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Burgeoning and Domestication of Grasscutter (*Thryonomys swinderianus*) in a Post-Ebola Era: A Reassessment of its Prospects and Challenges in Nigeria

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ABSTRACT

Nigeria has been declared free from Ebola, but Nigerians are left with the aftereffect of the experience. The Post Ebola era is the era where the aftereffect of the disease is felt. This era is characterized by a low demand for bushmeat, although the trend may reduce as time goes on. Unfortunately, this is the era where Grasscutter domestication is tipped to be a tool for poverty and unemployment reduction in the country. Nigeria is rich in biodiversity and its natives relish bushmeat. There is practically no ecological zone in Nigeria where this delicacy is not consumed. Grasscutter (*Thryonomys swinderianus*) also known as cane rat, is seen throughout sub-Saharan Africa; its flesh is very popular for domestic consumers but it is scarce and highly priced. Researchers and civil society organizations have fronted the advantages of its domestication and multiplication, but all efforts seem to produce little result since low patronage was recorded. Therefore, this review aims to revisit the prospects associated with Grasscutter domestication in a time like this, also identifying its corresponding challenges. The review also presents Grasscutter farming as a tool for sustainable development in Nigeria. The study identifies good meat quality, ethno-medicinal importance, economical advantages and conservational values as the prospects while diseases, reproductive issues, and nutritional constraints were presented among challenges facing Grasscutter farming in Nigeria. The study recommends proper sensitization of people on zoonotic diseases associated with bushmeat consumption, also tipping government to encourage peoples participation in Grasscutter farming through trainings and extension services.

Keywords: Grasscutter, Ebola, Bushmeat, Domestication, Zoonosis, *Thryonomys swinderianus*

1. INTRODUCTION

Grasscutter have many breeds, these include: *Thryonomys swinderianus gregorianus* (Thomas, 1894), *Thryonomys swinderianus logani* (Romer Nesbit, 1930), *Thryonomys swinderianus raptorum* (Thomas, 1922), *Thryonomys swinderianus swinderianus* (Temmincks, 1927) and *Thryonomys swinderianus variegatus* (Ansell, 1960). This animal is also known as greater cane rat, it is a non-timber forest product (NTFP) that is tropical in distribution (Unaeze 2016). It has great impacts on the livelihood of rural communities (Adedapo and adekunle, 2013). The animal commonly lives among dense grasses mostly along river banks and swamps and is rampant among herbaceous vegetation where there is a good cover. They do not dig burrows like other rats but they hide in holes and scrape a small saucer- shaped depression among the vegetation (Aluko *et al.*, 2015). Despite their large size, they run quick and they are good swimmers. The climatic situation in Nigeria helps them to acclimatize into so many habitats and forests alike (Adedapo and Adekunle, 2013).



Map 1. Geographic Range of *Thryonomys swinderianus* (Temminck, 1827).

The Ebola virus disease (EVD) outbreak in West Africa has been the largest in the history of the disease since its first case in 1976 (Mafunda *et al.*, 2016). At the height of the year 2013, the Ebola crisis hit Africa and was declared in Nigeria by the Federal Ministry of Health on

24th July, 2014, which marks the inception of Ebola era. As of September 23rd, 2014 the Federal Ministry of Health reported 19 confirmed cases, 15 were from Lagos, while four cases were reported in Rivers State. A total of 7 deaths were recorded, accounting for 40 percent of the case mortality rate. It had been reported that transmission of EVD to human being occurs through contact with dead or living infected animals such as primates (UNICEF, 2014).

Despite the yet to be claimed epizootic nature of the disease, news making round was that Ebola was transmitted by bat. Subsequently, the widespread news resulted in viral information on how the virus supposedly emanated from bushmeat. Policy and announcement were made on different media and forums that bushmeat were ban from consumption (Ndem *et al.*, 2015). This mindset was stamped into the subconscious of many people, and this negatively affects the marketability and productivity across the bushmeat value chain. Bushmeat dealers reportedly ran out of business because of consumers refusing to eat bushmeat due to fear of contacting Ebola (Ese *et al.* 2016).

Experts reported the potential importance inherent in domesticated Cane rat in West Africa (Asibey, 1979; Baptist & Mensa 1986; Adedapo and Adekunle, 2013). Reports in the literatures also show some level of success in the domestication of Grasscutter in Ghana, Benin and Nigeria (Adedapo and Adekunle, 2013). Cane rat in captive is reported to be human friendly and its odour is less unfriendly (Benjamin *et al.*, 2006). Despite the enormous potential in Cane rat farming, its acceptance by farmers and consumers may be low compared to other established domesticated animals, therefore there is a need to explore the prospects and challenges in an era where the fear of Ebola and other zoonotic diseases affects the marketability and meat value of wild and domesticated animals alike.

