Journal of Agriculture and Environment Vol. 10 Nos. 1 and 2, 2014: 15-25
ISSN 1595465X

SOME PRODUCTIVITY INDICES OF DABAGI FARM RANGELAND IN SOKOTO, NORTH-WESTERN NIGERIA

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ABSTRACT

Species composition, herbage yield and dry matter production of Dabagi farm rangeland was evaluated during late rainy season. Results of the study showed higher composition of trees in the Virginland (10 species ha^{-1}); with *Acacia nilotica*, *Balanites eagyptiaca*, *Piliostigma reticulatum* and *Azadirachta indica* being dominant, compared to 4 and 0 species ha^{-1} in the Fallowland and Hillyland respectively; with *Azadirachta indica* and *Piliostigma reticulatum* as dominant species on Fallowland. Virginland and Fallowland had higher composition of shrubs (29 and 25 species ha^{-1}, respectively), dominated by *Combretum micranatum*, *Guera senegalensis*, *Lennea kerstingii*, *Cassia arereh* and *Boscia senegalensis* on the Virginland; *Piliostigma reticulatum*, *Guera senegalensis* and *Dichrostaychys cineria* on the Fallowland and *Guera senegalensis* and *Combretum micranatum* on Hillyland. Fallowland recorded higher composition of grasses (11 species m^{-2}), with *Chloris robusta*, *Seteria pallid-fusca* and *Pennisetum pedicellatum* being dominant, than the Virginland (6 species m^{-2}), with *Andropogon pseudapricus* and *Pennisetum pedicellatum*, and Hillyland (6 species m^{-2}), with *Andropogon pseudapricus* being dominant. Virginland and Fallowland recorded higher composition of legumes and forbs (19 species), with *Monechma ciliatum*, *Alysicarpus vaginalis* and *Seteria verticillata* being dominant, than in Hillyland, where *Monechma ciliatum* and *Seteria verticillata* dominate. Herbage yield and herbage dry matter production were higher ($P < 0.05$ in Fallowland (2.803 t DM ha^{-1}; 140.156 t DM) and the Virginland (2.386 t DM ha^{-1}; 95.422 t DM) compared to the Hillyland (0.027 t DM ha^{-1}; 2.65 t DM). Fallowland and Virginland sites at Dabagi farm hold greater potentials for pasture productivity during the rainy season than Hillyland.

Keywords: Species composition; Herbage yield; Dabagi farm

INTRODUCTION

Forage resources remain the most important feed resource for ruminant livestock production worldwide and provide the cheapest source of nutrition for these animals in

tropical Africa (Crowder and Chheda, 1982; Aregheore, 2009). Rangeland forages, apart from being the main source of nutrition for ruminant animals, also offer the opportunity of eliminating the unnecessary competition for common feeding resources between the ruminant animals and humans (Akinola and Olorunju, 1990). However, the existing rangelands in West African (Nigeria inclusive) semi-arid Savanna are now in various states of dilapidation, producing forages less than their potentials both in quantity and quality (Yahuza, 1998; Malami, 2005; Aregheore, 2009; Rabah, 2011). The Dabagi farm rangeland of Usmanu Danfodiyo University, Sokoto, Nigeria may not be an exception to this general problem.

In order to maintain their role as main source of nutrition for ruminant livestock in the country, there is urgent need to take measures that would arrest further deterioration of the pasture resources and improve their potentials for herbage production to be utilized on sustainable basis. The measures include evaluation of rangeland potentials to provide adequate pasture that would support efficient livestock production. This can be achieved through adequate knowledge about species composition, herbage yield and dry matter production of rangelands together with application of sound grazing management (Kallah, 1982; Baba and Mark, 1992). This study was carried out to evaluate species compositions and density of the herbaceous and ligneous plants, the herbage yield and herbage dry matter production of the rangeland types in the Dabagi farm of the Usmanu Danfodiyo University, Sokoto, Nigeria. This would provide a basis for taking appropriate decisions on stocking density and application of sound grazing management that is currently lacking in the institutional rangeland. It would also pave way for further studies for sustainable utilization of rangelands in the study area.

