Herd simulation model of muturu cattle under sedentary pastoral farming in derived savannah, Southeast, Nigeria

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Abstract

Herd simulation model was adopted to assess the productivity of Muturu cattle under sedentary pastoral system within southeast, Nigeria. The model involved biomass and other productivity investigations of the Muturu herds on field-gazed and stall-fed management within the wet and dry season period. Biological entities of Muturu herds from 500 Muturu cattle holders (MCH) and Non-Pastoral holders (NPH) surveyed from year 2010 to 2019 were studied. The sedentary production system was simulated and statistically analyzed. The results showed 70 percent MCH and 30 percent NPH, with 60 percent of the Muturu stock sourced through donation/leasing arrangement by the NPH, while only 5 percent of the stock for the study was through purchase arrangement by the MCH. Sedentary pastoral system in southeast Nigeria operates at a very low commercial level. There were significant differences ($P < 0.05$) in some of the biological entities such as live weight at 12 and 24 months, which were better in the wet season than in the dry season. The stall-fed management was relatively better than the field grazed management. Simulated values were higher than the actual values in some of the biological entities but fit in with field grazed and stall-fed management. The efficiency of Livestock/forage production under the sedentary system was very low with 13.02, 15.32 and 17.35 percent respectively for field-grazed, stall-fed management and simulation model. The herd biomass and productivity values of Muturu herd under the sedentary pastoral system in the Southeast region were very low with 25.00 and 33.33 percent for field grazed and stall-fed management respectively.

Keywords: Sedentary, Pastoral Farming, Muturu Cattle, herd simulation, derived savannah.

Un Modèle de simulation de troupeau de bovins muturu sous élevage pastoral sédentaire dans la savane dérivée au sud-est du Nigeria

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Résumé

Un modèle de simulation de troupeau a été adopté pour évaluer la productivité des bovins Muturu sous système pastoral sédentaire dans le sud-est du Nigeria. Le modèle impliquait des études sur la biomasse et d'autres études de productivité des troupeaux de Muturu sur la gestion surveillée sur le terrain et nourrie en stabulation pendant la période de saison humide et sèche. Les entités biologiques des troupeaux Muturu de 500 éleveurs Muturu (le 'MCH') et non pastoraux (le 'NPH') enquêtés de 2010 à 2019 ont été étudiées. Le système de production sédentaire a été simulé et analysé statistiquement. Les résultats ont montré 70 pour cent de 'MCH' et 30 pour cent de 'NPH', avec 60 pour cent du stock de Muturu provenant d'un accord de don / location par le 'NPH', tandis que seulement 5 pour cent du stock de l'étude provenait d'un accord d'achat par le 'MCH'. Le système pastoral sédentaire du sud-est du Nigeria fonctionne à un niveau commercial très bas. Il y avait des différences

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significatives ($P < 0,05$) dans certaines des entités biologiques telles que le poids vif à 12 et 24 mois, qui étaient meilleures pendant la saison des pluies que pendant la saison sèche. La gestion des étables était relativement meilleure que la gestion des pâturages sur le terrain. Les valeurs simulées étaient plus élevées que les valeurs réelles dans certaines des entités biologiques, mais cadraient avec la gestion des pâturages sur le terrain et des stalles. L'efficacité de la production de bétail / fourrage dans le système sédentaire était très faible avec 13,02, 15,32 et 17,35 pour cent respectivement pour le modèle de gestion et de simulation sur pâturage au champ, en stabulation. Les valeurs de la biomasse et de la productivité du troupeau de Muturu sous le système pastoral sédentaire dans la région du Sud-Est étaient très faibles avec 25,00 et 33,33 pour cent respectivement pour la gestion des pâturages au champ et des stalles.

Mots clés : Sédentaire, élevage pastoral, bovins *Muturu*, simulation de troupeau, savane dérivée.