2. IMPORTANCE OF BUSHMEAT IN NIGERIA

Nigeria faces huge food security challenges; about 70 percent of its population live on less than N 100 (US\$0.70) per day, experiencing hunger and poverty (Nwajiuba, 2012). The neglect witnessed by the Agricultural sector in Nigeria can be linked to the discovery of petroleum in Nigeria and the over-dependence on petroleum resources causes decline in Agricultural output and man power therefore affecting the overall food production (Matemilola and Elegbede, 2017). The food crises emanated as a result of this neglect, resulting in malnutrition and hunger despite being an agrarian economy. The sector (Agriculture) provides over 40% of gross domestic product (GDP) with between 60% and 70% of the population productively engaged in farming (Nwajiuba, 2012).

Nigeria's population is the largest in Africa and 7th in the world, yet it depends on imported food staples. The United Nations projected that the overall population of Nigeria will reach about 398 million by the end of the year 2050. By 2100, if current figures continue, the population of Nigeria will be over 746 million. With this projection in place, if agricultural production remains as it is, more food crisis will be experienced in the near future. Therefore, there is a need to explore every available resource to meet up with food security demand in the nation.

Animal production is a very important sector of the economy of any nation, and it is crucial in ensuring food security. Bushmeat have been known for ages to meet the animal protein and health requirements of man. Food and Agricultural organisation (FAO) as cited in Ebenebe and Okpoko (2015) recommended consumption of 34g of animal protein per person

per day for normal growth and development. However, animal protein consumption in Nigeria stands averagely at 7-10 g/person/day because of high poverty levels and ignorance (Ebenebe and Okpoko, 2015). Livestock meat appears to be unavailable and unaffordable by many Nigerians due to high poverty levels in the country (Meludu and Onoja, 2018). Therefore, Bushmeat is projected as an alternative to conventional livestock with competitive nutritional advantages (Table 1).

Table 1. Nutritional assessment of bushmeat and livestock meat.

Animal name	Protein (%)	Fat (%)	Cholesterol (%)	Sum Saturate fatty Acids	Sum Unsaturated fatty Acids (%)
Elk	22.72	1.33	64.41	35.75	53.06
Deer	22.36	1.90	70.57	42.13	50.04
Roe deer	22.82	1.59	67.92	37.54	54.34
Wild boar	22.92	2.82	95.07	34.79	52.88
Beef	19.61	1.48	76.31	40.11	49.96
Pork	21.32	2.77	67.85	37.46	56.82

Source: Strazdiòia et al. 2013.

3. EBOLA AND ITS IMPACT IN NIGERIA

3. 1. Pre-Ebola Era

The inception of bushmeat consumption by man can be traced to man's history and marks the beginning of pre-Ebola era; the era ends immediately Ebola virus was announced in Nigeria. This era is characterised by a high interest in bush meat consumption and wild animal utilisation such as for ethno medicinal purposes. Ajayi (1972) reported that wild animal consumption among rural people in Nigeria's rainforest was 20% of their total animal protein intake compared to the 13% for the whole country. In this era, there was little fear or awareness of contacting any disease by eating bushmeat. Adeola (1987) researched on utilisation of wildlife resources in Nigeria and reported that 80% or more of the population would eat bush meat irrespective of their ecological zone, tribe or culture. In this era, there was a low supply of bushmeat as opposed to demand because of the high rate of consumption. Many tribal areas in Nigeria are mounting pressure on wildlife resources and it is feared at this time that the state of unorganized and uncontrolled exploitation could diminish the remaining game stock rapidly to an unsustainable level. Due to this, there is awareness about the need for conservation.

3. 2. Ebola Era

The first case of Ebola in Nigeria occurred on July 24th 2014 as declared by the Federal Ministry of Health and ended 24th September, 2014. The EVD outbreak has a much wider

impact on food security by affecting food availability and accessibility (Gatiso et al, 2018). Bush meat consumption was perceived to be the cause of the widespread of the virus. The resultant effect of this is that many households in rural communities whose livelihood depended on bushmeat could not meet up to the feeding and financial needs of their households, thereby depending on cheaper food with less quality nutrients such as cassava with little or no protein sources. This era was characterized by surplus supply but low demand for bushmeat, marking the lowest point of bushmeat sales in the history of the nation. Consequently, many bushmeat business owners completely folded up because of the fear of contracting Ebola. The assumption was that even when bushmeat is touched, they can easily contract the virus.

3. 3. Post Ebola Era

This era began immediately Nigeria was declared free from Ebola virus. At the inception of this era, the sale of bushmeat remained affected by the just curtailed Ebola virus. Fear of contacting the virus would not make them touch the bushmeat for consumption. Ebewore et al (2015) show that several constraints were adduced for the drop in the consumption of bushmeat in Delta state, Nigeria (Table 2).

