Original Research Article

Differential Availability of different Weed Species for Cattle Production in the selected Derived savannah and Rainforest Agro-ecological Zones of Nigeria~~.~~

Abstract

Among the major factors that determine the success of cattle production in Nigeria is the availability of palatable weed species. Hence the need to conduct research on the availability of palatable, edible and non-edible weed species for cattle production in the selected two agro-ecological zones (Derived savannah and rainforest) of Northcentre and Southwest ~~in~~ Nigeria becomes imperative. The study involved three parallel transects, each of 12.5 m x 12.5 m and ten evenly spaced different weed species sampled quadrats (1m x1m) were taken and replicated three times. The results showed that non-edible *Hyptis suaveolens*(94.2%) dominated the derived savannah and palatable*Pennisetum*species (36.8%) dominated the rainforest. The analysis of variance and New Duncan Multiple Range Tests($p = 0.05$) revealed that there was a statistically significant($p \leq 0.01$) difference within the agro-ecological zones and availability of palatable, edible and non-edible weed species. However, in the derived savannah agro-ecological zone, the non-edible weed species had pronounced significant ($p \leq 0.01$) availability, while in the rainforest agro-ecological zone, the palatable weeds had pronounced significant ($p \leq 0.01$) availability. It could be concluded therefore, that if urgent steps are not taken, cattle will continue to move from the derived savannah (more non-edible weeds) to rainforest (more palatable weeds) and this will cause farmers-herders~~'~~ conflict. In addition, there would be more propagation of these non-edible weeds especially *H.~~yptis~~suaveolens*as a result of cattle movement to the rainforest, an act that couldcause more weeds imbalance in the rainforest.

Key words: Weed species;*Hyptis suaveolens*; Cattle production; palatable; edible; climate change.

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Introduction

Among all the livestock that makeup farm animals in Nigeria, ruminants, comprising sheep, goats and cattle, constitute the farm animals largely reared by farm families in the country's agricultural system (Lawal-Adebowale, 2012). Exclusive pastoral practice or nomadic preoccupation entails sole management of ruminants, especially cattle forsocioeconomic well-being of the pastoral farmers~~,~~ (Blench, 1998).Exclusive pastoralists do not grow crops but simply depend on sales of their ruminants and dairy products to meet their food needs, whereas their animals depend mainly on available pastures, hence asplant is very important to the survival of man so also is it for animals. Most plants that are palatable for human beings are also suitable for animals. However, not all plants that are palatable for animals are also good for the consumption of man. A dimension to this development is the increase in farmer-herder conflicts throughout much of the western Sahel, due toexpansion ofagriculturist population and cultivated land which is at the expense of pasturelands; deteriorating environmental conditions, desertification and soil degradation;population growth(Ilo *et al.*,2019), breakdown in traditional conflict resolution mechanisms of land and water disputes; and proliferation of small arms and crime in rural areas(Baca,2015). Insecurity and violence have led many populations to create self-defense forces and ethnic and tribal militias, which have resulted in further violence. Most ~~of~~farmer-herder clashes have occurred between Muslim Fulani herdsmen and farmers, thereby exacerbating hostilities(IPI, 2015).This is to say that there is competition between man and animal for space, water and plant resources especially when the resources are useful to both.

Sometimes, this competition has metamorphosed into unsettled conflicts owing to climate change which has drastically reduced the existence of some resources. For instance, in the 60s, the Sahel and Sudan Savannah of Nigeria were filled with shrubs and grasses that are palatable

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for cattle and other ruminants. However, due to the inability to manage the ecosystem well, shrubs and water resources have been seriously depleted thereby giving room to the emergence of invasive plants such as *Hyptis ~~S~~suaveolens.*This plant has the characteristics of multiplying itself within a very short time as well as suppressing other plants. The seed has the opportunity of sticking to the fur of cattle while the cow dung serves as fertilizer for its growth.

