animal factors such as physiological state (Gibb *et al*., 1999; Gregorini *et al*., 2006) and nutritional requirement (Olson *et al*., 1989) and management (Patterson *et al*., 1998; Gibb, 2006, Arachige *et al*., 2013) such as pasture's size (Hart *et al*., 1995) and grazing time (Kristensen *et al*., 2007; Kennedy *et al*., 2011). In traditional livestock production system, forage is affected mainly by climatic condition causing production limitation in terms of quantity and quality at particular time of the year. In response to challenges in the grazing environment there is a modification in the grazing behavioural pattern of the grazing animals (Provenza and Balph, 1990). For grazing animal nutrient needs to be met, the animals adjust their grazing pattern (Kristensen *et al*., 2007) and associated time budget to satisfy their nutritional demands (Manning *et al*., 2017). The time budgeted for different grazing behavioural pattern is influenced by the forage quantity and quality between season and location. Investigation into the behavioural response of ruminants to differences in their grazing environment has led to improved understanding of grazing process (Gibb, 2006).

The essence of grazing management is to obtain optimal and effective utilization of the forage by the grazing cattle. Grazing management is imperative for sustaining productivity and health grazing land (Ash *et al*., 2011). In traditional livestock system pastor use grazing management as an indigenous coping strategy. By manipulating grazing animals in ever varying environmental conditions, pastors achieve good production performance through grazing management. However, daily pattern of grazing behaviour characteristics is modified by grazing management (Gibb *et al.,* 1998). So, the decision made by the pastor in traditional livestock system influence livestock grazing behaviour, utilization of forage resources and supply of nutrients to the grazing animals. For effective management of grazing livestock, a deep knowledge of interrelationship between animal and its environment is necessary (Moyo *et al*., 2012). This could be used to develop management strategies which are not only sympathetic to the animal's natural behaviour, but improve the level and efficiency of resource use (Gibb, 2006).

In spite of scanty information on cattle grazing behaviour, there is a clamour for ranching establishment in Nigeria. A comprehensive understanding of cattle behaviour is needed for optimal management of pasture resource and forage availability (Meisser *et al*., 2014). Information on cattle grazing behaviour in agro-pastoral system will provide knowledge on forage optimal utilization. This could be done by quantifying time spent by cattle on grazing activities in traditional system. Therefore, this study was designed to elucidate information on grazing activities pattern of cattle in agro-pastoral system in Ido Local Governmnent Area of Oyo state, Nigeria.

Materials and methods

Study area

This study was conducted in Ido Local Government Area of Oyo state which lies in between latitudes 7°45N, 7°15N and longitudes 3°30E, 3°50E with landmass of 986 Km^2 (Denton and Ogunkunle, 2014). The sites selected for the study were biophysical representative of the entire Local Government Area which is characterized as derived savannah agro-ecological zone. There is variability of climate from wet (early and late) seasons and dry (early and late) seasons. The main rain falls during wet season and little at early dry season. Average rainfall is 1800mm annually with relatively high humidity.

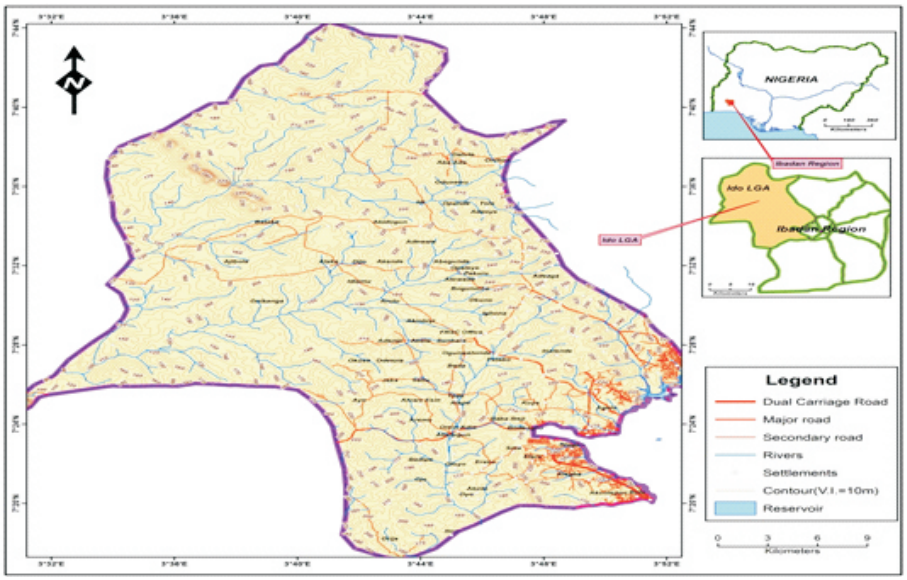

Figure 1: Topography map of Egbeda Local Government Area

Study animals

The predominant cattle breed in the study area was the White Fulani breed (*Bos indicus*). It is characterized by longhorn lyre shaped horns, short white coat on dark skin and it appeared with tall and narrowed body which gives it a leggy appearance for long distance trekking in the pastoral corridor. Also, the breed is heat tolerant. It has 58-60cm and average weight of 201-249kg (Kanal *et al*., 2013). Herd size ranges from 13-135 heads/ household and herd is structured with largest percentage of cows and least percentage of calves (Regge *et al*., 1993a). The breed usually kept for milk production in traditional management system, and kept for meat and draught purposes (Olutogun, 1976).

