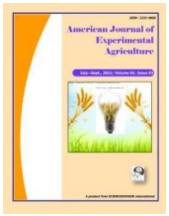

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Grasscutter (*Thryonomys swinderianus*) Production in West Africa: Prospects, Challenges and Role in Disease Transmission

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Authors' contributions

This work was carried out in collaboration between all authors. Author LAFA designed the study and drafted the manuscript, Authors IE and SRE edited the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

This review brings together and consolidates the various researches that had been undertaken in grass-cutter with the aim of providing adequate information that will be capable of improving and sustaining the production of the animal as well as its consumption in West Africa. Given the above scenario, this paper reviewed the results obtained by different researchers on feeding and nutritional requirement of the grasscutter, housing, performance, anatomy and morphology, some environmental issues, the challenges and the role of grasscutter in disease transmission. It was clear from this study that grasscutter is widely acceptable, utilizes inexpensive feed to produce good meat of high biological value, survives in simple housing apartments when confined, has good litter size and short generation interval, has simple anatomical dispositions which helps in breeding and they are capable of adapting to intensive rearing environments. However, some challenges of the grasscutter production include irregular supply of breeding stock, environmental issues, poor processing and marketing plan, lack of balanced diet, poor producer training and education, inadequate infrastructural development, poor information dissemination, incidences of diseases and

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mortality. With good understanding of the prospects and positive utilization of the challenges, there will be great improvement and sustainability in the production of the animal, such that more jobs will be created, more income generated and protein intake in the sub-region will be increased. This overview therefore highlights essential elements for sustainable grasscutter production and consumption in West Africa as well as suggests the direction of further research on grasscutter production.

Keywords: Grasscutter; feeding; housing; performance; diseases transmission; challenges.

1. INTRODUCTION

Wildlife has great potentials for meat production and serves as an important source of the highly desired animal protein for both in urban and rural communities in Africa [1]. In Nigeria there is an abundant variety of wildlife resources capable of supporting the protein intake of the populace. But in recent times, there had been significant short fall between the production and supply of animal protein to feed this ever increasing population [2]. To arrest this unacceptable trend, efforts had been directed towards boosting the micro-livestock sector. Among the micro-livestock species is the grasscutter or cane rat (*Thryonomys swinderianus)* popularly called Oya by the Yorubas, Nchi by the Igbos and Gegbi in Hausa Language in Nigeria, Akranti/Akrantie in Ghana and simply grasscutter in other West African Countries (Figs. 1 and 2).

Grasscutter is a hystricomorphic rodents widely distributed in the African sub-region and exploited in most areas as a source of animal protein [3]. It is a heavily built animal with round muzzle, small round ears, short tail and hursh bristly fur [4]. Apart from being the most preferred [5,6], it is the most expensive meat in most countries in West Africa including Nigeria, Togo, Benin, Ghana and Cote d' Voire [7]. It contributes to both local and foreign earnings in some of these countries [8]. Most rural populations in Nigeria depend on bush meat for their dietary protein supply [9]. Grasscutter meat has been reported to have higher nutritional value [10] and meat yield [11]. Consequently, the demand for livestock products could be solved through the production of grasscutter meat [12]. It is considered a delicacy in West and Central Africa [3]. It serves as a steady source of animal protein in many rural areas of Nigeria and other West Africa countries like Benin, Ghana, Togo, Cot D' Voire [13] and South Africa [14]. Most Chinese who are resident in Nigeria cherish grass-cutter meat as regular meal and form a delicacy for entertainment for their guest from abroad [15]. This preference for grasscutter is attributable to its high carcass quality and protein that is comparable to that of poultry, especially turkey and other domesticated livestock like rabbit, cattle, sheep, goat and pig [16,17]. A crude protein content of 22.7% had been reported for grasscutter meat. This value is higher than the crude protein values of 20.7% for rabbit meat, 19% for chicken meat and 18.2% for beef and 22.2% for turkey [18]. Its mature weight has been reported to be more than 9kg for males and 5-7 kg for females [17]. It is therefore obvious that with the ever increasing human population and obvious protein shortage in Africa, there is need to explore other means of providing readily and acceptable meat on short term basis. A good understanding of the principles and techniques of production will lead to profitable grasscutter business [19]. Thus with appropriate information regarding the prospects and possible challenges of grasscutter production, more farmers will engage in the production of grass-cutter. This will go a long way in alleviating poverty, reducing hunger, creating jobs, improving income and the immune system of Nigerians against diseases associated with low level of protein intake.