The drift of herdsmen to the southern derived and rainforest zones also comes along with the invasive plant (*Hyptis spp*) in all the available land causingdrastic reduction in the availability of other pastures. Thus, if quick attention is not taken, further conflicts are still imminent and inevitable. This seems to be the main reason for looking at the weed/plantsurveys for determining species palatability, edibility, non-edibility and their distribution as they affect cattle production (Nkoa *et al.* 2015). The number of weed species has changed as a result of the changing climate and alterations caused by agricultural practices including cattle production (Keller *et al.* 2015; Richner *et al*. 2017).

General objective

The general objectiveof this study was to assess the differential availability of different weed speciesfor cattle production in the selected derived savannah and rainforest agro-ecological zones of Nigeria.

Specific objectives

The specific objectives are to determine the differential availability of palatable, edible, and non-edible weed species in the study area.

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Materials and method

Location/sites

Two agro-ecological zones (Derived savannah and Rainforest zones) were selected from the Southwest and North central of Nigeria. The Savannah agro-ecological zone comprises of Ibarapa North Local Government area in Oyo State, Southwest Nigeria and Baruten Local Government area in Kwara State (North-central). The Rainforest agro-ecological zone comprises Akinyele Local Government area in Oyo State, Southwest and Ayedaade Local Government area in Osun State (Southwest).Ibarapa North, Baruten, Akinyele and Ayedaade Local Government areas.

Weed data

Weed~~/plant~~surveys for determining species palatability, edibility, non- edibility involved three parallel transect lines each ~~of~~ 12.5 mlength and 12.5 m apart from each other were set out. Quadrats of 1 m × 1 m were laid down along the transect lines and weed species data were collected from 10 evenly spaced sample quadrats replicated three times which gave thirty quadrats per location. Individual weed species falling within the quadrat were identified, counted and listed, using a field identification guide prepared by Stroud and Parker (1989). An ~~I~~in-depth interview was also conducted with the cattle herders with a view to gaining knowledge based on the contact of cattle with weed species.

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Weed data analysis

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~~A~~availability of weed species was calculated by counting the number of recorded species per quadrat. The data on weed species availability was generated using frequency, abundance and dominance procedures as outlined in Tesema and Lema (1998). The frequency of weed species was calculated by dividing the number of quadrats in which particular weed species occurred by the total number of quadrats and multiplying the outcome by 100 using the formula:

f = x/ n × 100, (Tesema and Lema, 1998),

where f = frequency of a particular weed species

x = number of samples in which a particular weed species occurs

n = total number of samples

Statistical analysis

The generated data were subjected to analysis of variance by minitab 17.0 and the meansseparated using New Duncan's multiple range test.

Results and discussion

The characteristics of the sampled agro-ecological zones (Table 1) indicated that combined Akinyele and Ayedaade Local Government areas (rainforest) had more ~~of~~ square kilometers of land area (466,005), population (362,203) and mean annual rainfall (1,377.8 mm) than the savannah (Ibarapa North and Baruten local government areas).

Weed species as sampled from Ibarapa LGA (Table 2) indicated that five (5) weed species were palatable and edible respectively, while seven (8) were non-edible. *Stylosanthes gracilis* (55%) was the highest, and *Elusine indica* (3.1%) was the least palatable weed species available.*Axonopus Compressus* (40.8%) and *Sorghum halepense* (4.9%) were the highest and least available edible weed species respectively, while *Hyptis suaveolens* (91.7%) and *Achyranthes aspera* (0.3%), which were the highest and least available non-edible weed species respectively from derived savannah zone of Ibarapa North LGA. The reason for the prevalence of *Stylosanthes gracilis* is that it is a leguminous grass that can survive in an odd environment. *Hyptis suaveolens*is the most prominent non-edible grass because it has a high tendency to multiply faster than all other weeds in the zone. The implication for cattle production is that less palatable and ediblegrasses are available in the derived Savannah zone.

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Comment [I18]: This section only presents research results and is not followed by discussion. Therefore, it must be discussed and use relevant references to discuss the results of the research.