Cattle grazing behaviour and activity sampling

Cattle behaviour was described based on six identified protocols: grazing, walking, grazing/walking, drinking, resting and ruminating. The behaviour protocols were modification from previous studies on zebu cattle in Nigeria (Bayer, 1990) and Kenya (Butt, 2010). Observed cattle were selected randomly from herd of agro-pastoralists who continuously grazed their herd on the heterogeneous grazing land in the study area. Observation was chromatically made at interval of one hour

for five minutes (Lampkin e*t al*., 1958) on each animal using fixed interval time point sampling procedure (Martin and Bateson, 1985). Observation was made four times in month on five animals from release from their kraal in the morning (7:00) till the end of grazing day when the animal returned back to their kraal (19:00).

Daily activity patterns were recorded for the cattle grazing behavioural activities in four different seasons: early wet (April to June), late wet (July to September), early dry (October to December) and late dry (January to March) Olafadehan and Adewumi (2010).

Table 1: Grazing behaviour protocol and description

Behaviour	Description
Grazing	Biting, chewing and swallowing of harvested continuously for more than 10 seconds with head lowered down
Walking	Moving around for more than 10 seconds with head raised up
Grazing/Walking	Both grazing and walking with head lowered and raised
Drinking	Drinking of water from water source
Resting	Idle mode of cattle with no observation of other grazing behaviour activity
Ruminating	Chewing and regurgitation of swallowed forages in the mouth while cattle lying down or standing

Cattle grazing behavioural activities

Activity budget data were proportion of each grazing day observation period that described the time cattle spends employed in grazing behavioural activity as percentage of the total time engaged foraging (Moyo *et al*., 2012). From allotted data recorded for six behavioral categories. Activity was calculated as the percentage of the observed time spent in a particular activity for each observed five animals for duration of observation for each season. Time budgets were developed from activity pattern in different period of day and season. Grazing behavioural observation data were cumulated and grouped by seasons (early wet, late wet, early dry and late dry) to construct time budget. For each season time budget was summarized by four periods of day: Period 1 (P1, 7:00hr to 9:59hr), Period 2 (P2, 10:00hr to 12:59hr), Period 3 (P3, 13:00hr to 15:59hr) and Period 4 (P4, 16:00hr to 18:59hr) to test for activity pattern variation.

Forage sampling and collection

The grazed forage sample representatives were marked and harvested. The harvested forages were pooled into; grass, legume, forb and shrub groups. Grazed forage samples were weighed, air-dried, thereafter oven dried at 60^{o}C for 48 hours. Oven dried forage samples were milled to pass through one millimeter screen. The milled samples were packed in zip lock and labeled appropriately by name, season and group.

Chemical analysis of grazed forage samples

Milled oven dried samples were scanned with near infrared spectroscopy and chemical composition (dry matter, crude protein, crude fibre, ash, fat, starch, neutral detergent fibre, acid detergent fibre and acid detergent lignin) of the samples were assessed using equation for the feed sample analysis based on the mixed feed global calibration model using the software package (Win ISI II FOSS, Denmark, Model NIRS™ 5000) calibrated against convectional wet laboratory analysis. Spectral data were recorded in the wavelength range 1100-2500nm using NIR system mode 5000 scanning monochromatic infrared spectrophotometer.

Statistical analysis

Analysis of variance (ANOVA) using Fisher's LSD for means separation were used to analysed the proportion of time spent on cattle grazing behavioural data (grazing, walking, grazing/walking, drinking, resting and ruminating). All tests were considered statistically significant at p=0.05. Statistical analyses were conducted using SAS (2012) software package.

The relationship between the cattle grazing behavioural activity (grazing, walking, grazing/walking, drinking, resting and ruminating) and nutrients (dry matter, crude fibre, crude protein and neutral detergent fibre) was obtained by canonical correlation analysis using PROC CANCORR (SAS, 2012). Test were considered statistically significant at p=0.05 and canonical coefficients were considered significant when higher than 0.30, Wilk's Lambda (Harris, 1975).