According to them, respondents’ perceived that Ebola crisis ($X = 4.78$) was the most serious constraint militating against bushmeat consumption in Delta region of Nigeria. Oyediran *et al.* (2015) reported the effects of Ebola (EVD) Outbreak on bushmeat marketing in Oyo state Nigeria stating that before the EVD outbreak 54.30% of bushmeat sellers realized ₦11,000.00 – ₦20,000.00 and more per day as against 34.30% of bush meat sellers that got ₦5,000.00 – ₦10,000.00 and less after the EVD outbreak. Also, 42% of food vendors had more than ₦21,000.00 in a day before EVD outbreak as against 78% of the food vendors that got less than ₦5,000.00 a day (Figure 1).

The implication of this is that the return gotten from bushmeat businesses may have reduced due to the outbreak. Post Ebola era is experiencing lower sales of bushmeat than the Pre-Ebola era. World Wildlife Fund (WWF) reported that in spite of the pre scare of Ebola, hunting of wild animals for bushmeat business is still going on significantly in parts of Nigeria. Ebola pandemic has raised awareness and consciousness of people on impending danger of zoonotic diseases in Nigeria.

Table 2. Constraint militating against the consumption of bushmeat.

Constraint	Mean	SD	Rank
Ebola factor	4.78	0.66	1 st
Availability/Adequacy	4.68	0.71	2 nd
Socio-economic (income)	4.62	0.59	3 rd
Cultural prohibition	3.40	0.63	4 th
Government regulation	1.24	0.48	5 th

Source: Ebewore et al 2015

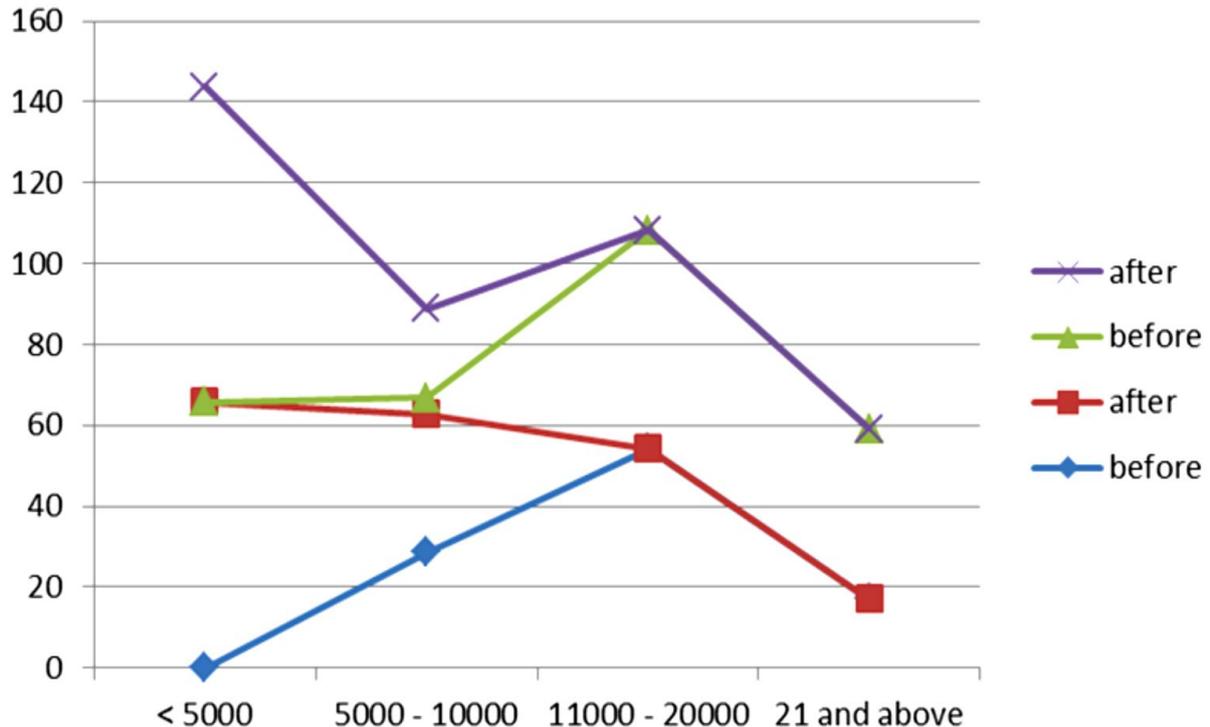


Figure 1. Distribution of respondents based on bush meat sold.
(Source: Oyediran *et al.*, 2015)

4. POTENTIAL OF GRASSCUTTER AS ALTERNATIVE LIVESTOCK

4. 1. History and current situation of Grasscutter production in Nigeria and other countries

Cane rat has two species belonging to the genus *Thryonomys*. These are: *Thryonomys swinderianus* known as greater Cane rats which are found in Africa South Sahara and *Thryonomys gregorianus* known as lesser cane rats found in Cameroon, Southern Sudan, and Zimbabwe (Okarafor *et al.*, 2012; Adu *et al.*, 2017). The native giant Grasscutter, *Thryonomys swinderianus*, is a bushmeat that is a prime candidate for commercial farming given its size, habitat preferences, high market price, and current consumption rate (Unaeze, 2016). Prior to now, people solely depend on the wild for Grasscutter meat through adoption of different hunting tactics (Akinola *et al.*, 2014; Andem, 2012). But now it can be reared. Animals are often domesticated for many reasons, according to Zeder (2012) over the past 11,000 years, wild animals have been domesticated as livestock, working animals, household pets, and companions.