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Comment [I20]: use references related to environmental influences on the adaptability of weeds, so that there are weeds that are found to be dominant in each observation plot

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Table 1: Characteristics of sampled agro-ecological zones

Agro-ecological Zones	Land area (Km^2)	Population	Latitude	Longitude	Mean annual temperature	Mean annual rainfall
a. Derived savannah						
i. Ibarapa North LGA	1,218	101092	7.6865°N	3.1780°E	28^0C	300mm
ii. Baruten	9749	209459	9.3493°N	3.5813°E	28^0C	101.5mm
b. Rainforest						
i. Akinyele LGA	464,892	211811	7.5503°N	3.9470° E	29^0C	1,250mm
ii. Ayedaade LGA	1113	150392	7.2800°N	4.2100° E	29^0C	127.8mm

Source: Author, 2022

Table 2: Average number of weed species in the selected Ibarapa North local government area in Oyo State, derived savannah agro-ecological zone (q = 30).

Palatable	f	(%)	Edible	f	(%)	Non-edible	f	(%)
ST	160	55	AX	42	40.8	BO	14	0.7
PA	12	4.1	SO	5	4.9	BI	60	2.9
PU	75	26	IN	10	9.7	AC	7	0.3
CY	34	12	CP	12	11.7	AE	40	1.9
EL	9	3.1	CH	34	33	HY	1923	91.7
						TR	8	0.4
						PS	24	1.1
						PY	21	1.0

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However, the *H.~~yptis~~suaveolens* have taken sizeable areas of agricultural land with ~~an~~ invasive plant that are not edible for cattle production. This implies that cattle may not get quality feeds on time which may delay their growth or enforced the herders to move into farmlands to feed their animals, thereby resulting in conflicts.There are more available palatable (9) weed species (Table 3) than the edible (3) and non- edible (5) in Baruten LGA. However, *S.~~tylosanthes~~*

gracilis (46.4%), *A.~~spilia~~ africana*(51.9%) and *H.~~yptis~~suaveolens* (98%) were the highest available for

Table 3: Average number of weed species in the selected Baruten local government area in Kwara State, derived savannah agro-ecological zone (q = 30).

Palatable	f	(%)	Edible	f	(%)	Non-edible	f	(%)
ST	123	46.4	CP	26	32.9	CA	7	0.5
PA	6	2.3	AS	41	51.9	AG	6	0.4
PU	42	15.8	CH	12	15.2	HY	1443	98
BR	21	7.9				CM	6	0.4
EL	7	2.6				ME	16	1.1
AN	13	4.9						
PP	7	2.6						
CY	6	2.3						
TI	40	15.1						

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palatable, edible and non-edible,while *P.~~anicum~~ maximum* (2.3%) and *C.~~ynodon~~ dactylon* (2.3%), *C.~~hromolaena~~ odorata* (15.2%), *A.~~geratum~~ conyzoides (*0.4%) and *C.~~assia~~ mimosoides* (0.4%) are the least for available palatable, edible and non-edible respectively. The dominance of *S.~~tylosanthe~~ gracilis* and *P.~~ueraria~~phaseoloides* in Baruten LGA is due to the fact that both weeds are leguminous plant. Fewer numbers of edible weeds imply that they have been suppressed by the invasive plant; *H.~~yptis~~suaveolens*. The in-depth interview carried outin the study area revealed that their cattle ~~have~~ started eating the tender part of *H.~~yptis~~suaveolens* when they could not get enough feed~~s~~. This may not give them any nutritious value.

There were average fifteen different weed species available in Akinyele LGA (Table 4); palatable (9), edible (3) and non-edible (3). *Pennisetum spp* (37%), *C.~~hromolaena~~ odorata* (74.4%) and *H.~~yptis~~suaveolens* (77.8%) are the highest available for palatable, edible and non-edible, while *S.~~tylosanthes~~ gracilis* (0.5%), *C.~~yperus~~ rotundus* (6.9%) and *P.~~hyllanthus~~ amarus* (5.9%) are the least for available palatable, edible and non-edible weed species respectively.