MATERIALS AND METHODS

Study Area

The study was conducted at the Dabagi farm rangeland of Usmanu Danfodiyo University, Sokoto, Nigeria, during the late rainy season (between August and October, 2014) when the herbage biomass production was highest in the study area. The Dabagi farm (now renamed; Centre for Agricultural and Pastoral Research – CAPAR) is located on Latitudes 12^{O} 45' N and Longitude 5^{O} 25' E; 33 Kilometers from the Sokoto metropolis, along the Sokoto – Gusau road in Dange - Shuni Local Government Area of Sokoto State, Nigeria. Sokoto State lies in the Sudan Savanna vegetation at an altitude of 350 m above sea level (Singh, 2004). The climate is characterized by distinct wet and dry seasons. The short rainy season starts in May/June and end in September/October while the long dry season is from October to April/May. Mean annual rainfall varies from 500 to 900 mm with a wider inter annual variations. Relative humidity is moderate to high (51 – 79 %) during the rainy season and very low (10 – 25%) during the dry season. Mean monthly temperatures vary widely; from about 14^{o}C in December/January to about 41^{o}C in April with annual mean of about 28^{o}C (Mamman *et al.*, 2000; SERC, 2010).

Vegetation at the Dabagi farm was described as Shrub-savannah, composed of few scattered trees, many shrubs and herbaceous species of grasses, legumes and forbs; typical of the disturbed Sudan Savannah vegetation, (Isah and Shinkafi, 2000). According to CAPAR (2010) the Dabagi farm occupies a total land area of about 512 ha; comprising of about 400 ha of arable land under continuous crop cultivation, 20 ha of 'forest reserve' and

the remaining 92 ha being utilized mainly for livestock grazing. Initial survey of Dabagi farm to identify areas utilized for grazing by livestock (rangeland types) identified the following: (i) about 40 ha of uncultivated or 'virgin' land, (ii) extensive cropping area (about 400 ha) of which an estimated 50 ha was left fallow and being used for livestock grazing and (iii) about 100 ha of hillyland (also uncultivated) at the northern, western and eastern borders of the farm, also used for livestock grazing during the dry season. These were in addition to about 20 ha developed for infrastructure; such as dairy facilities, administrative building and staff quarters (Na-Allah, 2015).

Treatments and Sampling

The treatments for this study consisted of the three rangeland types (Virginland, Fallowland and Hillyland) identified during a preliminary survey. Stratified sampling was employed to select sampling plots along transects in the three rangeland sites. Two transects; each measuring 800 m long were marked in the Virginland and Fallowland at nearly equal distances apart; while in the Hillyland, four transects each measuring 1000 m long were marked, giving a total of eight transects. For measurement of ligneous (tree and shrub) species composition and density, 1 ha circular plots of 56.4 m radius (10,000 m^2) were marked at 200 m interval as sampling plots along each transect in the three rangeland sites. This gave a total of six sampling plots each for the Virginland and Fallowland, and 12 sampling plots for the Hillyland.

Data Collection

For estimation of species composition of trees and shrubs in the three rangeland types (Virginland, Fallowland and Hillyland), all trees and shrubs within the study plots were counted and recorded using common names while botanical names were later identified using Blench (2007). For estimation of herbaceous species composition and density, herbage yield and herbage dry matter production, herbage samples were collected using $1m^2$ quadrat thrown randomly three times within each of the study plots. This gave a total of 18 herbage samples each from the Virginland and Fallowland, and 36 herbage samples from the Hillyland. All herbaceous plants within each sampling quadrat were harvested at about 2 cm above the ground, using a sickle, tied together and weighed immediately using a Pan Scale. The reading obtained for each quadrat was then recorded as fresh weight (in grams). The various species from each collection were later separated, counted and recorded using common names, while botanical names were later identified using Blench (2007).