Results

Presented in table 2 are the effects of seasonal on behavioural budget pattern of cattle. The results showed that was significance difference between behavioural activities across the seasons except for drinking where non-significant difference was observed for the seasons. Greater value was observed for grazing at late wet (42.19), walking (23.67) at early wet, grazing/walking (31.06) at late dry, resting (10.63) at early dry and ruminating (22.98) at early dry. However, there was no significant difference between grazing value for late wet (42.49), early dry (39.78) and early wet (38.19). Likewise, early dry (10.63) and late wet (10.04) and late dry (7.88) were not differ significantly. While from table 3, behavioural pattern in cattle as influenced by seasonal and time of day was significant across behavioural activities for both season and time of day but no significance was observed for resting across the season and grazing/walking across the time of day. It was shown from figure 2, that, grazing activity had more than 25% of time budgeted for behavioural activity across the seasons. Walking was less than 20% in late wet, early dry and late dry seasons but was 27.53% at early wet season. At late wet and early dry seasons, grazing/walking activity was 15.51% and 16.33%, respectively, while at early wet and dry seasons was 22.99% and 31.05%, respectively. Time budget for resting was less down 10% across the seasons while for drinking activity was less down 3%. While, ruminating activity had more than 10% budgeted time for the seasons except for early wet season that 4.58% budgeted time was recorded. From Table 4, Dry matter ranged from 91.38±0.33 g/100g DM (shrubs) to 93.30±0.13 g/100g DM (grass) and 91.75±0.27 g/100g DM (shrubs) to 93.48±0.10 g/100g DM (grass) for wet and dry seasons, respectively. Highest crude protein value of 20.06±0.76 g/100g DM and 17.58±0.84 g/100g DM was recorded for legumes in wet and dry seasons, respectively. Mean value recorded for crude fibre and neutral detergent fibre for wet season and dry seasons were; 25.12±16.55 g/100g DM and 47.89±9.12 g/100g DM; 21.59±0.51 g/100g DM and 40.38±5.88 g/100g DM, accordingly.

In wet seasons, as shown in Table 5, there was a positive relationship between forage nutrient and cattle grazing behavioural activity budget at wet season in the study local area as shown by canonical correlation of 0.77. Comparison between original variable of crude fibre (-0.82) and crude protein (-0.82) with resting (0.5) shows a decline in forage crude fibre and crude protein has indirect relationship with time frequency on resting. Forage nutrient and cattle quantity behavioural activity budget in the study area at dry season

relationship was strong as shown by high canonical correlation (0.79) and Wilk's lambda in Table 6. The canonical pairs between forage quality and cattle activity budget were significant ($p<0.05$). Comparison between original cattle walking behavioural activity budget with the canonical variates of forage nutrient in the study area at dry season indicate that that activity budget on walking (0.85) was correlated with crude protein of forage (-0.92).

Table 2: Effect of seasonal on behavioural budget pattern of cattle in Ido Local Government Area of Oyo state

Behaviour	Season				SEM	P- Value
	Early Wet	Late Wet	Early Dry	Late Dry		
Grazing	38.19^{ab}	42.49^{a}	39.78^{a}	30.99^{b}	2.72	0.03
Walking	23.67^{a}	11.65^{b}	12.37^{b}	15.18^{b}	1.77	<0.0001
G/walking	21.03^{b}	14.62^{c}	16.33^{bc}	31.06^{a}	1.73	<0.0001
Drinking	1.43	3.32	2.39	2.81	0.70	0.28
Resting	6.18^{b}	10.04^{a}	10.63^{a}	7.88^{ab}	1.00	0.02
Ruminating	12.39^{b}	13.22^{b}	22.98^{a}	12.09^{b}	2.60	0.02

^{abc} **means in the same row within a location with different superscripts are significantly different ($p<0.05$)**

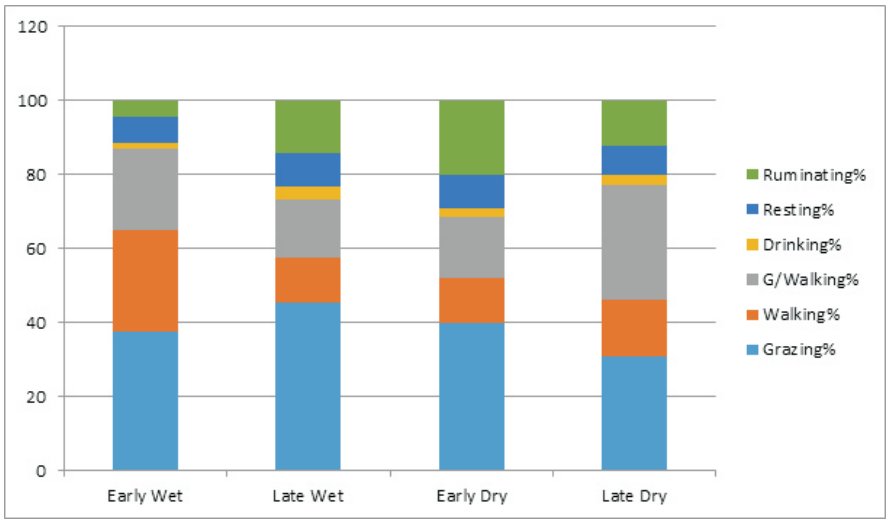

Figure 2: Seasonal activity budgets of cattle grazing behavioural activity in Ido Local Government Area, Oyo State.