Unlike in the derived Savannah zone, more palatable weed species were available in the rainforest zone of Akinyele LGA with ~~litt~~le edible and non-edible weed species. The presence

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Table 4: Average number of weed species in the selected Akinyele local government area in Oyo State, rainforest agro-ecological zone (n = 30).

Palatable	f	%	Edible	f	%	Non – edible	f	%
ST	7	0.5	CP	14	6.9	PT	22	16.3
PA	357	23.4	AS	38	18.7	HY	105	77.8
PU	152	10	CH	151	74.4	PY	8	5.9
BR	287	18.8						
AN	89	5.8						
PE	566	37						
PP	34	2.2						
CY	22	1.4						
TI	14	0.9						

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of *H.~~yptis~~suaveolens* was not noticeable in the zone. However, since cattle have started moving to the zone, it calls for ~~a~~ quick attention so that it does not suppress other weed species in a relatively short time.Eleven different weed species were available inAyedaade local government area; palatable (7), edible (2) and non-edible (2) (Table 5).The available weed species *P.ennisetum spp* (36.5%) *C.~~hromolaena~~ odorata* (67.6%) and *H.~~yptis~~suaveolens* (82.1%) had the highest, while *S.~~tylosanthes~~ gracilis* (0.3%), *A.~~spilia~~ africana* (32.4%) and *C.~~assia~~ hirsute* (17.9%) were the least available palatable, edible and non-edible weed species respectively. As it is in Akinyele LGA which is in the rainforest zone, there are more palatable weed species in Ayedaade LGA of Osun State which is also a forest zone. There were fewer numbers of edible and non-edible weeds.

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The derived savannah agro-ecological zone of Nigeria (Table 6) represented by two local governments; Ibarapa Local Government area in Oyo State and Baruten Local Government area in Kwara State indicated that the available non-edible weed species *H.~~yptis~~suaveolens* (94.2%)

was predominated, followed by palatable weed species; *S.~~tylosanthes~~ gracilis* (51%), and edible weed species of *A.~~xonopus~~ compressus* (28.4%) were the least. Considering the availability of

Table 5: Average number of weed species in the selected Ayedaade local government area in Osun state, rainforest agro-ecological zone (q = 30).

Palatable	f	%	Edible	f	%	Non –edible	f	%
ST	4	0.3	AS	44	32.4	CA	21	17.9
PA	283	18	CH	92	67.6	HY	96	82.1
PU	94	6						
BR	262	16.7						
AN	192	12.2						
PE	574	36.5						
TI	163	10.4						

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Table 6: Average number of weed species in the all selected savannah agro-ecological zone (q = 30).

Palatable	f	%	Edible	f	%	Non – edible	f	%
ST	283	51	AX	42	28.4	CA	7	0.2
PA	12	2.2	SO	5	3.4	AG	6	0.2
PU	117	21.1	IN	10	6.8	BI	60	1.7
BR	21	3.8	CP	38	25.7	AC	7	0.2
CY	34	6.1	AS	41	27.7	AE	40	1.1
EL	16	2.9	CH	12	8.1	HY	3366	94.2
AN	13	2.3				TR	8	0.2
PE	6	1.1				CM	6	0.2
PP	7	1.3				PS	24	0.7
CN	6	1.1				ME	16	0.5
TI	40	7.2				PY	21	0.6
						BO	14	0.4

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different weed species in the savannah, it was discovered that palatable and non-edible species had eleven different weed species each, while the edible weed species were only six. This implies that with six *H.~~ypti~~suaveolens* stands in the area, there will be only one palatable weed specie. It alsoindicates that before cattle will get one of the palatable weed species, they will get

six ~~of~~*H.~~yptis~~suaveolens*. With this figure, there is no way herdsmen will not move into arable land to get feeds for their cattle, an act that may result inconflict.A total of 31 different weed species were identified across the sampled agro-ecological zones as palatable, edible and

Table 7: Average number of weed species in the all selected rainforest agro-ecological zone (q = 30).