Animal characteristics for domestication differs, it may be due to biological properties, opportunities that the animals brought into domestication and different cultural contexts of their human partners. Grasscutter is domesticated for its meat (food), income generation (Benjamin *et al.*, 2006; Yeboah, 2009), and conservational purpose (Zeder, 2012; Ijeomah *et al.*, 2016). Many researchers have reported successful domestication of Grasscutter in Nigeria (Adedapo and Adekunle, 2013; Akinyemi *et al.*, 2015; Falade *et al.*, 2010).

Table 3. Local names of *Thryonomys swinderianus* in West Africa.

Vernacular	Ethnic group	Country/region
Oya	Yoruba	Nigeria
Akranti/Akrantie	Twi	Ghana
Nchi	Igbo	Nigeria
Udi	Urobo or Isoko	Nigeria
Ikiri	Ijaw	Nigeria
Izay	Igbira	Nigeria
Evuator	Binin	Nigeria
Emi	Igala	Nigeria
Unam-ukot	Efiks/Ibibios	Nigeria
Agouti*	French speaking	West Africa

*Agouti is the French name for rats generally

Table 4. Food items fed to Domesticated grasscutter.

Type	English Name	Scientific Name
Leafy Material	Cassava	<i>Manihot utilissima</i>
	Guinea grass	<i>Panicum maximum</i>
	Elephant grass	<i>Pennisetum purpureum</i>
	Spear grass	<i>Heteropogon contortus</i>
	Plantain pseudo-stem	<i>Musa paradisiaca</i>
	Fresh groundnut tops	<i>Arachis hypogea</i>
	Fresh maize stover	<i>Zea mays</i>
	Job's tears	<i>Croix lacryma jobi</i>
	Centro	<i>Centrosema pubescens</i>
	Spurge weed	<i>Euphobia heterophylla</i>
	Sandpaper tree	<i>Ficus exasperate</i>
	Paspalum	<i>Paspalum polystachyum</i>
	Sweet potato	<i>Ipomea batatas</i>
	African giant star grass	<i>Cynodon nlemfuensis</i>
Cane sugar	<i>Saccharum officinarium</i>	

	Oil palm seedlings African marigold	<i>Elaeis guinensis</i> <i>Aspilia Africana</i>
Tubers and underground stems	Spear grass Cassava Yam Sweet potato	<i>Heteropogon contortus</i> <i>Manihot utilissima</i> <i>Dioscorea spp</i> <i>Ipomea batatas</i>
Fruits and grains	Mango (unripe) Oil palm Pineapple Maize	<i>Mangifera indica</i> <i>Elaeis guinensis</i> <i>Ananas sativa</i> <i>Zea mays</i>
Miscellaneous	Wheat bran Bread Kitchen leftovers Salted corn cobs	

Source: (Adu et al. 2005; Falade et al. 2010, Opara, 2010; Adu et al. 2017)

Grasscutter is easy to rear as majority of their feed requirements can be sourced locally (Adu et al., 2017), the feed composition contains leaf of plants, Tubers, underground stems, food and grains (Table 3). All these feed material require less spending unlike poultry and catfish, it only need little time to source them out. Wogar, (2011) reported that forages and crop residues used in feeding Grasscutters in captives are nutritionally poor and not balanced for optimum growth of the animal, the research proposes feed supplementation with concentrate diet. Many researchers have formulated Grasscutter feed with nutritional supplements (Wogar, 2011; Akuru et al, 2016; Wogar and Ayara, 2015; Edoror and Okoruwa, 2017), they have attributed some of these feed supplements to positive growth.

Conventional livestock such as cattle, sheep and goats are usually kept extensively, requiring substantial areas of land. On the other hand, Grasscutter does not require much land and can even be raised in the backyard and on flat roof tops by the landless (Opera, 2010). Grasscutter produces minimal waste that is almost odourless and can readily be disposed off (Opera, 2010). Despite great potentials embedded in Grasscutter raised as livestock, only few farmers are aware of its potentials in Nigeria. The scantiness of information on the prospects and the biological management of the domesticated animal has led to poor participation of grasscutter farming compared to other micro-livestocks such as rabbit (Adu *et al.*, 2005).