Table 4: Wet and seasons mean of chemical composition (g/100g DM), of NIRS-analysed five classes of forages grazed by cattle in open grazing field in Ido Local Government Areas

Forage Class	Nutrient (g/100g DM)							
	Wet Season				Dry Season			
	DM	CF	CP	NDF	DM	CF	CP	NDF
Grass	93.30±0.13	20.59±0.40	13.67±0.55	63.03±0.83	93.48±0.16	24.50±0.70	11.50±0.55	39.85±2.18
Legume	92.26±0.15	18.46±0.93	20.06±0.76	48.07±0.97	92.69±0.13	23.41±0.80	17.58±0.84	34.03±0.62
Forbs	92.45±0.14	54.46±0.70	19.95±0.65	39.84±1.71	92.76±0.09	20.08±0.96	14.42±0.62	36.34±0.99
Shrubs	91.38±0.33	18.49±1.99	20.23±1.71	42.02±2.63	91.75±0.27	18.27±1.64	21.04±1.59	42.55±2.33
Crop Residues	91.66±0.35	14.26±1.73	12.24±1.43	46.73±3.47	91.82±0.28	21.69±1.85	10.52±0.86	49.15±2.12
Mean	92.23±0.69	25.12±16.55	17.45±4.17	47.89±9.12	92.50±0.73	21.59±0.51	15.01±4.35	40.38±5.88

Key: DM= Dry Matter, CF= Crud Fibre, CP= Crude Protein, NDF= Neutral Detergent Fibre, , SEM= Standard Error of Mean

Table 5: First canonical correlation coefficient between forage quality and cattle grazing behaviour activity budget in Ido Local Government Area of Oyo state in wet season

Variable	Canonical coefficient	Original variables versus their canonical variates	Original variables versus opposite canonical variates
Forage Nutrient			
Dry Matter	-11.6004	-0.1682	-0.1332
Crude Fibre	9.5241	0.4460	0.3533
Crude Protein	0.0000	-0.9202	-0.7291
NDF	1.3603	-0.8512	-0.6743
Behavioural Activity			
Grazing	0.0215	-0.1340	-0.1062
Walking	0.2384	0.8502	0.6736
Grazing/walking	0.0330	0.1945	0.1541
Drinking	-0.1531	-0.2931	-0.2322
Resting	0.0285	0.0196	0.0155
Ruminating	0.0000	-0.4995	-0.3957
Statistical Analysis			
Canonical correlation	0.7922		
P>F	0.6941		
Wilk's Lambda	0.2803		

Table 6: First canonical correlation coefficient between forage quality and cattle grazing behaviour activity budget in Ido Local Government Area of Oyo state in dry season

Variable	Canonical coefficient	Original variables versus their canonical variates	Original variables versus opposite canonical variates
Forage Nutrient			
Dry Matter	-0.0603	-0.7073	-0.5417
Crude Fibre	-1.3409	-0.8198	-0.6279
Crude Protein	0.0000	-0.8198	-0.6279
NDF	0.8053	-0.1763	-0.1350
Behavioural Activity			
Grazing	0.1048	-0.0976	-0.0748
Walking	0.4098	0.0422	0.0323
Grazing/walking	-0.2999	-0.2607	-0.1997
Drinking	0.8599	0.8511	0.6519
Resting	0.3640	0.5023	0.3848
Ruminating	0.0000	-0.1385	-0.1060
Statistical Analysis			
Canonical correlation	0.7659		
P>F	0.5385		
Wilk's Lambda	0.2247		

Discussion

Seasonal dynamics of cattle behavior budget in Ido Local Government Area

Cattle budgeted not lesser than one-quarter of their total time on grazing activity both in wet seasons and dry seasons. This invariably determines the forage intake of the animal as grazing time is a factor of consideration to intake of grazing cattle (Allden and Whittsker, 1970). Also, cattle dedicated enough time on grazing to satisfy their daily dry matter requirement for their maintenance and production. At late wet season, grazing activity budget was higher