2. PROSPECTS OF GRASSCUTTER PRODUCTION

Research has been carried out on the nutritional requirement of grass-cutter [20,21], reproductive performance [22-24], housing [24,25], environmental and reproductive biology [26] disease and mortality [27,28].

2.1 Feeding and Nutritional requirement of Grasscutter

The grasscutter is primarily a herbivore, but in confinement, they require supplementary feed [29]. It is easy to feed and it is a good food transformer and practices coprophagy [30]. The large caecum which forms part of the digestive tract of the grasscutter is adapted predominantly to microbial digestion of feeds [31]. Grasscutter prefers mainly thick-stemmed grass species [32]. The feeding habits of grasscutter and other

rodents (e.g. rabbits) are directly opposite. Whereas the grasscutter prefers to eat stalks to leaves, the rabbit, for example on the contrary choose the leaves and waste stem [32,33]. This habit leads to waste of feed resources by the grasscutter, especially during the dry season when there is scarcity of grass. Thus, irrespective of the kind of forage, grasscutters first eat stalks, the bark of twigs and finally some leaves [20]. This eating habit causes wearing of the animal's teeth, and unfortunately leads to high forage wastage [34].

They prefer grasses with lots of moisture and soluble carbohydrate [35,36], preferring succulent grasses and stems like sugar cane [37,38] and Guatamala plants [39]. Grasscutter can also be raised by feeding them with kitchen left-overs [40]. They also eat fallen fruits, nuts and many kinds of cultivated crops [41]. Some grasses and plants that are highly utilized by grasscutter during the dry and wet season have also been identified [42]. These include: *Pennisetum purpureum* (elephant grass), *Saccharum officianarium* (sugar cane), *Zea mays* (maize), *Sorghum vulgare* (Guinea corn), *Oryza sativa* (rice), *Andropogon gayanus* (gamba grass) etc. According to [20] grasscutters show high preference for grass and particularly favor *Pennisetum purpureum* (elephant grass) and *Panicum maximum*. Good carcass quality and highest live weight was reported by [21] when grasscutters were fed 2000 KcalMEkg^{-} in combination with chopped elephant grass (*Pennisetum purpureum*). Feeds containing 12-20% crude protein have been reported to be suitable for grasscutter [43] while 18% crude protein (CP) was required for optimum growth of grasscutter from weaning to reproductive stage [44]. According to [45] gestating grasscutter give optimum result in terms of litter size, birth weight of pups and feed conversion ratio when 14% CP is included in their diet. Thus, [46] recommended that the optimum energy requirement of growing grasscutter is 2200 KcalME/kg in the humid tropics when the CP is 18% while [47] stated that the preferred source of fibre for the growing grasscutter is palm kernel cake.

Table 1 shows the nutrient requirement of grasscutter as reported by [48,49] while Table 2 gives the quantity of feed consumed by grasscutter per day at different ages as stated by [17].

According to [30,50] the water intake of the grasscutter is reduced when the temperature is hot and more when the out-door temperature is low. They recommended this as a subject for further research since the reason for this unexpected behaviour was not yet understood.

2.2 Production System/ Housing

Production system of grasscutter can be classified according to production objectives into commercial or subsistence [51]. Report has shown that the animal can be bred 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 [52]. The report by [24] 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. [25] therefore advocated for use of block pens (with wood shavings on the concrete floor) at the beginning of rearing grasscutter as they recorded lesser deaths of the animal than those in iron cages. The housing of grasscutter consist of stables and pens equipped with cages and hutches made of good materials and blocks, strong enough to stop the very sharp incisors of the animal [17,53].