Introduction

Muturu breed of cattle, which is one of the indigenous non-zebus, shorthorn cattle found in the Southern and North Central, Nigeria is at the verge of extinction. The cattle population estimated at 0.76 percent of Nigerian indigenous breed (Payne, 1990) continued dwindling on yearly basis due to poor pastoral farming system and lack modern cattle facilities. Reports have indicated that Muturu cattle rearing are becoming unattractive for commercial purpose particularly in the Southeast region probably due to small herd size and poor productive capacity (Nweze, 2006, Nweze and Ekwe, 2012). The cattle have relatively smaller body size and lower milk yield than other Nigerian indigenous breed such as N'dama, White Fulani cattle, etc (Fricke, 1993 and Payne, 1990). Despite these limitations for Muturu cattle, it has been reported that the breed is hardy and with reasonable tolerant to *trypanosomiasis* disease (Payne, 1990). Muturu breed is popular cattle among the Igbo speaking tribe of Nigeria. The “*Efi-igbo*” as called by the natives of Southeast, Nigeria is highly regarded customarily for ceremonial activities such as traditional rites, title taking, naming ceremonies, burial and marriage rites (Nweze, *et al.*, 2002).

A popular production system of Muturu cattle in Southeast region is sedentary pastoral farming, characterized by

subsistent or semi-subsistent small size holding of herd under low input management (Fricke, 1990 and Nweze, 2017). Under this pastoral system, the cattle is common property in which the owner of stock has no regard for the livestock as a business venture and with no serious management effort put in place during the production process. This situation usually results into a very low output from the animal. In addition to this, other cattle rearing challenges arise due to improper diseases and pest control management, poor feeding, breeding and inadequate housing management. In some cases, seasonal tethering and field grazing under the control of children occur. Muturu cattle roam within the neighborhood, scavenging in some villages within the zone without any proper record kept for the Livestock (Nweze, 2003). The sedentary pastoral system is unpopular within southeast region due to little economic benefit. It cannot fit into the modern cattle production system because of low patronage by investors. It lacks the capacity of engaging the youth as a reliable means of livelihood.

One of the major attributes of this pastoral system is that of socio-cultural emphasis on royalty rather than the real economic value that is worthy of means of livelihood. Within societal setting of many southeast villages, Muturu cattle production is not a lucrative business venture even as it is a

highly capital intensive enterprise and therefore the livestock farming is not worthy of any attention. Moreover, the pastoral system does not even give room for proper assessment of the Livestock/forage resources within the region. Furthermore, there is overstretched land space due to developmental activities as well as the use of land for other agricultural and non-agricultural purposes in many part of Southeast region. These factors make the operation of pastoral system difficult (Apata *et al.*, 2011). There are unusual clashes between pastoralists and crop farmers (Nweze, 2017 and 2008) as well as competition for land resources between the pastoral farming and arable cropping. These complex challenges need a model that can assess feedback effect of livestock/forage resource. Assessment of herd-unit-economy of Muturu cattle is necessary under this traditional livestock husbandry system to define the future of cattle production in this region.

In view of the above situation, herd simulation model involving the use of integer, stochastic, non-optimizing and type dynamic system (Krumel *et al.*, 1986) to evaluate the productivity of Muturu cattle under the rural sedentary production system is necessary. The forage potential in response to animal activities within the savannah region requires a study that should provide feedback mechanism (Agyemang *et al.*; 1996). The assumption under this model is that there is sufficient forage resources that can sustain the biological activities of cattle herd with the corresponding economic benefit under the

existing pastoral system. The study looked at the qualitative description of Muturu cattle productivity at the beginning of simulation with the input at the initial herd biomass, the production process and the output at the final herd biomass at the end of simulated period. The production processes specified the conditions, management regimes and alternative production strategies as well as stipulates a consistency check and other assessment methods.