than in other seasons. This was due to adjustment in the time budgeted by the cattle as influenced by grazing time restriction in the traditional system (Jung *et al*., 2002). However, Bayer (1990) concluded that cattle compensate for the restricted time by increased grazing efficiency. Meanwhile, selection behavior of cattle at wet seasons when there is abundance forages increase time budgeted for grazing activity (George *et al*., 2007). In agro-pastoral system managed by Fulani in the study area, cattle had restricted grazing time due short herding time at raining season which the herders spent some of the time on crop field before setting out for grazing. This agreed with the finding of Bayer (1990) that herded cattle has as shorter grazing time while compare with free ranging cattle. Thus, herded cattle have shorter grazing hours and this restricted them from consuming enough forages to meet their daily dry matter requirement. This re-affirms the study of Haggar (1968) that cattle are allowed on pasture for shorter time during wet season by Fulani agro-pastoralist because of labour requirement of the herder on their crop field. At this, season milking time of the cows was not earlier like dry seasons. Also, it is strategy to prevent the cattle to graze wet pasture due to early morning dew that can cause diarrhoea and means of prevent worm infestations. Kraaling was practiced in agro-pastoral system of the study area to prevent crop damage by the cattle and to prevent theft of cattle at night. This was similar practice in sub-humid zone of Kurman Biri and Abet, Nigeria in the study done by Bayer (1990). This practice denies cattle of night grazing, and for these reason cattle adjust their behavior by budgeting more on grazing at late dry season to meet the nutritional requirement within the ample time of restriction grazing in agro-pastoral system in the study area. A similar compensation manner was observed by Jung *et al*. (2002), where cattle increase time budgeted on grazing to compensate for the restricted time on pasture. Restricted grazing at dry season was observed to have bad influence on the cattle production performance (body score and milk yield) during dry seasons. Unlike, wet season the animals are compensated to better grazing land with quality forages. Therefore, improved cattle production performance at wet seasons. Homewood *et al*. (1987) revealed that reduced grazing time caused limitation in the productivity of cattle.

In agro-pastoral system, early wet is a period of crop field preparation, more fertile lands near the homestead were turned to cultivated fields (Nicholson, 1984). This make cattle to be herded between the patches of available pasture farther from the household, thus increase their walking budget. Meanwhile, at this season pasture are lush and low in dry matter which is not enough to provide cattle their daily dry matter requirement to fill up their gut. This support the work of Rutter *et al.* (2002a), that cattle have capability of regulating their grazing rhythm in relation to forage quality and employed dietary strategies of optimizing grazing time budget. Competition was quite high between herds from various households, resulting to pronounced walking behavior by the cattle while searching around for available pasture. Over grazing can occurred once grazing land available is declining due to competition for pasture from different herds (Nicholson, 1984).

Grazing while walking is an indicator of nutritional stress to cattle as a result of inadequacy of pasture and also as an influence of managerial practice of herding of Fulani. The forage available to the animal on their way to target pasture by the herder is often unsuitable for grazing (Jung *et al*., 200). This behaviuor is rampart during dry

season when forage had dried- off due to lack of rain. Cattle relies on shrubs, forbs and grass re-growth after bush burning at the study area during dry seasons. Thus, there was an increase in the frequency of grazing/walking behavior when cattle move in between niche of plants available for their grazing. Budgeted time for resting activity was observed to significantly higher at late wet and early dry seasons, because cattle get satisfied by fill up their gut due to abundance and available forage resource with high dry matter at this seasons. These seasons also coincide with harvest time of some crops making crop residues such as maize stove, groundnut haulm, cowpea vine, cassava leaves and peels left on crop field for cattle utilization. However, due to the nature of tropical grasses that get lignified and becomes fibrous earlier likewise the crop residues, cattle spent significant amount of time on ruminating to break down the ingested forages by re-mastication and re-salivation for better utilisation by ruminal microbes for the benefit of the cattle. Ruminating was not significant high at late dry season when compare with early dry season, nature of diet of cattle resulted to this, cattle grazed more on shrubs and forbs which at this season are not tough and mild fibrous in nature. Rumination is basically affect by dietary type. (Grant and Dan Willam, 2015). And rumination was suspended to later time probably at night time due to restricted grazing in agro-pastoral system. This agrees with the previous reports of Smith (1961) that animals with restricted grazing time deferred ruminating to night when they are confined. For, early wet season cattle adjust their budgeted plan on behaviour to devote more time on grazing and little time on ruminating during the period of herding. Since, young forages are much at this season are low in dry matter content and could not be enough for dry matter intake satisfaction of the cattle.

Dynamics of cattle activities pattern across periods of day in Ido Local Government Area

Behavioural pattern of cattle is affected by season in agro-pastoral system as a result of several factors such as abiotic (Senft *et al.,* 1987) and biotic factors (Bailey *et al.,* 1996), especially precipitation (Ellis and Galvin, 1994) that determines availability, abundance and accessibility of pasture as influenced by water lodging and insect infestation at a particular period of time of a season. However, resting pattern is not influenced by seasons because cattle rest when there is a need to do so and suspend other activities. Land use system by man in traditional system is important factor of consideration that causes variation in behavioural pattern of cattle (Kassahum *et al.,* 2008), across the seasons, especially for crop agriculture (Niamir, 1990) that make use of land to plant for increasing human population demand. Nevertheless, there was mutual benefits of crop residues use by the cattle and there was dung as a manure in return on the field for soil improvement. Land use when not well manage arose to social conflict in the agro-pastoral system not in dry seasons alone but also in wet seasons.