Herbage yield and herbage dry matter production were evaluated using the procedures described by Kallah (2004b). Herbage samples collected from the selected sampling plots, using quadrat, in the three rangeland types were used. Sub-samples were then taken from the herbage samples collected from each quadrat to form a representative sample for each of the rangeland sites. The representative samples were oven dried to obtain the dry weights, expressed as percentage of the herbage fresh weights, and the readings obtained were also recorded. Mean yield of herbage dry matter 'P' (g/m^2) from each rangeland type was then calculated by dividing the total dry yields from all the individual quadrats by number of the quadrats taken. Mean herbage dry matter yield (Kg/ha) and total herbage production (Kg) were then estimated by using the formula below:

- Mean herbage dry matter yield = P (g/m^2)
- Mean herbage dry matter yield (Kg/ha) = P x C
- Total herbage production (Kg) = P x C x A
  Where; C = 10 for 1 x 1 m quadrat and A = surface area of rangeland in hectares (Kallah, 2004b).

Data Analysis

The data collected on species compositions for both the ligneous and herbaceous plants in the three rangeland sites were analysed using descriptive statistics, such as mean and percentage. Analysis of variance (ANOVA) using Proc GLM procedures of SAS was carried out to determine the significant difference of the data on herbage yield and dry matter production (SAS, 2003). Treatment means that showed significant difference were separated using Lest Significant Difference (LSD) test ($t < 0.05$).

RESULTS

Ligneous Species Composition

Results on the species composition of ligneous trees and shrubs in the Virginland, Fallowland and Hillyland of Dabagi farm during the late rainy season (August - October) are shown in Tables 1 and 2, respectively. The tree layer in the Dabagi farm rangeland composed of eleven species; of which 10 and 4 species encountered on the Virginland and Fallowland, respectively, while no tree species was encountered on the Hillyland (Table 1). In the Virginland, the tree layer was dominated by *Acacia nilotica*, *Balanites eagyptiaca*, *Piliostigma reticulatum* and *Azadirachta indica*; with 4, 3, 3 and 2 stands per hectare, respectively. The dominant species in the Fallowland were *Azadirachta indica* and *Piliostigma reticulatum* at 2 and 1 stands per hectare, respectively.

The shrub layer in the study area composed of thirty-one species, of which 29, 25 and 12 species were found on Virginland, Fallowland and Hillyland, respectively (Table 2). The shrub layer in the Virginland was dominated by such species as *Combretum micranatum*, *Guera senegalensis*, *Lennea kerstingii*, *Cassia arereh* and *Boscia senegalensis* at 101, 95, 77, 67 and 66 stands per hectare, respectively. The dominant shrub species in the Fallowland and Hillyland were *Piliostigma reticulatum*, *Guera senegalensis* and *Dichrostaychys cineria* at 62, 35 and 23 stands per hectare, and *Guera senegalensis*, *Combretum micranatum*, *Combretum inigricans* and *Boscia senegalensis* at 418 and 329, 64, and 35 stands per hectare, respectively.

Table 1: Species composition (number ha^{-1}) of trees in three rangeland types of the Dabagi farm, Usmanu Danfodiyo University, Sokoto, Nigeria during late rainy season (August - October)

Species		Rangeland types		
Scientific Name	Local Name (Hausa)	Virginland	Fallowland	Hillyland
Acacia nilotica	Bagaruwa	3.7 (24.7)*	0.7 (14.0)	0 (0.0)
Azadirachta indica	Dogonyaro	2.3 (15.3)	2.3 (46.0)	0 (0.0)
Acacia sieberana	Farar-kaya	0.7 (4.7)	0 (0.0)	0 (0.0)
Balanites eagyptica	Aduwa	2.7 (18.0)	0 (0.0)	0 (0.0)
Bombax brevicus	Kurya	0.7 (4.7)	0 (0.0)	0 (0.0)
Cassia arereh	Malga	1.0 (6.7)	0 (0.0)	0 (0.0)
Dichrostaychys cineria	Dundu	0.7 (4.7)	0 (0.0)	0 (0.0)
Diospyros mespiliformis	Kanya	0 (0.0)	0.3 (6.0)	0 (0.0)
Mimosa pigra	Gumbi	1.0 (6.7)	0 (0.0)	0 (0.0)
Piliostigma reticulatum	Kalgo	2.7 (18.0)	1.3 (26.0)	0 (0.0)
Schecarya birrea	Nunu	0.7 (4.7)	0 (0.0)	0 (0.0)
Total		15 (100)	5 (100)	0 (100)