Materials and methods

Location of study

The study was conducted at Savannah region Southeast, Nigeria lying on longitude 060°4' N and latitude 080°65' (Lawson, 1980). The weather condition is considerably a bi-modal rainfall pattern, occurring around June-July and September-October. The wet season is usually around March-April and last up to December with mean rainfall and temperature of 1250mm and 28°C respectively and 75 percent humidity. Late December to early March is the dry season, characterized with low humidity, dry forage materials and bush burning of the surrounding environment. The forage materials are mainly annual, perennial grasses, legumes and scattered bushes of trees and shrubs that are hardly accessible to cattle. There is availability of abundant forage species during wet season. These forage materials mature rapidly and decline digestible nutrients within a short period of wet season (Umunna and Isi, 1993). Table 1 represents the forage characteristics of the area (Nweze, 2017).

Table 1: Forage characteristic of the derived savannah region

Parameters	Wet Season	Dry Season
Feed type	grasses/legumes/browses	fodder/agro-by-products/pasture
Feed availability	very high – high	low – very low
Digestible nutrient(%)	68.00 – 5.50	52.00 – 48.00
Animal mobility	low	High
Disease and pest	high – low	Low
Water availability	high	Low
Grazing time	high	low

Sources: Nweze, 2017

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Experimental procedures

There were two type Of Cattle holdings in this study, namely Muturu cattle holders(MCH)and Non-pastoral holders(NPH). NPH are wealthy men, politician, traditional rulers, etc, that own one or more cattle as stockholder but are not able to keep them and manage but give the cattle for other people(MCH) to manage for them.

A survey conducted in which structured questionnaires and group interview were administered to cattle stockholders within communities of five states of Ebonyi, Enugu, Abia, Anambra and Imo that makes up the Southeast Geo-political zone

involved. 200 MCH and NPH who were randomly drawn from five local government areas in each state. The data collected from year 2010 to 2019, validated and analyzed using a secondary data from previous studies were involved in the model (Nweze *et al.*, 2013).

Validation process

The validation process involves herd identification, spot observation and assessment of biological entities from the herd gotten from MCH and NPH. The birth rate of the herd was assessed using the expression represented below (Andrezejewske, 1992).

$$b = \frac{KN_t \cdot 100}{N_b} \quad k = \text{biological process}$$

N_b = total breeding cows

Where b = birth rate N_t = number of cow that calved at time (365 days).

Biological process (k) involved

Litter size (L) = 1 Calf

Study period (T) = $365\frac{1}{4}$ days

Muturu gestation period (t_p) = 280 days

$$K = \frac{LT}{t_p} = 1.30$$

$$b = \frac{1.30 N_t \cdot 100}{N_b}$$

The mortality and survival rates of the Muturu herd were analyzed using the expression below

$$d = \frac{N_0 + N_t - N \cdot 100}{N_b}$$

Where d = death rate, N = total number of cattle in the herd, N_0 = initial number of cattle in the herd, N_t = number of new animal in the herd at (T period = $365\frac{1}{4}$ days).

$$S = \frac{N + N_b - N_d \cdot 100}{N}$$

where S = Survival rate

N = Number of cattle at end of T = $365\frac{1}{4}$ days

N_b = Number of births and

N_d = Number of animals that died

$$b = \frac{d_s}{d_t} \geq 1$$

Muturu simulation process

Figure 1 shows the components of biological entities.

Figure 1. Components of Muturu herd biological system

A type dynamic, stochastic and non-optimizing model involving entity vectors of year-type input/out configuration was involved in the simulation process (Figure 2).

Figure 2. Input/output configuration of Muturu Sedentary Pastoral System

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There was experimental grazing orbit and the total number of 5-10 Muturu cattle per a grazing orbit was estimated. These were carried out for dry and wet season by casting of quadrat on grazing areas. The relative abundance of forage species was

determined for the forage biomass (Nweze, 2017). Simulation model followed the computer package indicated in the data analysis using system-related and animal-related variables (Table 2).