Fig. 1. A family of grass-cutter

Fig. 2. A mature Grass-cutter

2.3 Dentition in the Grasscutter

The dentition of the grassscutter is typical of the rodentia with 10 pairs of teeth [17,51,54]. These comprise of one incisor (1I), no canine (0C), one premolar (1P) and three molars (3M). [55] reported that the incisors of grass-cutter are probably the most powerfully built of any African rodent. The time of eruption of the teeth helps the farmer to know the appropriate type of feeding to be offered to the animal and know the age of the animal. Table 3 shows a summary of a 51 weeks study on the eruption of grass-cutter teeth as stated by [56].

2.4 Reproductive Performance of Grasscutter

The reproductive outputs are measured according to animal maturity, litter size, length of inter-birth interval and age at last reproduction [23]. Thus, [24] identified some reproductive parameters of breeding grass-cutters to include having signs of mating on the 3rd day and 7th day, gestation interval of 155±8 days and 157±3 days, average litter size of 4 and 5, sex ratio of litters, 3 males : 1 female and 3 males: 2 females and mean weight gain of litter at six weeks of weaning 539±12g and 595±12g respectively for grass-cutter housed in iron cage (IC) and block–cement pen (BP) having same size of 120cm x 75cm x 30cm. Studies on the reproductive performance of female grass-cutter (does) at first parity in the humid tropical environment showed that 50% of the does studied had open vaginal status at first paring while the remaining 50% were either closed or plugged [57]. The result also indicated that 50% of the does conceived at second exposure while 18.8% conceived at first exposure with more female off-springs. This confirmed the finding by [40,58] that grass-cutter and rabbits show variations in reproductive activity even though they are identified as induced ovulators. Studies by [59] revealed that the grasscutter has a mean gestation length of 163.11±1.58 days (with a range of 152-170 days), litter size of 4 (with a range of 2-7), mean birth weight of 117.70±34.08g (with male birth weight being generally heavier, 118.10±27.70g than females, 100.90±27.50g). They observed that breeding occurred in January, March, April, June, July, November and December with 67% of the parturition occurring at night. Further studies by the authors showed that litter weight decreased with increase in litter size, but did not influence the growth performance of the baby grasscutter during the first months of life. A mean litter size of 4 had been previously reported by [60].

2.5 Anatomy and Morphology of Grass-cutter

A good knowledge of the anatomical dispositions of the reproductive organs of grass-cutter is vital to the understanding of the reproductive biology of animals and provides information which would assist in the breeding of the cane rat and improve its domestication. The male reproductive organ of the grasscutter is similar to that reported by previous authors [61]. The testes of the cane rat has ovoid shape with creamy white coloration covered with stroma [62,63], typical of rodents. The surface of the testes of the cane rat showed the presence of *Tunica vaginalis propria* with radical septa (*Septuli testes*) of pyramidal shape [64]. The shape of the epididymis is sigmoid unlike that of a typical rodent and the distal part of the caudal epididymis is convoluted as in mammals [63] and provides useful information in the comparative regional anatomy of rodents. The morphology and morphometry of the grasscutter male accessory sex gland has also been reported [65]. According to [29] the best way to identify the different sexes is by studying the distance between the anus and the genital organs which is usually wider in the males and almost double that obtainable in the female.

2.6 Environmental Issues in Grass-cutter Production

The interaction of the grasscutter in captivity with its immediate environment appears very important in relation to mortality, improve reproductive competence, improve health and overall performance. [26] reported that a pit pen housing design was able to maintain the room temperature of the house and pens (24.43 – 30.71ºC) against the diurnal fluctuations outside the building (25.86 – 34.71ºC). They however stated that the relative humidity inside the building (67.57 – 85.80%) showed a tendency to fluctuate with the ambient relative humidity outside the building. They concluded that if captive grasscutter were housed in environment similar to the night period, they are likely to shed their nocturnal habit and be more active during the daytime, with the likelihood of increased productivity.