* Figures in brackets are percentages

Herbaceous Species Composition

Results on species composition of herbaceous grasses, legumes and forbs in the Virginland, Fallowland and Hillyland of Dabagi farm during the late rainy season (August - October) are shown in Tables 3 and 4, respectively. All the grasses encountered in the three rangeland types were annual species, except *Andropogon gayanus* recorded on the Virginland and Fallowland (Table 1). The Fallowland recorded higher composition of grasses (11 species m^{-2}), with *Chloris robusta*, *Seteria pallid-fusca*, *Pennisetum pedicellatum* and *Chloris gayana* being dominant; at 59, 55, 33 and 20 stands per meter square compared to the Virginland and Hillyland sites where 6 and 4 species m^{-2} were recorded. The dominant grass species were *Andropogon pseudapricus* and *Pennisetum pedicellatum* in the Virginland; at 107 and 56 stands m^{-2} and *Andropogon pseudapricus* in the Hillyland at 81 stands m^{-2}.

Similarly, all the herbaceous legumes and forbs encountered in the study area (25 species) were annual species, with 16, 19 and 5 species per square meter recorded from the Virginland, Fallowland and Hillyland, respectively (Table 2). The dominant legume species from both Virginland and Hillyland was *Monechma ciliatum*), *Alysicarpus vaginalis* and *Seteria verticillata* (Table 4). In the Fallowland, *Monechma ciliatum* and *Seteria verticillata* were dominant at 35 and 32 stands m^{-2}, respectively.

Table 2: Species composition (stands ha^{-1}) of shrubs in three rangeland types in the Dabagi farm rangeland, Usmanu Danfodiyo University, Sokoto, Nigeria during late rainy season (August - October)

Species		Rangeland type		
Scientific Name	Local Name (Hausa)	Virginland	Fallowland	Hillyland
Acacia nilotica	Bagaruwa	48.0 (9.1)	3.3 (1.6)	0 (0.0)
Acacia sieberana	Farar kaya	0.3 (0.0)	0.7 (0.3)	0 (0.0)
Anagueissus leocarpus	Marke	7.0 (1.3)	0.3 (0.1)	0 (0.0)
Azadirachta indica	Dogonyaro	7.0 (1.3)	9 (4.3)	0 (0.0)
Balanites eagyptica	Aduwa	13.5 (2.6)	5 (2.4)	0 (0.0)
Bauhinia rufescens	Jirga	0.3 (0.0)	0 (0.0)	0 (0.0)
Bombax brevicupsi	Kurya	0.7 (0.1)	0 (0.0)	0 (0.0)
Boscia senegalensis	Anza	65.7 (12.3)	12 (5.7)	34.5 (3.7)
Cassia arereh	Malga	66.7 (12.7)	6 (2.9)	8.5 (0.9)
Cassia singueana	Runhu	23.3 (4.4)	9.3 (4.4)	0 (0.0)
Combretum glutuinosum	Taramniya	36.3 (6.9)	2 (1.0)	0.5 (0.1)
Combretum micranatum	Geza	101.3 (19.2)	7.3 (3.5)	329 (35.0)
Combretum nigricans	Tsiriri	45.7 (8.7)	3.7 (1.8)	63.5 (6.7)
Deterium microcarpum	Taura	2.3 (0.4)	12 (5.7)	0 (0.0)
Dichrostaychys cineria	Dundu	40.7 (7.7)	23.3 (11.1)	0 (0.0)
Diospyros mespiliformis	Kanya	1.3 (0.2)	3.3 (1.6)	0 (0.0)
Feretia apondenthera	Kuru-kuru	3.7 (0.7)	1.3 (0.6)	0.7 (0.1)
Gardenia aqualla	Gaude	0 (0.0)	0 (0.0)	86 (9.1)
Grewia mollis	Kamomowa	8.3 (1.6)	2 (1.0)	5.5 (0.6)
Guera senegalensis	Sabara	95.3 (18.1)	34.7 (16.6)	417.5 (44.4)
Lennea kerstingii	Farun-doya	77 (14.6)	1.0 (0.5)	0 (0.0)
Mimosa pigra	Gumbi	7.3 (1.4)	2.7 (1.3)	27.5 (2.9)
Piliostigma reticulatum	Kalgo	35.7 (6.8)	62.3 (29.8)	0 (0.0)
Schecarya birrea	Nunu	5.7 (1.1)	1.3 (0.6)	0 (0.0)
Solanum incanum	Idon-shanu	3.3 (0.6)	0 (0.0)	0 (0.0)
Terminalia macroptera	Kamdare	29.3 (5.6)	0.7 (0.3)	0 (0.0)
Vitex doniana	Dunya	0.3 (0.0)	0 (0.0)	0 (0.0)
Xemenia Americana	Tsada	0.3 (0.0)	0 (0.0)	0.3 (0.0)
Zizipus abyssinica	Magarya	0.3 (0.0)	0.3 (0.1)	0 (0.0)
Zizipus mucronata	Magaryar-kura	0.3 (0.0)	6 (2.9)	0 (0.0)
-	Kefsiya	0 (0.0)	0 (0.0)	31 (3.3)
Total		527 (100)	209 (100)	941 (100)