Palatable	f	%	Edible	f	%	Non- edible	f	%
ST	11	0.4	CP	14	4.1	CA	21	8.3
PA	640	20.6	AS	82	24.2	HY	201	79.8
PU	246	7.9	CH	243	71.7	PS	22	8.7
BR	549	17.7				PY	8	3.2
AN	281	9.1						
PE	1140	36.8						
PP	34	1.1						
CY	22	10.7						
TI	177	5.7						

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non - edible. In the savannah (Ibarapa North and Baruten local government areas)agro-ecological zones (Table 7), a total of 29 weed species wereobserved and identified and categorized as palatable (11), edible (6) and non-edible (12), while in the rainforest (Akinyele and Ayedaade local government areas) agro-ecological zones (Table 8), a total of 16 weed species were also identified and categorized as palatable (9), edible (3) and non-edible (4). It was also noted that some of the 31 different weed species cut across the two agro-ecological zones.The rainforest (Table 7) which consisted of two local governments in Oyo State and Osun States indicated that there were more palatable weed species (9) in the rainforest zone than the non-edible (4) and edible (3) as estimated. *P.ennisetum spp* (36.8%), *C.~~hromolaena~~ odorata* (71.7%) and *H.~~yptis~~suaveolens*(79.8%) are the highest, while *S.~~tylosanthes~~gracilis*(0.4%), *C.~~yperus~~ rotundus* (4.1%) and *P.~~hyllanthus~~ amarus* (3.2%) are least for palatable edible and non-edible respectively. Unlike the derived savannah zone that was predominantly dominated by

H.~~yptis~~suaveolens, there were more palatable weed species in the rainforest agro-ecological zone. Considering the ratio of the palatable to *H.~~yptis~~suaveolens*, we have ratio18:1 respectively which differs from that of the derived Savannah agro-ecological zone. This shows the reason why herdsmen move their cattle to the forest zone. Before, the zone used to be very thick forest that are very difficult for cattle to move into. Gradually, the forest may soon be depleted in due course as a result of cattle invasion and the presence of *H.~~yptis~~suveolens*.

The analysis ofvariance of different weed species indifferent ecological zone (Table 8) indicated that there wasstatistically significant ($p \leq 0.01$) difference within the ecological zones and availability of weed species (palatable, edible and non-edible), inall derived savannah (Ibarapa North and Baruten local government areas) zone, the non – edible weed species had pronounced significant (3,055,161; $p \leq 0.01$) availability than the palatable (20,909.7; $p \leq 0.01$) and edible (904; $p \leq 0.01$). New Duncan's multiple range test (Table 9)~~that~~ was used to separate means weed species within different ecological zones, indicated 11 weed species across the derived savannah ecological zone were sampled; availability of palatable weed species of *S.~~tylosanthes~~gracilis* (284a), *P.~~ueraria~~ phaseoloides* (117b), *B.~~rachiaria~~ lata* (21e), *C.~~ymbopogon~~citratus*(34d), *A.~~ndopogon~~ gayanus* (13g) and *T.~~ithonia~~ diversifolia* (40c) were statistically significantly (p=0.05) different from availability of *P.~~anicum~~ maximum* (18f) and *E.~~lusine~~ indica* (16f) that are statistically (p =0.05) the same. Also,*P.ennisetum spp* (6h) *P.~~aspalum~~ polystachyum* (7h) and *C.~~ynodon~~ dactylon* (6h) had the same (p =0.05) availability index. New Duncan multiple range test (Table 10) revealed that six available edible weed species in derived savannah with *A.~~xonopus~~ compressus* (42a) and *A.~~spilia~~ africana* (41a) are statistically (p =0.05) the same, also *I.~~ndigofera~~ tinctoria* (10c) and *C.~~hromolaena~~ odorata*(12c) are statistically (p =0.05) the same and statistically (p =0.05) different from *S.~~orghum~~ halepense*

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(5d) and *C.~~yperus~~ rotundus* (38b). It was, therefore noted (Table 8) that, the derived savannah agro-ecological zone had more pronounced statistical significant ($p \leq 0.01$) availability of non-edible weed species of *H.~~yptis~~suaveolens*(3366a) than other weed species. However, availability of non-edible of