Time of day as influenced by behavioural pattern of cattle in agro-pastoral system was observed across the seasons. This probably due to climatic conditions (Semenye, 1988) and managerial decision of the pastors (Grandin *et al*., 1991). Grazing behavior was frequently more at morning and mid-morning, when the animals were release for grazing from the kraal. This observation was in contrast with the earlier study of Gregorini *et al*. (2006) that cattle exhibit diurnal grazing when most of the grazing was done at morning and evening. Cattle exhibits hunger stress by their ferocious grazing when release and set for grazing in

the morning. This was due to lower rumen fill. Chilibroste *et al*. (1997) stated that rumen fill is inversely related to hunger. Thus cattle were motivated to graze ferociously in the morning by hunger at the study area. Kraaling is a common practice among the Fulani agro-pastoralists in the study area which prevent the animals from night grazing that lasts more than 10 hours at each seasons. Kraaling caused adjustment in behavioural pattern of cattle to maximize their daily nutrient intake (Moyo *et al.,* 2012). This phenomenon could be reinforced by satiety factor (Campling and Balch, 1961). The animal adjusts their grazing pattern by budgeted more time grazing at morning and mid-morning to avoid combination of stress associated with environmental temperature that often higher at afternoon with heat generate from muscle exercise due to grazing activity. This observation was consistent with Ratnakaran *et al.* (2017) who reported that cattle exhibits adaptation mechanism to thermal stress by change in their behavioural response. While, walking activity was quite higher at evening when the animals were returning to kraal than any other period of day was influenced by herding strategy of the Fulani agro-pastoralists that drive the animals hard when returning from grazing field to halt other activities by the cattle. Drinking activity pattern was not observed to be of necessity at morning like grazing activity by cattle. This is an indication also that water source for the drinking of cattle that usually streams and perennial rivers are far from the households. For this reason, herders watered their herds at any period of the day when they have the chance to do so. This particular behavioural pattern is greatly influenced by the herders' decision.

Cattle rest more in the afternoon period of the day when environmental temperature is often high in the tropical environment by seeking shade and in the evening period when their rumens are filled or when their dry matter requirements had been met. This coincides with observation of Semenye (1988) that cattle rest more in hot afternoon and dry season and supports Moyo *et al.* (2012) that resting by cattle particularly in afternoon is a mechanism of averting of heat stress. But ruminating activity pattern is done at any time of the day as except in the morning when less of it is done due to empty gut and high dedication of time on grazing at this period but more from mid-morning till evening as soon as the animal's gut was being loaded with feed. Rumination time of cattle is a response to dietary nature (Van Soest, 1982) and managerial practices (Grant and Dan William, 2015), and this behavioural of cattle could be used as indicator to nutrition well- being of cattle.

Forage Quality and Grazing Behaviour Pattern in Ido Local Government Area

In wet seasons, the higher the crude fibre of the grazed forages the more budgeted time on walking activity by the cattle. This was due to quick maturation and lignification of tropical plants (Jung, 2002). The consequence was revealed in the decline of grazing activity budget by the cattle. Grazing efficiency, however, is minimized when dry matter is lower and consequently more time spend on walking activity in search of forage to satisfy cattle daily dry matter and nutritional requirement. Crude protein is the main nutrient that influences adequate function ruminal ecology (Ganskopp and Bohnert, 2009). It supplies nitrogen needed for rumen microbial protein synthesis for effective fermentative digestion of ingested forage. As crude protein decreases in dry seasons ruminating activity decreases among cattle managed in agro-pastoral system in the study area due to lower degradation of ingesta. Elevated crude protein accompanied with lower

crude fibre impaired digestibility (Ganskopp and Bohnert, 2009); and this prompt high grazing frequency. This supports the findings of the study, that decline in crude protein and elevated crude fibre affect decrease in grazing and ruminating frequency. Grazing which is a proxy to intake is influenced by forage digestibility and physical characteristic (Kenney and Black, 1984). Reduced dry matter intake is the major impact of inadequate nutrition of grazing animals (Hogson, 1982a). Animal forage intake persist by grazing cattle expend more time searching for available and accessible forage. Thus, increase walking frequency because of fibrous available forage. The energy consumed was found to be functional entity of the amount of feed consumed and utilizable energy and concentrated in the feed (Coleman, 2005). Therefore, there always a poor performance in cattle production in the study area at dry season especially late dry season.

Conclusion

Understanding of the factors that impact cattle grazing behavior has implication of improving livestock management in agro-pastoral system. Forage quality and quantity are the most important factors that affect grazing behavior and overall cattle production performance in traditional system. Herding decision in agro-pastoral system is a function of the farming system, coping strategy and season. However, it is through the basic understanding of the intricate details of forage-livestock interaction as influence by seasons that cattle management on heterogeneous grazing land in Ido local government area can be improved. This understanding gives intervention and new opportunities of developing effective management of grazing animals and grazing land.