* Figures in brackets are percentages

Herbage Yield and Dry Matter Production

Herbage yield and dry matter production of the three rangeland types in the study area are shown in Table 3. Fallowland recorded higher ($P < 0.05$) herbage yield (2.803 t DM ha^{-1}) and herbage dry matter production (140.156 t DM) compared to the Hillyland (0.027 t DM ha^{-1}) and the Virgin land for herbage dry matter production (95.422 t DM), but herbage yield was similar (2.386 t DM ha^{-1}).

Table 3: Species composition (number $1m^{-2}$) of herbaceous grasses in three rangeland types in the Dabagi farm of Usmanu Danfodiyo University, Sokoto, Nigeria during late rainy season (August - October)

Species		Rangeland type		
Scientific Name	Local Name (Hausa)	Virginland	Fallowland	Hillyland
Andropogon gayanus	Gamba	11.2 (5.7)*	5.5 (2.3)	0 (0.0)
Andropogon pseudapricus	Jan-Bako	107.3 (54.2)	1.8 (0.7)	80.5 (75.2)
Chloris gayana	-	0 (0.0)	19.5 (8.1)	0 (0.0)
Chloris robusta	Dawan-Dala	11.3 (5.7)	58.8 (24.4)	0 (0.0)
Dactyloctenium aegyptium	Gude-gude	0 (0.0)	18.8 (7.8)	0 (0.0)
Digitaria horizantalis	Harkiya	10.7 (5.4)	12.3 (5.1)	5.2 (4.9)
Eragrostis tremula	Burburwa	1.6 (0.8)	21.5 (8.9)	5.5 (5.1)
Pennisetum pedicellatum	Kyasuwa	56.1 (28.3)	32.8 (13.6)	5.9 (5.5)
Rottboellia exaltata	Dawa-dawa	0 (0.0)	7.3 (3.0)	0 (0.0)
Seteria pallid-fusca	Geron-Dala	0 (0.0)	54.5 (22.6)	9.4 (8.8)
Sorghum arundinaceum	Dawar-dankurana	0 (0.0)	8.2 (3.4)	0 (0.0)
	Total	198 (100)	241 (100)	107 (100)

* Figures in brackets are percentages

Table 4: Species composition (number per 1 m^{-2}) of herbaceous legumes and forbs in three rangeland types in the Dabagi farm of Usmanu Danfodiyo University, Sokoto, Nigeria during the late rainy season (August - October)