4. 2. Meat quality

Grasscutter (*Thryonomys swinderianus*) is an important source of meat, it is acknowledged to be the preferred bushmeat virtually throughout West African Sub-Region (Adu et al, 2015). The nutritional quality of the meat is one of the reason grasscutter is acceptable as food (Adu et al, 2017). Grasscutter meat is very low in cholesterol and high in

protein, evidently, it is high in mineral such as iron, calcium and phosphorous (Table 5) (Ogogo et al. 2017; Adu et al, 2017). Meat fat content of Grasscutter include many types of lipids, but has triglycerides as the main components, phospholipids and cholesterol, with the phospholipids component being relatively constant compared to the triglycerides and cholesterol (Hernández and Gondret, 2006).

Grasscutter meat is richer in protein compared to cow meat 18.3%, 16.3% respectively and contains lower cholesterol 53.4% than Rabbit, chicken, goat, sheep and cow 135%, 76%, 100.3%, 78.2%, 73.1% and 68.6% respectively (Table 5). Meat from captive bred and wild Grasscutter differ in protein, fat, and moisture content as well as in organoleptic properties (aroma, colour and texture) which sum up to the variation in palatability (opera 2010). Grasscutter has higher percentages of crude protein in wild Grasscutter than captive bred Grasscutter ($P < 0.05$) and higher percentages of fat and moisture content in captive Grasscutter than in wild Grasscutter ($P < 0.05$) (Table 7). Ogogo, (2017) stated that the reason for the higher crude protein content of the wild Grasscutter could be due to the wide varieties of feed exposed to in their natural environment as oppose to when domesticated. The meat yield of Grasscutter is higher though it has a much smaller body weight compared to cattle, sheep, goats and pigs, with higher dressing percentage 57.9% compared to the major livestock species such as sheep (52.1%), goats (49.0%) and cows (52.1%), with the exception of pig which has a dressing percentage of 74%. Grasscutter plays an important role in traditional African medicine such as preparation of concoctions for fertility (Aluko et al 2015; Vink, 2014). The hair of the animal is used to season food just as much as its stomach and intestinal contents. The pancreas of the cane rat contains a high concentration of insulin which is used for local preparation for the treatment of diabetes (Bello *et al.*, 2012; Aluko *et al.*, 2015).

Table 5. Chemical composition of Grasscutter meat compared to other meat types

Species	Grasscutter	Rabbit	Chicken	Goat	Sheep	Pig	Cow
Moisture (g/100 g)	67.0-71.2	67.9	67.6	76.6-78.6	55.8	64.8	55.0-73.8
Energy (J/100 g)	678-804	1749	1782	849	3124	1054	3168
Protein (g/100 g)	17.8-18.3	14-25	21.8	20.38	21.02	19.4	16.3
Lipids (g/100 g)	6.50-10.1	3.0-6.0	11.0	3.16	8.47	13.4	28.0
Cholesterol (mg/100 g)	48.5-53.4	135	76.0	94.0-100.3	78.2	70-73.1	58.9-68.6
Ash (g/100 g)	0.9	1.1	0.9-1.2	0.95-1.2	1.0	0.8	1.0
Iron (mg/100 g)	2.8	1.1-1.3	1.5	3.3	3.1	3.1	5.1
Calcium (mg/100 g)	83.0	22.0	10.0	25.3	3.0	3.0	3.9
Phosphorus (mg/100 g)	111	222-230	150-180	57.8	80.0	73.0	57.0

Source: Adu et al, (2017)

Table 6. Carcass traits of Grasscutter compared to other livestock species

Species/Parameter	Grasscutter	Rabbit	Goat	Sheep	Pig	Cow
Live weight (kg)	2.49-3.63	2.40-2.45	20.5	28.5	82.3	162-309
Proportion of live weight to that of Grasscutter (%)	100.0	67.5	563.6	786.2	2267.2	8512.4
Carcass weight (kg)	1.41-2.12	1.08-1.20	18.8	26.7	61.4	74.1-156
Chilling loss (%)	0.9-2.1	11.1-15.9	2.3-4.5	2.85	2.27-	--
Cooking loss (%)	-	27.7-29.7	22.7	20.7	21.6-23.5	23.2-30.3
Meat: bone	4.34-4.67	2.86-4.06	3.90	4.38	4.02	4.10
Dressing out (%)	56.8-57.9	55.3	49.0	52.1	75.4-78	45.9-52.1
External offal (%)	21.4-22.5	24.9-27.7	48.1	15.8-18.8	15.9-19.3	17.3-23.7
Internal offal (%)	12.0-15.6	11.3-12.5	17.7	14.8	17.2-21.4	11.1-13.8

Source: Adu et al, (2017)

Table 7. Proximate nutrient composition of domesticated and wild Grasscutter.

Trait	Treatment (%)		P-value ²
	T1 (Domesticated Grasscutter meat)	T2 (Wild Grasscutter meat)	
Crude Protein	20.602 ± 0.303a	25.145 ± 0.420****	0.0001
Ether extract	1.402 ± 0.147 a	0.977 ± 0.064**	0.0242
Crude fat	0.163 ± 0.022a	0.315 ± 0.164ns	0.3799
Ash	0.903 ± 0.196a	1.010 ± 0.085ns	0.6290
Nitrogen free extract	2.393 ± 0.285a	2.258 ± 0.243ns	0.7257
Moisture content	74.537 ± 0.426a	70.295 ± 0.315****	0.0001

Statistical significance was set at $P < 0.05$ (Source: Ogogo et al, 2017).