References

Ash, J. A., Confield. J. P., Melvor, J. G and Ksiksi. T. S. 2011. Grazing management in tropical savannas: utilization and rest strategies to manipulate rangeland condition. *Rangeland Ecology and Management. Vol 64; issue3: pp 223-239. https://doi.org/10.2111/REM-D-09-00111.1*

Bailey, D. W., Gross, J. E., Laca, E. A., Rittenhouse, L .R., Coughenour, M. B., Swift, D. M and Sims. P. L. 1996. Mechanism that results in large herbivore grazing distribution patterns. *Journal of range Mgt*. 49; 386-400.

Bayer, W. 1990. Behavioural compensation for limiting time by herded cattle in central Nigeria. *Applied Animal Behav.* Sc:27, 9-19.

Butt, B. 2010. Seasonal space-time dynamics of cattle behaviour and mobility among Maasai pastoralists in semi-arid Kenya. *Journal of Arid Environment 74 (2012) pg 403-413*.

Campling, R. C and Baleh, C. C. 1961. Factors affecting the voluntary intake of foods by cows. I Preliminary observations on the effect of voluntary intake of hay on changes in the amount of the reticule-rumen content. *Br. J. Nutr* 15: 523-531.

Chilibroste, P., Tamminga, S and Boer. H. 1997. Effects of length of grazing session, rumen fill and starvation time and dry matter rumen production sizes of grazing lacataing dairy cows. *Grass forage sci*. 52:249-257.

Denton, O and Ogunkunle, A. 2014. Land use change analysis in a deived savannah zone of sout western

Nigeria and challenges for Agricultural land. *Journal of Biology, Agriculture and Healthcare. Vol.4. No. 18.*

Ellis, J and Galvi, K. A. 1994. Climate patterns and land use practices in dry zones of Africa. *Biosciences* 44; 340-349.

George, M., Baile, D., Borman, M., Ganskopp, D., Surber, G and Harris., N. 2007. Factors and practices that influences livestock distribution. *Rangeland Mgt series*. ANR Publication 8217.

Gibb, M. J., Huckle, C. A.and Nuthall., R 1998. Effect of sward surface height on intake and grazing behaviour by lacatation Holstein Friesian cows. *Grass Forage Sci. 52, 309-3.*

Gibb, M. J. 2006. Grassland management with emphasis on grazing behaviour. In: Elgerma, A., Dijkstra, J., Tamminya, S (Eds). Fresh Herbage for Dairy Cattle. *Springer, Durdrecht. The Netherlands, pp. 141-157.*

Gibb, M .J, Huckle, C. A, Nuthall and Rook, A. J. 1999. Effect of physiological state (lactating or dry) and swaed surface height on grazing behaviour and intake by dairy cows. *Applied Animal Behaviour Sc. 63(4): 269-287. Doi;10.1016/so168-1591(99) 000 14-3.*

Grandin., B. E, de Leeuw., P. N and de Souza., M. 1991. Labour and livestock management. In: Bekure., S, de Leeuw, P. N, Grandin, B. E and Neate, P. J. A (eds). Massai herding. An analysis of the livestock production system of Massai pastoralists in eastern Kajiado district. Kenya. FAO.

Grant, R. J and Dann. H. M. 2015. Biological importance of rumination and its use on-farm. William. H Miner Agriculrural Research Institute, Chazy, NY.

Gregorini, P., Tamminga, S and Gunter, S. A. 2006. Behaviour and daily grazing patterns of cattle. The *Professional Animal Scientist. Vol 22, issue 3. Pp 201-209. https://doi.org/ 10.15232/S1080-7446(15) 31095-0.*

Gregorini, P., Tamminga, S and Gunter, S. A. 2006. Behaviour and daily grazing patterns of cattle. *The professional Animal Scientists*. Vol 22, issue 3, pg 201-209.

Gregorini, P., Soder, K. J and Kensinger, R.S. 2009. Effects of rumen fill on short- term ingestive behavior and circulating foraging of ghrelin, insulin and glucose of dairy cow. J. Dairy sc 92: 2095-2105.

Haggar, R. J. 1968. Grazing behavior of Fulani in Shika, Nigeria. *Tropical Agric,* Trinidad 45; 179-185.

Homewood, K., Rodgers, W. A and Arhe, K. 1987. Ecology pastoralism in Ngorongoro conservation area, Tanzania. *Journal of Agricultural Sc*, Cambridge 108, 47-72.

Jung, J., Yngvesson. J and Jensen. 2002. Effects of reduced time on pasture caused by prolonged walking on behavior and production of Mpwapwa Zebu cattle. *J. grass and forage sc*., 57, 105-112.

Kanal, E.T,, Wamagi, I. T and Zagi, I. 2013. Phenotypic characterization of white Fulani (Bunaji) and Bunaji x Friesian breed of cattle from National Animal Production Research Institute (NAPRI) cattle herd from Nigeria. *World Journal of Agricultural Sci. Vol. 1 (5), pp. 185-189.*

Kassahum, A., Snyman, H. A and Smit,

G. N. 2007. Livestock grazing behaviour along a degradation gradient in the Somali region of eastern Ethiopia. African *journal of range and forage science*.