Herbaceous legumes and forbs species		Rangeland type		
Scientific (Botanical) Name	Local Name (Hausa)	Virginland	Fallowland	Hillyland
Alysicarpus vaginalis	Gadagi	78.3 (27.9)*	0 (0.0)	9.2 (13.5)
Cassia tora	Tafasa	3.7 (1.3)	8.3 (6.2)	2.3 (3.4)
Chamecrista mimosoides	Bagaruwan-kasa	5.3 (1.9)	0 (0.0)	0 (0.0)
Combretum molle	Wuyan damo	0 (0.0)	0.5 (0.4)	0 (0.0)
Corchorus tridens	Lalo	0 (0.0)	0.7 (0.5)	0 (0.0)
Crotalaria mucronata	Birana	0.8 (0.3)	0.5 (0.4)	0 (0.0)
Hibiscus sabdariffa	Sure/ Yakuwa	0.4 (0.1)	0 (0.0)	0 (0.0)
Indigofera astragahina	Kaikayin mashekiya	0 (0.0)	10.9 (8.1)	0 (0.0)
Indigofera hirsute	Masahi	0 (0.0)	5.5 (4.1)	0 (0.0)
Ipomea eriopcarpa	Yaryadi	1.2 (0.4)	8.3 (6.2)	0 (0.0)
Ipomoea repens	Duman-kada	0 (0.0)	0.8 (0.6)	0 (0.0)
Isobalinia doka	Takalmin-kwado	0.7 (0.3)	10.3 (7.7)	0 (0.0)
Jussiaea suffruticosa	Shashatau	1 (0.4)	0 (0.0)	0 (0.0)
Merremia tridentate	Yambururu	0 (0.0)	3.7 (2.8)	0 (0.0)
Mitracarpus hirtus	Harwatsi/Goga-masu	0 (0.0)	6.2 (4.6)	0 (0.0)
Monechma ciliatum	Danfarkami	88.8 (31.6)	35 (26.1)	10 (14.7)
Pupalla lappacea	Madaddafin-kusa	1.7 (0.6)	7 (5.2)	0 (0.0)
Saccharum spontaneum	Kyamro/Kyauro	0.1 (0.0)	0 (0.0)	0 (0.0)
Seteria verticillata	Dangere	34.4 (12.2)	31.5 (23.5)	41 (60.3)
Sida cordifolia	Garmani	0 (0.0)	1 (0.7)	0 (0.0)
Sida oveta	Miyan-tsanya	0.2 (0.1)	0 (0.0)	0 (0.0)
Stylosenthes guinensis	-	20.7 (7.4)	0.2 (0.1)	5.7 (8.4)
Tephrosia vogelii	Kini	1.3 (0.5)	0.3 (0.2)	0 (0.0)
Typha domingensis	Geron-tsuntsaye	0 (0.0)	0.2 (0.1)	0 (0.0)
Urena lobate	Rama-rama	1.5 (0.5)	3.5 (2.6)	0 (0.0)
Total		281 (100)	134 (100)	68 (100)

* Figures in brackets are percentages

Table 5: Herbage yield and dry matter production of three rangeland types in the Dabagi farm of Usmanu Danfodiyo University, Sokoto, Nigeria during the late rainy season (August - October)

Parameter	Rangeland type			
	Virginland (40 ha)	Fallowland (50 ha)	Hillyland (100 ha)	SEM
Herbage yield (tones DM ha^{-1})	2.386^{ab}	2.803^{a}	0.027^{c}	0.185
Dry matter production (tones DM)	95.422^{b}	140.156^{a}	2.65^{c}	0.055

Means in the same row carrying different superscript letters differ significantly ($P < 0.01$).