Table 2. Assumed correction-factor-multipliers for system-related variables of derived savannah

Variable	Wet Season	Dry Season
Forage quantity (Q) in dry matter basis (t/ha)	2.50	0.50
Digestibility of forage (d) (%)	58.00	53.00
Forage efficiency (F _e)	0.45	0.18
Forage intake co-efficient (a)	0.60	0.40
Grazing orbit distance (D) (km/day)	5.00	10.00
Digestibility of forage on offer (d) (%)	58.00	53.00
Crude protein of forage on offer (CP)(%)	7.50	3.40
Net energy for maintenance (E _m) (MJ/days)	24.50	25.10
Net energy for weight gain (E _g) (MJ/days)	13.20	13.18

Sources: Nweze (2017)

Weight of Muturu cattle as well as feed on offer within and outside the paddock was routinely determined on weekly basis. The Digestible feed nutrient based on dry matter on-offer expressed as

$$D_n = I_m - F_m, \text{ where } D_n = \text{digestible dry matter feed consumed}$$

$$I_m = \text{feed intake of Muturu herd}$$

$$F_m = \text{fecal output from Muturu herd}$$

In estimating simulated feed intake of Muturu herd on field grazing condition under sedentary pastoral system within the region, an expression represented below was used (Nweze, 2017).

$$I = m(d,t) \cdot m(Q) \cdot m(D) \cdot m(t) \cdot m(x,t) \cdot m(p,t) \cdot q \cdot W_i^{-0.73}$$

I = average daily forage intake of mature herd

m(d,t) = digestibility of forage available on offer in day (t)

m(Q) = Quantity of forage available on offer in day(Q)

m(D) = daily grazing time (number of hours per day(D))

m(t) = average ages of mature herd (months or year)(t)

m(x, t) = physiological states of Muturu herd (pregnant or not pregnant)(x)

a = intake co-efficient of metabolic weight of Muturu herd

W_i = Live weight of the Muturu herd

Tables 3 is the assumed correction factor multipliers for both the system related and animal related variables.

Table 3: Assumed Correction-factor-multipliers for animal related-variables

Variables	Values
Considered average age of Muturu herds (E) (years)	2.00
Average weight of Muturu bull (w) (kg)	175.00
Average weight of Muturu cow (w _{ic}) (kg)	150.00
Coefficient variation (K _i)	2.50
Upper limit Live weight Muturu bull (W _{maxb}) (kg)	180.00
Lower limit Live weight Muturu bull (W _{minb}) (kg)	175.00
Upper limit Live weight Muturu cow (W _{maxc}) (kg)	165.00
Lower limit Live weight Muturu cow (W _{minc}) (kg)	135.00
Voluntary dry matter intake (I) (kg)	5.60
Potential weight gain (α _p) (kg)	0.25

Sources: Nweze, 2017

Modified expression under stall-fed feed intake is

$$I = M [1 - e^{(px/m)}]^{1/h}$$

Where I = stall-fed feed intake

X = feed on offer including supplementary feed

P= edible feed consumed

h = correction factors

The output in term of herd Biomass is

$$B = \frac{N_i + N_f}{2} \cdot a \cdot W_i^{-73}$$

Where B = herd biomass

N_i = initial Muturu population herd

N_f = final Muturu population herd

a = coefficient feed intake on metabolic weight

W_i = mean metabolic weight

Reproductive index (RD) is express as

$$RD = \frac{S_b}{N_t} \text{ where } b = \text{birth}$$

N_i = herd pop.

Exploitative index (EI) is express as

$$EI = \frac{I \cdot N}{B \cdot T} \cdot \frac{100}{1}$$

Where EI = Exploitative index

I = Intake of feed

B = herd biomass

T = 365 $\frac{1}{4}$ days

Productive Index (PI) is express as

$$PI = \int_f b_z \cdot s_z \cdot B_z$$

Where PI= Productive index

bt = birth rate

st = survival rate

Bt = Biomass

Efficiency of Livestock/Forage production (FE) is express as

$$FE = \frac{1}{B} \cdot \frac{100}{1}$$

Where I = forage intake

B = Biomass

Ranking of biological system

There were six parameters used for the ranking of Muturu herd biological system. These include calving rate, survival rate, weight gain, productive and reproductive indices as well as livestock/forage efficiency of production. The maximum grade for each variable is 6 point making the cumulative grade to be 36.