Table 8: Analysis of variance of weed species of selected agro-ecological zones (Savannah and Rainforest)

Ecological zones /Sources of variation	Palatable ms	p-v	Edible ms	p-v	Non-edible ms	p-v
Ibarapa LGA (Oyo State)	11804.1**	0.001	800.4**	0.001	1542209**	0.001
Baruten LGA (Kwara State)	4301.3**	0.001	631**	0.001	1234297**	0.001
Akinyele LGA (Oyo State)	112887**	0.001	16057**	0.001	6247**	0.001
Ayedaade LGA (Osun State)	98771.7**	0.001	3456**	0.001	8437.5**	0.001
All derived savannah zone	20909.7**	0.001	904**	0.001	3055161**	0.001
All forest zone	418271**	0.001	41493**	0.001	25596.8**	0.001

Notes: **significant at $p \leq 0.01$, ms = mean square, p-v = probability value.

Table 9: New Duncan Multiple Range Test (NDMRT) to separates palatable weeds species means as they occurred at various selected ecological zones (Savannah and Rainforest).

Weed species	ILG	BLG	ALG	AYL	ALS	ALF
ST	160a	123a	7c	4g	284a	11i
PA	12d	6e	357b	283b	18f	640b
PU	75b	42b	152d	94f	117b	246e
BR	NA	21c	287c	263c	21e	549c
CY	35c	NA	NA	NA	34d	NA
EL	9e	7e	NA	NA	16f	NA
AN	NA	13d	89e	192d	13g	281d
PE	NA	NA	563a	574a	6h	1140a
PP	NA	7e	34f	NA	7h	34g
CN	6e	22e	NA	NA	6h	22h
TI	NA	40b	14h	163e	40c	117f

Notes: Means that do not share a letter within the column differs significantly at p = 0.05**.** NA= Not available.

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Table 10: New Duncan Multiple Range Test (NDMRT) to separates Edible weeds species means as they occurred at various selected ecological zones (Savannah and Rainforest).

Weed species	ILG	BLG	ALG	AYL	ALS	ALF
AX	42a	NA	NA	NA	42a	NA
SO	5d	NA	NA	NA	5d	NA
IN	10c	NA	NA	NA	10c	NA
CP	12c	26b	14c	NA	38b	14c
AS	NA	41a	36b	44b	41a	82b
CH	34b	12c	151a	92a	12c	243a

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Notes: Means that do not share a letter within the column differs significantly at p = 0.05**.** NA= Not available.

Table 11: New Duncan Multiple Range Test (NDMRT) to separates Non – edible weeds species means as they occurred at various selected ecological zones (Savannah and Rainforest).

Weed species	ILG	BLG	ALG	AYL	ALS	ALF
BO	14f	NA	NA	NA	NA	NA
CA	NA	7c	NA	21b	7g	21b
AG	NA	6c	NA	NA	6g	NA
BI	60b	NA	NA	NA	60b	NA
AC	7g	NA	NA	NA	7g	NA
PT	NA	NA	22b	NA	NA	NA
AE	40c	NA	NA	NA	40c	NA
HY	1923a	1443a	105a	96a	3366a	201a
PY	21e	NA	6c	NA	21e	8c
TR	8g	NA	NA	NA	8g	NA
CM	NA	6c	NA	NA	6g	NA
PS	24d	NA	NA	NA	24d	21b
ME	NA	16b	NA	NA	16f	NA

Notes: Means that do not share a letter within the column differs significantly at p = 0.05**.** NA= Not available.

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C.assia hirsuta (7g), *A.geratum conyzoides* (6g), *T.riumfetta rhomboidea* (8g), *A.chyranthes aspera* (7g) and *C.assia mimosoides* (6g) are statistically (p =0.05) the same and statistically (p =0.05) different (Table 11)from *B.idens bipinnata* (60b), *A.eschynomene americana* (40c),*H.yptissuaveolens* (3366a),*P.hyllanthus amarus* (21e), *P.assflora foetida* (24d), and *M.elanthera scandens* (16f).