2.7 Other Benefits of the Grasscutter

Despite a lack of defined or measurable indications for its contribution to the gross

domestic product (GDP), the grasscutter subsector has been recognized as an important economic tool for rural poverty alleviation and household food and nutrition security [66,67]. The grasscutter is a considerable income earner for both the small scale peri-urban or rural livestock producer in the country. It also contributes to both local and export earning of countries like Kenya, Benin republic and Nigeria [8]. It is known to be economically important as an agricultural pest and its meat is widely accepted by all classes of people. The smoked grasscutter could serve as a source of foreign earnings when it is well packaged and exported.

Grasscutter meat is cheaper to produce than most other traditional livestock and its meat is more valuable and appreciated by local population. It has been shown that with only five mature grasscutters (4 females and 1 male), a household is nutritionally secured for 6 months to one year [68]. In times of droughts and related calamities, grasscutter serves as a critical source of animal protein.

During important occasions and ceremonies, grasscutters are heavily consumed by many households in rural and urban areas in Nigeria. Dried grasscutter meat is used to serve the elders during traditional rights like marriages, excursion and Chieftaincy installations. This confirms that grasscutter is the favorite bush meat species. The hair or fur is used to make decoration and the teeth are used to perform traditional card reading in place of cowries especially in the Southern part of the country.

Table 1. Nutrient requirement of an adult grass-cutter

Component	% dry matter basis
Crude protein	12 to 18.5
Crude lipid	2.5 to 4.5
Crude fibre	25 to 45
Ash	2.5 to 4.5
Nitrogen free extract	45 to 65
Neutral detergent fibre	42 to 64
Acid detergent fibre	25 to 35
Acid detergent lignin	3 to 8

Source: Mensah [48,49] (1995,2005)

Table 2. Quantity of feed consumed by grass-cutter per day

Subject	Grass/forage (g)	Supplement (g)
Cutling (Young grass-cutter)	10 – 150	10 -50
Weaner/grower grass-cutter	152 – 250	51 – 100
Adult grass-cutter	251 – 450	101 – 200

Source: Fayenuwo et al. (2003) [17]

Table 3. Cutting of teeth (teeth eruption) periods in grass-cutter

Age/Period	Teething per half jaw				
	Incisor (I)	Canine (C)	Premolar (P)	Molar (M)	No. of teeth (%)
Birth	$P1^1$(n=51)	-	Op^1 (n=51)	-	40
2 weeks	,,	-	Ap^1 (n=48)	Om^1 (n=48)	60
2-4 months	,,	-	Pp^1 (n=42)	Pm^1 (n=42)	60
5-8 months	,,	-	,,	Pm^2 (n=35)	80
9 months	,,	-	,,	Pm^3 (n=33)	100

Source: Fayenuwo et al. 2005 [56]
= Tooth present = Tooth absent

$P1^1$ = Presence of one incisor
Op^1 = Opening of premolar
Ap^1 = Appearance of the premolar
Pp^1 = Presence of premolar
Om^1 = Opening of the 1^{st} molar
Pm^1 = Presence of 1^{st} molar
Pm^2 = Presence of the 2^{nd} molar
Pm^3 = Presence of 3^{rd} molar
Dental formular:
I =Incisor, C = Canine
I(1) C(0) P(1) M(3) = 20
P = Premolar, M = Molar

3. CHALLENGES OF GRASS-CUTTER PRODUCTION

According to [69], some of the major problems encountered by grass-cutter farmers include: high initial capital, stock procurement, time constraint, inadequate medical attendant, disagreement with landlords over space to rear grass-cutter and inadequate follow-up by extension services. Recently, [25] ranked some constraints encountered by the grass-cutter farmer from the most severe to the least as follows: lack of capital, insufficient feed, disease, housing, lack of enough land, handling and lack of knowledge of rearing grass-cutter. Other challenges of grass-cutter include irregular stock supply, environmental issues, processing and marketing, feeding, producer's training and education, infrastructure development, poor information dissemination and disease/mortality.

3.1 Irregular Supply

The production of grass-cutter is a relatively novel practice. Although most breeding stock and cane rat meat is still obtained by hunting and trapping of the animals which does not ensure steady and regular supply of the meat [70] as well as the breeding stock.