Percentage grade=

$$\frac{\text{total grade}}{\text{Cumulative grade}} \times \frac{100}{1}$$

Data analysis

Best linear unbiased estimate and prediction selection model (Henderson, 1993), SPSS 2014 and SAS (2002) as well as least square analysis of variance (Harvey, 1997) were used for data analysis.

Results and discussion

The result in Table. 4 shows the sources of foundation stock and the distribution of Muturu cattle holders. A system of cattle ownership in the Southeast Nigeria exist in which wealthy individuals within rural communities give out their cattle to another person(s) to manage for them under a mutual agreement. Such agreement could stipulate the sharing formula for cow offspring and other leasing conditions for the animals. This cattle leasing system has given rise to two categories of Muturu cattle ownership namely Muturu Cattle Holder (MCH) and Non-Pastoral Holder (NPH). The MCH constituted about 70 percent. While NPH were only 30 percent of the

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Muturu holders. The results in table 4 show that MCH only got 5 percent of their foundation stock through purchase. This shows that there were some challenges in sourcing dams and proven sires of Muturu for foundation stock within the region. The fact is that healthy cattle are hardly given out by their owners for sales even at a very high price, except if the owner is seriously in emergency or needed money urgently. The only animals worthy of sale are unhealthy cattle or old stocks that have ran out of breeding values. Another challenge in sourcing foundation stock is the difficulties in locating a breeding stock and transporting the stock to the farm due to

bad road of the rural communities as well as absence of established proper Muturu cattle market in the zone. The NPH got higher values (30 percent) through purchase probably because some of them are willing to offer higher price. Muturu cattle sale is not usually on open market business, like other indigenous breed of cattle in Nigeria. The business is usually between individuals under on-farm arrangement. The Muturu cattle acquisition is by gift/donation from friends, relatives or in-laws during marriage or other events. Under such situations, the owner has the option of given out to the cattle out for other people to manage.

Table 4: Sources of muturu cattle foundation stock and holders' distribution

Parameters	G/I (%)	L/D (%)	P (%)	(%)
MCH	3,500	1,925 55	1,400 40	175 05 70
NPH	1,500	150 10	900 60	45030 30

Keys: MCH= Muturu Cattle holders
NPH = Non Pastoral Holder
N = Sample Survey Numbers

G/I= Source through gift or inheritance
L/D= Source through lease or donation
P= Source through purchase

Table 5 represents Muturu herd productive performance. There were no significant differences ($CP > 0.01$) for birth weight of male and female calves born on wet and dry season. However, the body weight of Muturu cattle at 12 and 24 months were significantly differences ($P < 0.05$) for the wet and dry season duration. The superior body weight of the cattle during the wet season could be because of abundant forage

species during the wet season (Table 3). This season provides higher feed resources for Muturu cattle than the dry season. Seasonal forage variability is one of the tropical challenges in cattle management (Agbola, 1982). Forage resources are serious issues especially with the prevailing global climate change affecting the ecosystem and the acute shortage of grazing land in the Southeast Nigeria.

Table 5: Muturu herd productive attributes under sedentary system in southeast, Nigeria

Wet Season	Dry Season			
Variables	Male	Female	Male	Female
Birth weight of calves (kg)	10.45±2.3	10.25±1.20	9.29±1.20	9.05±1.80
Body weight at 12 mnths (kg)	92.24±5.60 ^a	85.20±3.80 ^a	78.50±10.50 ^b	75.20 ^b ±10.28
Body weight at 24 mnths (kg)	180.50±10.20 ^a	175.25±5.20 ^a	165.28±5.00 ^b	135.10±3.00 ^c
Survival rate 2 years (%)	85.00±0.50	85.00±1.20	80.25±1.50	80.10±1.00
Survival rate 2 – 5 years (%)	75.10±5.00	73.10±5.00	75.00±2.00	73.10±5.00
Survival rate 5 years (%)	73.00±5.00	70.15±5.00	73.00±5.00	70.00±3.00
Calving rate 3 – 5 years (%)	20.00±5.00	19.80±10.50		
Calving rate 5 - 8 years (%)	44.50±8.00	44.50±10.00		
Calving rate 10 years (%)	35.00±5.00	35.00±10.50		

a, b, c mean with different superscripts are significantly different ($p < 0.05$).