The analysis of variance (Table 8) of availability of different weed species in the rainforest agro-ecological zone indicated that the palatable weed species had pronouncedstatistically significant (418,271; $p \leq 0.01$) availability than edible (41,493; $p \leq 0.01$) and non-edible (25,596.8; $p \leq 0.01$).New Duncan multiple range tests (Table 9) revealed that all the palatable weed species (nine) were statistically significantly (P =0.05) available, but *C.ymbopogoncitratus* and *E.lusine indica* species were not available (p =0.05), however, the availability of palatable weed species in the rainforest of *S.tylosanthesgracilis*(11i), *P.anicum maximum* (640b), *P.ueraria*phaseoloides (246e), *B.rachiaria lata* (549c), *A.ndopogon gayanus* 281d),*P.ennisetum spp* (1140a), *P.aspalum polystachyum* (34g), *C.ynodon dactylon* (22h) and *T.ithonia diversifolia* (117f) were statistically significantly (P =0.05) different in their respective availability, where *Pennisetum spp*(1140a) had more pronounced significant (p =0.05) availability than other palatable weed species in the rainforest zone. New Duncan multiple range tests (Table 10) revealed that all the three edible weed species (*C.yperus rotundus* – 14c, *A.spilia*

africana – 82b and *C.~~hromolaena~~ odorata*– 243a) were statistically significantly (P =0.05) different in availability in the rainforest zone, while availability of non-edible weed species of *C.~~assia~~ hirsuta* (21b) and *P.~~assflora~~ foetida* (21b) are statistically (p =0.05) different from *H.~~yptis~~suaveolens* (201a) and *P.~~hyllanthus~~ amarus* (8c) (Table 11).

Comparison of analysis of variance (Table 8) of availability of different weed species between the derived savannah and rainforest agro-ecological zone indicated thatrainforest zone had pronounced significant ($p \leq 0.01$) availability of palatable and edible (418,271; 41,493) weed species than the derived savannah zone (20,909.7; 904) respectively, while the derived savannah agro-ecological zone had more pronounced significant (3055161; $p \leq 0.01$) availability of non – edible weed species especially *H.~~yptis~~suaveolens* (3366a) than rainforest agro-ecological zone. The implication of the results in addition to less land area per person (0.04 km^2/personin derived savannah compare to rainforest (1.29 km^2/person) is that~~,~~cattle may growlean in the derived savannah agro-ecological zone due to lack/inadequate palatable and edible pasture than the cattle in the rainforest except they get supplement feeds. Without the availability of supplement feeds, herders may take their cattle to feed from agricultural lands in the rainforest agro-ecological zone due to more arable land~~s~~availability of palatable and edible pastures. This may be the reason more conflicts are recorded in the savannah zones thanthe rainforest agro-ecological zone.

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Conclusion and recommendations

The study noted that~~,~~ there were pronounced availability of palatable and edible pastures (especially, *Pennisetum spp,P.~~anicum~~ maximum,A.~~spilia~~ africana* and*C.~~hromolaena~~ odorata),*for cattle production in the rainforest agro-ecological zone than the derived savannah agro-ecological zone with pronounced availability of non – edible weeds (especially,

H.yptissuaveolens,B.idens bipinnata,A.eschynomeneamericana and*P.assflora foetida*). It was also observed that *H.yptissuaveolens*which dominated land in the derived savannah agro-ecological zone may spread torainforest zone through the movement of the cattle from the derived savannah in search of palatable pastures. This may eventually create pasture imbalance in the rainforest agro-ecological zone if not checked.

It is therefore, recommended that the Federal Ministry of Agriculture and environment should be encouraged to reduce the imbalance created by the invasion of *H.yptissuaveolens*and other weed speciesthrough the use of appropriate research institutions. Intensive cattle production should be encouraged with adequate support from the government and non – governmental organizations. Provisions of pastures seeds to the cattle herders and involvement in the multiplication should be encouraged.