DISCUSSION

Ligneous Species Composition

The low composition of the tree species in the study area was in line with the earlier reports by Adegbola (1982), Kallah (2004a) and Aregheore (2009) that rangelands in the Sudano-sahelian zone are composed of few scattered trees. Similar observations were also reported by Isah and Shinkafi (2000), Malami 2005 and Rabah (2011) in the study area. The tree species found dominant in the study area were similar to those reported in the Zamfara grazing reserve (Malami, 2005) and in Tullun-Gwanki grazing reserve (Rabah, 2011) both in Northwestern Nigeria. The low composition of trees on Fallowland recorded in this study could be attributed to frequent felling of trees for land preparation during the previous cultivation in the Fallowland. The Hillyland might have lost all the trees due to frequent felling of trees for fire wood as reported in the study area by Isah and Shinkafi (2000) or may be naturally devoid of trees.

The shrub species composition and density recorded in the present study was nearly similar to the composition and density of the shrub species across the Zamfara reserve, Nigeria (Malami, 2005). The higher composition and density of shrubs in the Virginland compared to in the Fallowland and Hillyland was expected due to the fact that no cultivation was taking place in the Virginland. On the other hand, the low composition and density of shrubs in the Fallowland and Hillyland could be attributed to frequent cutting of the shrubs and trees during land preparation for the previous cultivations that took place in the Fallowland, and for the frequent fire wood collection reported by Isah and Shinkafi (2000) in the study area.

Herbaceous Species Composition

The composition and density of annual grasses, herbaceous legumes and forbs in the study area was similar to the species composition and density of the rangelands in the Sudano-Sahelian zone of Nigeria reported by Kallah (2004b), Malami (2005), Aregheore (2009) and Rabah (2011). The higher composition and density of grasses (Table 3) and herbaceous legumes and forbs (Table 4) recorded in the Fallowland compared to the Virginland and Hillyland could be attributed to the opening up of the vegetation and tillage during the previous cultivation of the area. This might have encouraged seed germination and growth of many plants in the Fallowland. The dominant species recorded in the study area, which includes *Andropogon pseudapricus, Pennicetum pedicellatum chloris robusta* and *Seteria pallid-fusca*; for grasses and *Monechma ciliatum*, *Alysicarpus vaginalis* and *Seteria verticillata*; for herbaceous legumes and forbs differed slightly with the herbaceous species composition reported in Zamfara (Malami, 2005) and Tullun-Gwanki grazing reserves (Rabah, 2011) in this ecological zone. This may be explained by the fact that rangelands dominated by annual species show strong variations in botanical composition (Breman *et al.*, 1984).

Herbage Yield and Dry Matter Production

The higher ($P < 0.05$) yield of herbage recorded from the Fallowland (2.803 t DM ha^{-1}) and Virginland (2.386 t DM ha^{-1}) compared to the Hillyland (0.027 t DM ha^{-1}) could

be due to the rocky and hard nature of the soils at the higher elevation in addition to very large portions devoid of vegetation cover (bare ground). The herbage yields recorded from the Virginland and Fallowland in this study were higher than the mean herbage yield of 1.735 t DM ha^{-1} recorded in Zamfara reserve, Nigeria (Malami, 2005) and 354 – 1,673 kg DM ha^{-1} recorded in Tullun – Gwanki grazing reserve in Sokoto state, Nigeria (Rabah, 2011) during late rainy season (August – October). This has indicated higher potential of the Virginland and Fallowland in the Dabagi farm for herbage production during the rainy season. The higher ($P < 0.05$) herbage production from the Fallowland compared to the Virginland and Hillyland recorded in this study was similar to the higher herbage productivity reported from crop fields compared to the natural range in the Zamfara reserve, Nigeria (Malami, 2005). The very low herbage yield and dry matter production of the Hillyland in this study could be due to the very low composition and density of the herbaceous species recorded from the Hillyland reported in the present study.

CONCLUSION

Based on the results from this study, it was concluded that Fallowland and Virginland at the Dabagi farm of Usmanu Danfodiyo University, Sokoto, Nigeria hold greater potentials for pasture productivity than the Hillyland during the rainy season. However, the high composition of the shrub species recorded from the Hillyland can provide a great deal of browse feed supply during the dry season.

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