Kassahum, A., Snyman, H. A and Smit, G. N. 2008. Livestock grazing behavior along degradation gradient in the Somali region of Eastern Ethiopia. *African Journal of Range and Forage Sc.*

Kristensen, T., Oudshoorn, F., Munksgaard, L. and Sœgaar, K. 2007. Effect of time at pasture combined with restricted indoor feeding on production and beaviour in dairy cows. *Anim., 1: 439-448.*

Lampkin, G .H, Quarterman, J and Kinder, M. 1958. Observations on the grazing habits of grade and zebu steers in a high altitude temperature climate. *Journal of Agric sci. 50:211.*

Manning, J., Cronin, G., Gonźalez, L. Hall, E., Merchant, A and Imgram, L. 2017. The behavioural response of Beef cattle (Bostaurus) to declining pasture availability and the use of GNSS technology to determine grazing preference. *Agriculture 5(7) 45; doi: 10.3390/agriculture 7050045.*

Meisser, M., Deléglise, C., Frelěchouse, F., Chassot, Jeaigros. B and Mosimann. E. 2014. Foraging behaviour and occupation pattern of beef cows on heterogeneous pasture in the Swiesalps.

Moyo, B., Dube, S., Lesoli, M and Masika. 2012. Behavioural patterns of cattle in the communal areas of the Eastern Cape Province, South Africa. *Journal of Agricultural Research Vol. 7(18). Pp 2824-2834.*

Niamir, M. 1990. Traditional Africa range management management and technique: Implication for rangeland and development. FAO community Forestery note. No 4 pp VIII, pp126.

Nicholson, M. J. L. 1984. Pastoralism and milk production. ILCA Bulletin (International Livestock Centre for Africa), 20; 23-28.

Olson, K. C., Rouse, G. B and Malechek, J. C. 1989. Cattle nutrition and grazing behaviour during short-duration-grazing periods on crested wheatgrass range. *Journal of Range Management. Vol. 42, no. 2. pg 153-158. https://www.jstor.org/stable3899314.*

Olutogun. O. 1976. Reproductive performance and growth of N'Dama and Keteku cattle under ranching conditions innthe Guinea Savannah of Nigeria. Ph.D Thesis, University of Ibadan pp 126.

Patterso, D. M., McGilloway, D. A, Cashnahan, A., Mayne, C. S and Laidlaw, A. 1998. Effect of duration of fasting period on Short-term intake rates of lactating dairy cows. *Animsci, 299-305.*

Provenza, F. D and Balph, D. F. 1990. Applicably of five diet selection models to various foraging challenges ruminants encounter. In: hughes. R.N (ed). Behavioural mechanism of food selection. *NATO ASI series: Ecological sci 20. Springer-Verlag. Ber, Germany. Pp. 423-459.*

Ratnakaran, A. P., Sejian, V., Jose, V. S., Vaswani. S., Begath, M., Kric han, G., Beena, V, Devi, P.I., Varma,.G and Bhatta, R. 2017. Behavioural responses to livestock adaptation to heat stress challenges. *Asian journal of*

Animal Sc. Vol.II (1).

Redbo, I. 1992b. Sterotypies in dairy cattle and their relation to confinement, production related factors, physiological, reaction and adjoining behavior. Swedish University of Agricultural sc. Thesis, Report 212. Uppsala.

Redbo, I and Nordbad, A. 1997. Sterotype in heifers are affected by feeding regime. *Appl Animal Behaviour.* Sc 53,; 013- 202

Rutter, S. M., Orr, R. J., Penning, P. D., Yarrow, N. H., Champion, R. A. 2002a. Ingestive behavior of heifers grazing monoculture of rye grass or white clover. *App Anim Behav. Sc* 76, 1-9.

Semenye, P. P. 1988. Grazing behavior of Maasai cattle. In: Dzowela. B.H (Ed); African forage plant genetic resources evaluation of forage germplasm and extensive livestock production system. FAO Corporate Document Repository.

Senft, R. L., Coughenout, M. B, Bailey, D. W, Rittehhouse, L. R, Sala, O. E and Swift, D. M. 1987. Large herbivore foraging and ecological hierarchies. *Biosciences* 37: 789-799.

Senft, R. L., Rittenhous, L. R and Woodmansee, R. G. 1985. Factors influencing patterns of cattle grazing behavior on shortgrass steppe. Journal of Range Mgt, 38 (182): DOI:10.2307/3899341.

Smith, C. A. 1961. Studies on Rhodesia Hyparrhenia veld 3: The effect on the growth and grazing behavior of indigenous cattle of restricting their daily grazing tme by night kraaling. J Agric (Cambridge) 56: 243-248.

Van Soest, P. J. 1982. Nutritional ecology of the ruminant. O and B Books. Inc Corvallis, Oregon.

Received: 12th April, 2019
Accepted: 15th June, 2019