Legend:

Sampling zones: *ILG= Ibarapa North LGA, BLG= Baruten LGA, ALG= Akinyele LGA, AYL =Ayedaade LGA, ALS= All savannah, ALF=All forest.*

Weed species: *ST=Stylosanthes gracilis, PA=Panicum maximum, PU=Pueraria phaseoloides, BR= Brachiaria lata, CY=Cymbopogon citratus, EL=Elusine indica, AN=Andopogon gayanus, PE=Pennisetum spp, PP=Paspalum polystachyum, CN=Cynodon dactylon, TI=Tithonia diversifolia, AX=Axonopus compressus, SO=Sorghum halepense, IN=Indigofera tinctoria, CP=Cyperus rotundus, AS=Aspilia africana, CH=Chromolaena odorata, IN=Indigofera spicata, BO=Boehmeria nivea, CA=Cassia hirsute, AG=Ageratum conyzoides, BI=Bidens bipinnata, AC=Achyranthes aspera, PT=Passithora toetida, AE=Aeschynomene americana, HY=Hyptis suaveolens, TR=Triumfetta rhomboidea, CM=Cassia mimosoides, PS=Passflora foetida, ME=Melanthera scandens, PY=Phyllanthus amarus.*

References

Baca, M. W.(2015). My Land, Not Your Land: Farmer-Herder Wars in the Sahel. August 21, https://www.foreignaffairs.com/articles/2015-08-21/myland-not-your-land.Accessed25/10/2018.

Ilo, U. D; Jonathan, I; Adamolekun, Y. (2019). The Deadliest Conflict You've Never Heard of.

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Comment [I45]: Notes:

Comment [I46]: In weed science, it is not permissible to write the species of weeds in the form of symbols, but write the name of the weed in accordance with international standard writing

Foreign Affairs: America and the World. ISSN 0015-7120. Retrieved 2020-04-18.

Keller M, Böhringer N, Möhring J, Rueda-Ayala V, Gutjahr C, Gerhards R. (2015). Changes in weed communities, herbicides, yield levels and effect of weeds on yield in winter cereals based on three decades of field experiments in South-Western Germany. Gesunde Pflanzen 67: 11–20.

Lawal-Adebowale, O.A. (2012) Dynamics of Ruminant Livestock Management in the Context of the Nigerian Agricultural System. In: Javed, K., Ed., Livestock Production, IntechOpen, London, 61. https://doi.org/10.5772/52923.

Nkoa R, Owen M. D, Swanton C. J. (2015). Weed abundance, distribution, diversity, and community analyses.Weed Science Society of America 63: 64–90.View at: Publisher SiteGoogle Scholar

Onifade, O. S. and Agishi, E. C. (1990). A review of forage production and utilisation in Nigerian savanna [Available Online at http://www.fao.org/Wairdocs/ILRI/x5536E/x5536e08.htm. Accessed July 10 218.]

Richner N, Holderegger R, Linder H. P, Walter T. (2017). Dramatic decline in the Swiss arable flora since the 1920s. Agriculture, ecosystems & environment 241: 179–192.

Stroud A, Parker C. (1989). A Weed Identification Guide for Ethiopia, Food and Agriculture Organization of the United Nations Rome, Rome, Italy.

Tesema T, Lema Y. (1998). Qualitative and quantitative determination of weeds in tef in West Shewa Zone. In: Reda F, Tanner DG (eds), Arem 4. Addis Ababa: Ethiopian Weed Science Society. pp 46–60.View at: Google Scholar

Parsons WT, Cuthburtson EG (2000) Noxious weeds of Australia. CSIRO publications, pp 490–491.

Comment [I47]: Check the year

Comment [I48]: .

Raizada P. (2006) Ecological and vegetative characteristics of a potent invader, *Hyptis suaveolens* Poit. from India. Lyonia 11: 115–12.

Sharma GP, Raghubanshi AS. (2009). Plastic responses to different habitat type contribute to *Hyptis suaveolens* Poit. invasiveness in the dry deciduous forest of India. AMBIO: J Human Environ 38: 342–344.

Comment [I49]: not cited in the draft manuscript