Table 6 shows the birth rate of Muturu herd under field grazed, stall-fed and simulated values from year 2010 to 2019. There was significant difference ($P<0.05$) between the stimulated values and the values obtained from the two feeding managements. The simulated values were higher than the values from field grazed and stall-fed herd of cattle under the sedentary pastoral system suggesting that there was still unexploited potential in the pastoral system. The maximum number of cows that

conceived and calving rate potentials was low showing untapped Muturu herd potentials in that regard. It revealed that good breeding management, adequate breeding record, proper male to female ratio and good feeding management could give room for increased birth by Muturu cows. Prevention of reproductive and other diseases that cause abortion and sterility in the herd could still improve the calving rate of Muturu herds (Nuru and Burvenendran, 1994 and Ezekwe, 2001).

Table 6: Least square mean for Muturu birth rate (%) under herd-year grazing, stall -fed and simulated management

Year	N	Grazing	Stall-Fed	Simulated	SEM
LSM	5,000	21.32 ^b	24.80 ^b	54.50	9.32
2010	250	25.10 ^a	30.00 ^a	48.12 ^a	6.12
2011	500	15.11 ^c	27.10 ^b	44.32 ^a	5.12
2012	500	22.01 ^b	25.15 ^b	42.10 ^a	3.00
2013	750	28.32 ^b	32.12 ^{ab}	61.42 ^a	3.01
2014	500	21.10 ^b	30.15 ^b	47.10 ^a	4.32
2015	450	24.32 ^a	27.18 ^a	45.15 ^a	4.00
2016	500	27.16 ^b	31.32 ^b	51.00 ^b	5.50
2017	550	18.20 ^c	25.00 ^b	42.00 ^b	6.20
2018	420	16.32 ^c	20.18 ^b	48.10 ^a	5.00
2019	580	27.23 ^b	30.12 ^b	59.12 ^a	3.25
Wet season	2,500	34.13 ^c	47.20 ^b	54.50 ^a	5.30
Dry season	2,500	20.25 ^c	30.15 ^b	48.32 ^a	5.00

a, b, c mean with different superscript are significantly different ($p \leq 0.05$).

Table 7 shows the mortality rate of herd under field-grazed, stall-fed and simulated values from 2010 to 2019. The results show a relatively fit simulation model as there were no significant differences ($p>0.01$). The pattern of mortality rate, which was less than 20 percent, indicated no major

health issue within the period. The reason could be due to small herd unit (Nweze, 2003). The small health unit of cattle could reduce the difficulty in health management operations, experience in a large herd (Osoyimi, 2008, and Agyemang, *et al.*, 1996).

Table 7: Least square mean for Muturu herd mortality (%) under herd-year grazing, stall-fed and simulated management

Year	N	Grazing Condition	Stall-Fed Mgt	Simulated	SEM
LSM	5,000	10.25	10.70	10.50	0.20
2010	250	16.18	10.00	12.25	4.11
2011	500	13.10	12.65	12.20	1.32
2012	550	10.28	11.70	11.25	1.50
2013	750	18.15	15.00	15.70	3.30
2014	500	12.00	11.00	11.10	1.25
2015	450	10.10	10.25	11.25	1.00
2016	500	10.15	10.10	11.00	0.56
2017	550	19.15	18.00	18.32	1.32
2018	420	13.00	10.25	12.85	5.32
2019	580	10.25	10.18	10.75	0.78
Wet season	2,500	12.00	12.35	11.00	2.00
Dry season	2,500	11.85	12.25	11.15	2.32