4. 3. Economic Prospect

The meat of Grasscutter is of higher price per kilogram weight than chicken, beef, pork, mutton or chevon among many West Africans and elsewhere (Adu *et al.*, 2005). The economic gross return of grasscutter on rearing is (\$193.55) comparable to that of cow (\$183.87-\$193.55), much higher than most livestock species, and only lower than that of the pig (Table 8). This is so because of its perceived taste, cultural values and nutritional superiority to its direct alternatives (Ogogo, 2017; Adu et al, 2005). It has been ascertained that Grasscutter contributes to both local and export earnings (Bello *et al.*, 2012). For instance, cane rats are sold in families of 5 (that is one male and four females) in Songhai (Ijeomah *et al.*, 2016). One family is sold for ₦45,000 (\$130) while a single male adult is sold for ₦4,500 (\$13; 3kg). Aluko et al, (2017) stated that 80 million Grasscutter are harvested annually, equaling 300,000 metric tons of meat in west Africa. To increase meat availability, efforts have been made by government and civil societies to increase production and marketability. Grasscutter is a lucrative business, it can be done on small scale and large scale bases, depending on interest and capital available for investment. Benjamin *et al.*, (2006) conducted a break – even analysis of scale Grasscutter farms in Ibadan Oyo state Nigeria, he established that with improved management skills, a small scale farm could break even after the fourth year in business or earlier.

Table 8. Economic returns of Grasscutter compare with other domesticated Animals.

Species	Productivity per breeding female per year	Gross return per breeding female (US\$)
Cow	0.95-1	183.87-193.55
Sheep	1.24	13.82
Rabbit	29	187.10
Guinea pig	4.4	9.46
Grasscutter	6	193.55
Pig	8.1	260.34
Ducks	6.7	12.05
Chicken	7.1	13.29

Source: (Adu et al. 2005; Paterson et al. 2001)

4. 4. Conservation Prospect

Unsustainable poaching of wild animals for bushmeat and other uses is endemic in Africa. This has caused some animals to go into extinction and to others, their population is greatly threatened. The government has isolated some natural forests as protected areas for

conservation of wild animals and trees. However, the poor management of such facilities and not including community participation in protected areas policy formulation has led to the increase in environmental offences such as poaching and illegal falling of wood. Also, the neglect of some natural resources without protection has caused dilapidation of such resources without measure but some conservational measures have shown prospect in reducing this trend, among which is domestication of wildlife in captive. Although Grasscutter population is categorized among the least concern status on the IUCN red list, its domestication will help to reduce pressure on the population of the animal in the wild. Other advantage of keeping the animal in the wild includes helping to reduce zoonotic disease from the wild. Continuous hunting of bush animals with dogs and bush burning have environmental and health consequences, sustainable domestication will help reduce these risks (Opara, 2010).

4. 5. Perception associated with Grasscutter consumption

The reality in Africa, is that for the greater majority of rural people, bushmeat represents a vital dietary item for a complex combination of reasons dictated by lack of alternate sources. Financial limitations, preference and cultural values. For such people, wild animals constitute a valuable food resource which cannot be easily withdrawn or replaced without causing wide-ranging socio-economic imbalances (Yaa, 1997). In Nigeria, Grasscutter meat is perceived as the king of bushmeat because of its unique tastes (Aluko, 2015) and its good nutritional value Table 5. In most rural communities, bushmeat is a common meat aside the few domestic chicken and goats. Grasscutter is found in all grasslands in the country (Figure 2). Due to its popularity, virtually all ethnicities in the country relish Grasscutter meat. Aside the palatability, scarcity of this choice meat create significant effect on the pricing. *Bushmeat* prices increase with proximity to *urban areas* (Brashares et al, 2011). Being a rare meat in the cities, people who are familiar with it from their villages will pay more to have a taste of the delicacy. The meat is specially prepared and sold in special joints in cities and towns. Therefore, the domestication of Grasscutter will help to increase the protein intake of the people, provide a means of generating income and reduce employment in the country.