3.2 Environmental Issues

The collection of grass-cutter from the wild is attended by the destruction of the environment through setting of bush fires by hunters [3,8,66]. This leads to the destruction of valuable plants, animal life and tampers with the ecosystem [70]. Thus, there is need to domesticate the animals in order to avoid the problems associated with bush burning.

3.3 Poor Processing and Marketing Plan

Most small scale and medium-scale farmers do not provide a good plan for processing and marketing of their grass-cutter at the initial stage of their business, as a result when the animal attain market weight, only a few buyers are seen. The farmer then devices a means of marketing (live or processed) grass-cutters while operating at a loss or reduced profit because of the extension in feeding time. This leads to problem associated with storage facilities, waste disposal, and disease contamination, accompanied by reduction in selling price.

3.4 Lack of Balanced Diet

The domestication of cane rat has its own teething constrains, which include the need to provide regular supply of feeds rich and balanced in nutrients [70]. It has been observed that grasscutters prefer grasses such as elephant grass, sugar cane, guinea grass with succulent stalk [17] which may not be readily available. Furthermore, grasscutter reared in captivity on forages and grasses alone does not do well compared to those living in the wild. This is because grasscutter normally obtains balanced nutrient from a variety of feeds such as forages tubers, grains, nuts, herb etc in their natural habitat or in the wild.

3.5 Producer Training and Education

The education of farmers has been found to be one of the major factors affecting adoption of new technologies [71]. Intensified education on grasscutter breeding and production to save the animal from extinction will reduce poverty and create employment. Report by [72] showed that most grasscutter farmers (90%) in Oyo State, Nigeria, had completed one form of formal education or another, implying that education is a variable which widens the mental horizon and predisposes farmers to new ideas. This results in having better access to knowledge and information that will be beneficial to the production and management of grascutter.

3.6 Infrastructure Development

Grasscutter production is mainly concentrated in the rural areas which are characterized by poor infrastructural facilities such as road and telecommunication network. Installation of these facilities would open these areas for development [73] and enhance access by the producers to market for purchase of inputs and sales of his products. Construction of good roads would help the extension services providers to reach as many producers as possible allowing training on new production technologies which will result in increased productivity of grasscutter.

3.7 Poor Information Dissemination

The grasscutter farmers in Nigeria as in other developing countries are faced with poor information dissemination about the challenges (such as disease out breaks, feeding, breeding, housing, marketing and lack of credit facilities) facing their production. Information is an

essential ingredient in agricultural development programmes but Nigerian farmers seldom feel the impact of agricultural innovations either because they have no access to such vital information or because it is poorly disseminated [74]. The extent of information needed by grasscutter producers had been reported [72]. They identified grasscutter diseases, housing pattern and equipment needed for production as the 1st, 2nd and 3rd most essential information needed by the grasscutter farmer. Table 4 gives their findings and rating of the information needs of grasscutter farmer. These problems can be solved through well-designed and implemented information dissemination and awareness programmes, including seminar which will endow all the stakeholders in the sector with necessary knowledge and skill [75]. Thus, there is need for networking amongst grasscutter farmers to enable them acquire and share knowledge, views and experiences among themselves and with all other stakeholders along the grasscutter value chain.

3.8 Mortality and Disease of Grasscutter

Disease is one of the most important limiting factors to profit in many livestock enterprises in the tropics [76]. Apart from inadequate and unbalanced feeding, high disease prevalence and associated high neonatal mortality constitute a major obstacle to the promotion of large scale holding of livestock [77]. It is important to note that the severity of diseases depends on the nutritional state of the animals, especially during the dry season when feed is inadequate in quantity and quality [78]. Also, the incidence, severity and prevalence of disease had been shown to vary with the management system [67].

According to [26] 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. In another research, [28] observed that more grasscutters (28) died of pneumonia among those kept in concrete cages with cemented floor while only (3) died among those kept in iron cages as a result of trauma and dystocia (difficulty in parturition). Outbreak of intestinal coccidiosis was observed in cane rat [27] while [79] identified twenty major disease/disease conditions affecting grass-cutter in captivity. Gastro-intestinal disorders, caused by helminthes parasite had also been identified in the grasscutter [80]. Reports by [81] showed that grasscutters can be infected with trypanosomes, although without obvious clinical disease.