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Table 8 represents biomass and productivity of the Muturu herd. The results show significant difference ($P<0.05$) among the herd biomass and other parameters of productivity under field grazed, stall-fed management and the simulation model. The simulated livestock biomass-change value was lowest (193.20 tons) among the three values, followed by field grazed (204.47 tons). While the stall-fed herd had the highest values (1230.20 tons), indicating inherent discrepancy in the method of feeding system. The stall-fed system appeared to be a more reliable method of feeding cattle than the field-grazed system (Nweze, 2013). The grazing management under sedentary system in the region appeared not to provide adequate feeding arrangement for Muturu cattle within the region. There are a lot of challenging cattle production management issues such

seasonal variation of forage resources (Agbola, 1982), improper breeding and breeding record (Ezekwe, 2017), lack of modern cattle facilities (Nweze, 2017) and poor record of the animals. These discrepancies in the biological system indicators show a great departure of sedentary pastoral farming from the best global practice of cattle production (Ochere and Nuru, 1985). This also was evidenced in livestock/forage efficiency of production that was very low (13.20%, 15.32 percent and 17.35% for field grazed, stall-fed and simulated values respectively). Even though the survival rates of the Muturu herd under the system were very high, the reproductive and productivity indices were still below average, indicating ineffective production process. Similar low productive capacity of tropical forage species has been reported by scholars (Agbola, 1977; Awogbade, 1980; Powell, 1986).

Table 8: Muturu herd biomass and productivity under field grazing, stall-fed and simulated management

Parameters	Grazing	Still-Fed	Simulated
Livestock initial biomass (tons)	186.25±14.10c	478.15±15.00a	219.72±14.00
Livestock initial biomass (tons)	390.72±15.00c	1230.20±15.00a	484.92±15.00b
Livestock biomass change (tons)	204.47±15.00b	752.05±15.00a	193.20±3.50c
Muturu birth weight per head (kg)	13.50±1.50	15.22±3.20	14.15±3.50
Muturu body weight at 24 months (kg)	164.98±10.72c	191.37±15.00a	180.52±17.00b
Muturu monthly weight gain (kg)	6.98±3.25	8.70±2.00	7.20±2.50
Muturu calving rate (%)	29.19±5.10c	37.16±5.00b	56.44±10.00
Muturu surviving rate (%)	85.74±8.20	82.09±4.20	88.90±10.20
Muturu reproductive index (%)	28.53±2.00	29.00±1.20	35.52±5.20
Forage productivity index (%)	28.53±2.15	30.40±4.50	28.50±3.20
Livestock/Forage efficiency of production	13.20±1.00	15.32±3.50	17.35±3.50

a, b, c mean with different superscripts are significantly different ($p = 0.05$).

Table 9 represents herd biomass and productive ranking. There was low rank on both field-grazed and stall-fed management with 25 percent and 33.33% for field-grazed and stall-fed management respectively, indicating inappropriate cattle management system. The survival rate of the Muturu herd had good grade (4 point in both the field grazed and stall-fed management system). The field grazed cattle has a very low grade because there

was poor management already observed within the sedentary pastoral system. This means that there is urgent need to change the system of cattle production if Muturu cattle should continue to strive in the region. The sustenance of Muturu breed is necessary, as Muturu breed is one of the indigenous breed adapted to environment of the region and all effort should be made to prevent the extinction of cattle in the region.

Table 9: Herd biomass and productive ranking of Muturu on field-grazed and stall-fed management.

Parameters	Field Grazing Grade	Stall-Fed Grade
Calving rate (%)	1.00	2.00
Survival rate (%)	4.00	4.00
Body weight gain (%)	1.00	2.00
Reproductivity index (%)	1.00	1.00
Productivity index (%)	1.00	2.00
Livestock/forage efficiency of production	1.00	1.00
Total grade	9.00	12.00
Percentage grade	25.00	33.33

Cumulative weighing point = 36, maximum grade = 6 point

Key:

1= very poor 2= poor 3= fair
4= good 5= very good 6= excellent

Conclusion

The herd simulation model of Muturu cattle showed that sedentary pastoral system on Savannah, South East Nigeria was defective cattle production system. There was generally low ranking of Muturu herd productive capacity under the pastoral system. Therefore, there is a need to change the system with improved modern production system to enhance Muturu herd population and productive capacity.

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