5. CHALLENGES AND OBSTACLES OF DOMESTICATING GRASSCUTTER

5. 1. Reproductive competency

Addo et al 2007 conducted a research on Reproductive characteristics of female *Thryonomys swinderianus*, 34 female grasscutters were investigated to identify common features that could be used to formulate breeding strategies for Grasscutter in captivity. The parameter observed were female's ability to manifest an oestrous cycle, mate, conceive, deliver and wean its young in captivity, as well as elicit signs of successful mating, conception and imminent parturition (Table 7). Thirty-one (91.2%) females cycled erratically and Twenty-seven (87.1%) conceived. This suggest that the periodic vaginal membrane perforation is a dependable parameter for determining the sexual maturity of Grasscutter in captivity. Absence of this signs indicates that the female is an induced ovulator. All mated females presented post-mating vulval congestion, while those that became pregnant bled intermittently on the 32nd-38th day after mating, Eleven (44%) of the pregnant females adopted the 'penguin posture' 2-3 days before delivery. This result suggested that domesticated Grasscutter needs a common breeding programme, this can only be achieved by proper training. A research was conducted at forestry

research institute of Nigeria on Grasscutter growth assessment and structure analysis over a period of five years (2009-2013). This research was done to access the reproductive parameter of captive Grasscutters such as birth per month, sex ratio and mortality rate of young domesticated Grasscutter within the period. The research showed that more cases of parturition occurred during rainy season than dry season probably due to high quality forage that is always available during the season. More female Grasscutter were produced than males on yearly basis but mortality affected more females than males probably because the stress of continuous parturition coupled with age may weaken their resistance against diseases and environmental fluctuations. Also, mortality figure was higher during wet season than dry season, implying that the animals need more care and medical care during rainy season (Mustapha et al. 2015). Some of the constraints highlighted, may pose some challenges to uninformed farmers new to Grasscutter farming.

Table 9. Reproductive performance.

Criteria	Number	%
animals that manifested an oestrous cycle during 90 days of observation in captivity	34	91.2
animals that accepted to mate within 2 weeks of exposure to a male in captivity	31	100.0
animals that became pregnant within 2 weeks of exposure to a male in captivity	31	87.1
animals that delivered 148-158 days after mating in captivity	27	92.6
females that weaned at least 60% of their babies after 6 weeks of nursing in captivity	25	100.0
babies successfully weaned at 6 weeks in captivity	89	100.0
weaners that survived to the 5 th month in captivity	89	100.0
females that elicited post-mating visual cues in captivity	31	100.0
females that elicited pregnancy-associated visual cues in captivity	27	100.0
females that elicited parturition-associated visual cues in captivity	25	100.0
females that exhibited the 'penguin posture prior to parturition in captivity	25	44.0
Overall reproductive performance in captivity	-	92.3

Source: Addo et al. 2007

5. 2. Nutritional constraints

Nutrition is essential for livestock ultimate performance, poor nutrition affects growth rate, survival ability, birth rate and profitability. Research has shown that Grasscutter feed more on folder than feed supplements and that their feed intake increases with age (Table 10). It has

been reported that feed conversion rate of pelleted feeds are better than conventional grasses fed to Grasscutter (Table 11). Adeniyi (2008) investigated the effects of feeding different protein sources; groundnut cakes, soya beans meal and blood meal supplemented with different level of fish meal (0%, 1%) on growth performance of Grasscutter. Although blood meal diet had the highest impact on food intake and weight gain but soya beans had the best feed to gain ratio of about 31.74 (Table 12). But only few supplemented feeds are available in commercial quantity (Akuru et al, 2016).

Table 10. Feed intake (g) per Grasscutter per day.

Individual	Fodder	Feed supplement
Young grasscutter	100-150	10-150
Adolescent	150-250	50-100
Adult	250-400	100-200

Source: (Marani, 2018; Akinola et al, 2014)

Table 11. Grasscutter feed conversion rate of different feed type.

Feed type	Feed conversion ratio
Guinea Grass Leave fraction (GGL)	43.24
Whole Plant of Guinea Grass (GGW).	82.30
Guinea Grass Stem fraction (GGS)	119.38
Pelleted Soya	134.1
Pelleted Urea	199.6

Source: (Annor et al, 2008; Marani, 2018)

Table 12. Effect of feeding three protein sources with or without fish meal supplementation on the performance of Grasscutter.

Dietary factors	Feed intake (g)	Weight gain (g)	Feed gain ratio	Feed cost (Nkg⁻¹)
Protein source				
Groundnut cake	22.03	11.61	1.90	31.74
Soya beans meal	23.86	8.93	2.67	28.63
Blood meal	29.40 ns	12.95 ns	2.27 ns	28.25 ns

SEM	0.99	0.51	5.01	
Fish meal level				
0	22.27	9.52	2.34	28.64
1	27.85ns	12.50ns	2.23ns	30.43
SEM	2.61	1.25	0.26	

SEM (Standard error mean), ns = not significant at $p < 0.05$, Source: Adeniyi (2008)

5. 3. Management and Housing

Housing is important in Grasscutter rearing as it protects them from bad weather, predators and thieves. Report has shown that the animal can be reared and kept in boxes, empty drums, Poly Vinyl Chloride (PVC) pipes and enclosures among the rural communities and even in some urban areas among people with adequate space (Akinola et al, 2014). Ikpeze and Ebenebe, (2004) researched on the Productive performance of the Grasscutter reared under three different housing systems. It was discovered that the mortality rates (21.50%) occurred in floor-housing which is less than the closed-cage housing (22.60%) and open-cage (24.90%) housing systems. The report by Ogunjobi and Ineh, (2008) showed that cane rat litters reared for six weeks after parturition in block-cement pens had comparative advantage in terms of weight gain and the rate of survival compared to those reared in iron cages. Despite the advantages of using block-cement housing system, it is more expensive than cage systems and completely immovable. Benjamen et al, (2006) stated in their research on problems and prospect of Grasscutter farming in Ibadan Nigeria, that the major problem in Grasscutter farming is initial capital requirement including cost of housing. They also reported that parent stocks may be very expensive and unavailable. Grasscutter farming requires a lot of management practices and it may be time consuming to maintain.