Preliminary studies by [80] on the captive grasscutter in Cameroon showed the occurrence of ectoparasite such as fleas (*Xenopsylla* sp) and endoparasite like cestode (*Hymenolopsis* sp) and nematode (*Heterakis* sp). In another work by [82] in Ghana, four species of tick namely *Rhipicephalus simpsoni, Ixodes aulacodi, Ixodes sp* and *Haemaphysalis parmata*, six species of helminthes comprising of 2 species of cestodes (*Furhmanella transvalensis, Railettina mahone*) and 4 species of nematodes (*Longistriata spira, Trachyphanyx natalensis, Paralibyostongylus vondwei* and *Trichuris paravispicularis*) were also found.

4. ROLE IN DISEASE TRANSMISSION

It is interesting to note that the grasscutter had not been traced to harbor pathogens that can affect humans. Ebola virus disease for example, had been traced to chimpanzees, gorillas and bonobos and currently spreading to humans when the meat is handled or consumed. Also, gorillas and some other apes may also carry other diseases as simian foamy virus, smallpox, chicken pox, tuberculosis, measles, rubella, yellow fever and yaws (http://en.wikipedia.org/wiki/Bushmeat). It has occurred, on numerous occasions, that people who ate apes have caught such diseases or even died [83]. Thus, apart from posing a significant risk to the people who eat the meat, it poses great risk to the human population as a whole, as it opens a doorway through which animal viruses can be transmitted to humans. Other bush meat like the African squirrels (*Heliosciurus*, *Funisciurus*) have also been implicated as reservoirs of the monkey pox virus in the Democratic Republic of Congo (http//:enwikipedia.org/wiki/Bushmeat), implying that the use of their meat may serve as a means of transmission of these viruses to humans. According to [84] research in Africa has proven that Ebola disease can only occur through the handling of infested chimpanzes, gorillas, fruit bats, monkeys, forest antelopes and porcupines found dead or ill in the rainforest, so Ghanians can continue to enjoy their bushmeat delicacies, provided it is handled safely and prepared without any contamination. The commercial production of grasscutter will therefore be of great benefit to lovers of bush meat since the animal has not been linked to pathogens.

Table 4. Information needs of farmers in grass-cutter production

S/N	Information Needs	Scores
1	Rabbit housing pattern	2nd
2	Cleaning of housing unit	7th
3	Sources of stable grass-cutter breed	9th
4	Types of feed available	12th
5	Weaning	8th
6	Equipment required for grass-cutter production	3rd
7	Appropriate number of grass-cutter required in cages	15th
8	Incentive on grass-cutter	12th
9	Identifying various grass-cutter disease	1st
10	Selection of foundation stock	11th
11	Marketing of grass-cutter	5th
12	Record keeping	4th
13	Control of pests and diseases of grass-cutter	6th
14	Method of mating	10th
15	Ovulation and heat period	14th

Source: Fakoya et al. (2008) [72]

5. CONCLUSION

This study has showed that the grasscutter, a wild African rodent can be successfully domesticated as some of the essential elements in the successful production of the animal were reviewed. The feeding and nutritional requirement, production system and housing, dentition, reproductive performance, anatomy and morphology, environmental issues and the benefits have all been studied. Detailed information on the challenges, including irregular supply of the stock animals, environmental issues, feeding, poor producer training and education, infrastructural development, poor information dissemination, mortality and diseases among others have also been reviewed. This animal which provides juicy and palatable meat, and is highly preferred in meals of both Nigerians and foreigners, without any fear of disease transmission, therefore, offers suitable opportunities for enhancing livelihood and revenue generation in rural and urban areas in the sub-region Consequently, this review creates more opportunity for the grass-cutter farmers and intending farmers to easily sustain their businesses, create more jobs, increase income and increase protein consumption of the growing populace while it serves to assure the consumers of bushmeat (commercial grasscutter in this case) of the safety of the meat.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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