5. 4. Diseases and mortality

Disease is one of the key factors limiting livestock production. The profit margin and the viability of the business depend greatly on disease management. A single disease may cause total mortality in some livestock. High disease prevalence in Grasscutter is associated with high neonatal mortality rate (Akinola *et al.*, 2015). Severity of disease in livestock is also linked to poor nutritional quality (Opara and Fagbemi, 2009). Poor management practices have been linked to increase in disease occurrence (Opara, 2010), William *et al.*, (2011); Ikpeze and Ebenebe, (2004) reported that more grasscutters died when they were housed in iron cages at the beginning of farm operation than when they were housed in block-cement pens. Diseases associated with grasscutter includes pneumonia, intestinal helminths, trypanosomes (although no clinical signs), others includes ecto-parasites such as flea (*Xenopsyla* spp.) and ticks (*Rhipicephalus simpsoni*, *Ixodes aulacodi*, *Ixode* ssp. and *Haemaphysalis parmata*), other parasites such *Heterakis*spp and *Hymenolepis* (Akinola *et al.*, 2015). Grasscutter had been traced with a lot of diseases (Table 12) but their zoonotic link to man is unclear (Akinola, 2014). Uloko and Audu, (2010) conducted a research on the importance of health management of Grasscutters in captivity in David mark farm at akpa-otobi, Benue state, Nigeria, this research

was done between year 2003-2006. Results of their findings showed that Helminthiasis (43.90%) and pneumonia (43.80%) were the most occurred disease within the period.

Table 13. Parasites affecting grasscutter and their sites of action.

Site of Action	Phylum	Pathogen
Blood	Protozoan	<i>Trypanosoma</i> spp. (<i>T. lewisi</i> , <i>T. simiae</i>), Plasmodium, Babesia spp. (<i>Babesia bigemina</i> , <i>Babesia bovis</i>)
Gastrointestinal	Nematodes	<i>Ascaris</i> spp., <i>Bunostonum</i> spp., <i>Cooperia</i> spp., <i>Gaigaria</i> sp., <i>Gongylonema</i> spp., <i>Haemonchus</i> spp., <i>Heterakis</i> spp., <i>Mammomonogamus</i> spp., <i>Metastrongylus</i> sp., <i>Oesophagostomum</i> spp., <i>Strongyloides</i> spp., <i>Toxocara</i> spp., <i>Trichostrongylus</i> spp. and <i>Trichuris</i> spp.
	Cestodes	<i>Avitellina</i> spp., <i>Moniezia</i> spp., <i>Taenia</i> spp. and <i>Thysaniezia</i> spp.
	Acanthocephalan	<i>Moniliformis</i> spp.
Gastrointestinal	Protozoan	<i>Eimeria</i> spp, <i>Entamoeba</i> spp, <i>Gardia</i> spp.

Source: Opara, 2012.

6. CONCLUSIONS

- ❖ Grasscutter can be found in all the grassland of Nigeria and it has been successfully domesticated. Grasscutter can be reared as a livestock such as cow, goat, chicken and Rabbit.
- ❖ Grasscutter farming has a lot of potential as a tool for sustainable development. It is good as a source of protein and income. If developed, it can be a good source of employment opportunity to the youth, women and retirees.
- ❖ Grasscutter domestication will reduce pressure on the other animals in the wild, also grasscutter farmers should have target buyers before going into production.
- ❖ Challenges associated with Grasscutter farming centers on reproductive issues, feed formulation to be certain of balanced nutrition, management problems and mortality associated with diseases
- ❖ Grasscutter does not transmit Ebola to man, and its meat is perfectly safe for human consumption

- ❖ Post-ebola era is characterized by low bushmeat (Grasscutter) patronage due to fear of contracting disease from the animals
- ❖ Therefore, Grasscutter multiplication should be encouraged by government and civil society organizations to foster development.

Recommendations

- ❖ Proper Awareness and education about Grasscutter Farming through training and targeted extension services should be encouraged in Nigeria.
- ❖ Researches on zoonotic diseases of Grasscutter should be encouraged especially the impact of Lassa virus on Grasscutter and bushmeat sales in Nigeria.
- ❖ Researches on quality feed at less cost, genetic hybrid and better management practice for good yield of Grasscutter should be encouraged.

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