

Housing and Feed Management Practices among Rabbit Keepers in Enugu State, Nigeria

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Abstract The study ascertains housing and feed management practices among rabbit keepers in Enugu State of Nigeria. Snowball sampling technique was used to get at 67 respondents for the study. Structured interview schedule/questionnaire was used to collect data from the respondents. Outdoor cages were used by 85.1% of the respondents to house rabbits and about 40% considered temperature as the most important factor, when sitting rabbit hutches. Most (92.5%) of the respondents used zinc roofing for rabbit hutches while 89.6% used wood in hutch floor construction and 94% used wood in constructing the hutch walls. Greater proportion (66.6%) of the respondents used wood as bedding material. All (100%) the respondents cleaned their hutches. About 60% cleaned at least once a week. Majority (79.1%) fed rabbits with locally available forages, while 20.9% fed with a combination of local forages and commercial feeds. Potatoe leaf (*Solanum tuberosum*) was the most (59.7%) used forage, followed by sow thistle (*Sonchus*) and goose grass (*Galium aparine*) (53.7%) each among others. Majority (98.5%) of the respondents did not dry forages before feeding rabbits. About a third (32.8%) agreed that there are forages that are harmful to rabbits. The most observed harmful forages, were fresh cassava leaf (*Manihot utilissima*) (66.7%), spear grass (*Heteropogon contortus*) (23.8%) and basil leaf (*Occimomum Basilicum*) (9.5%). Respondents perceived scarcity of forages during dry season (M= 2.92) as the most serious constraint to rabbit feeding, followed by poor quality of available feed (M= 2.22). The most essential reason for low rabbit production is low demand for rabbits (37.3%). There is need for training programmes to be organized by extension agents with the support of governmental or non-governmental organizations, aimed at sensitization of the farmers on the benefits of rabbit production and the importance of rabbit meat.

Keywords Forages, Hutch, Low production, Roofing, Wood

1. Introduction

There is a pressing need for increased livestock production, given the rapidly growing demand for animal protein, as well as other animal products and the important contribution of livestock to the incomes and welfare of rural poor [1]. Shortage of protein, particularly those of animal origin is prevalent in most parts of Africa. It has been estimated that the daily minimum crude protein requirement of an adult in Nigeria varies between 65 and 85g per person. However, it is recommended that 35g of this minimum requirement should be obtained from animal products [2]. A review of the data of food supplies available for consumption in different countries shows that the per caput protein intakes in developing countries, Nigeria inclusive, is comparatively low. Not only is the total protein supply deficient but the quality of dietary protein available is inferior to that consumed in developed countries [2]. To ensure adequate

supply of animal protein to the rapidly growing population of Nigeria, the output of animal products has to be increased especially by short-cycle animals such as rabbits, poultry and pigs [3]. Unfortunately, poultry and pigs require feed sources which are in direct competition with man, while rabbits can be produced from the enormous forages and feed materials that freely abound in the tropics [4].

The rabbit has some unique advantages which make them a good specie of animal to combat protein shortages. Among these advantages are their high growth rate, high efficiency in converting forage to meat, short gestation period, and high prolificacy, relatively low cost of production, high nutritional quality of rabbit meat which includes low fat, and sodium levels. It also has a high protein level of about 20.8% and its consumption is bereft of cultural and religious biases [5]. However, low productivity of rabbit has limited their potential to improve the living standards of farmers in terms of income earning, animal protein requirement and significant contribution to rural development. As a result, rabbit production is left in the hands of secondary school students, who are now the main rabbit farmers in Enugu State (Personal observation).

Given the fact that management of rabbit is the major

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determinant of productivity in rabbit, there is therefore need for proper management to increase the production of healthy, strong and safe rabbits. Proper nutrition and adequate feeding is necessary in the management of rabbit diseases, because if the rabbits are fed properly with the right nutrient combination, their body immune system will be very active and can combat infections. Therefore, if Enugu State is to become self-sufficient in rabbit production, productivity has to increase. To achieve this, it is necessary to ascertain feed management practice among rabbit keepers in the state.

2. Materials and Methods

The study was conducted in Enugu State. The climate of the state can generally be described as tropical with two clear identifiable seasons, the wet and dry seasons. It lies within the tropical region with early rainfall usually in January/February with full commencement of rainy season in March and stopping in November of each year. The dry season lasts between four to five months. The highest rainfall is recorded from July to October with little break in August. The average highest annual rainfall is about 1952 mm. The temperature pattern has mean daily and annual temperatures as 28°C and 27°C respectively [6]. National Population Commission [7] put the population of the state at 7,226,640. Enugu State is located in the humid tropical rain forest zone and has a favourable soil for agricultural activities. Thus, most of their inhabitants are either full time or part time farmers. Crops produced in the state include: yam, cassava, rice, maize, pineapple, banana etc. Also produced in the state are poultry, small livestock (sheep, goat and rabbit) amongst others. The state has seventeen political local government areas and is divided into six agricultural zones.

Rabbit keepers (mostly students) in Enugu State constituted the population for the study. A snow ball sampling technique was used (due to few number of rabbit farmers) to identify 67 rabbit keeper used for the study. Structured interview schedule/questionnaires was used to collect data. The instrument was validated by 4 academic staff of Department of Agricultural Extension University of Nigeria Nsukka and pre-tested before used.

Housing, feed and feeding practices of rabbits were determined as follows: Farmers were requested to indicate the type of housing they use (loose group housing, caged outdoor, caged indoor etc.) in rearing rabbits. Farmers were asked if they housed their rabbits with other animals, and the type of animals they are housed with. Also, respondents were equally requested to state the factors they considered when siting the rabbit house, indicate the materials used in the rabbit house for the following structural parts; roofing materials, floor, walls and bedding. They were to ascertain if they clean their rabbit hutches, and the cleaning interval (once a day, twice a day, three times in a week, five times in a week, once a week, others specify).

Farmers were asked to indicate the type of feed (locally available forages/weeds, purchased/commercial

concentrates, homemade concentrates, combination of local forages and commercial concentrates, or combination of commercial concentrates and homemade concentrates) they provide for their rabbits. They were also asked to indicate the local forages they use in feeding rabbits, and the most preferred of the forages with reasons. They were asked if they dry forages before feeding them to the rabbits and if they do, their reason for doing so. They were also requested to indicate the season when forage availability is a constraint and to indicate harmful forages, if any, and their effect if fed to rabbit. They were asked if they preserve their forage, and if they do, the form of preservation they use (harvested hay, standing hay, or other forms).

Respondents were asked to state the constraints to rabbit feeding and to indicate the level of their perceived seriousness on a 3-point Likert type scale of; to a great extent = 3, to little extent = 2, to no extent = 1. These values were added together (3+2+1) to obtain the sum six (6) which when divided by three (3) gave a mean of 2. Variables with mean score of 2 and above were considered as possible constraints while those below 2 were considered as no constraint to rabbit feeding.

The respondents were equally requested to state reasons why rabbit production is low in Enugu State, and what they think needs to be done to increase rabbit production. The data generated was subjected to descriptive statistics.

3. Results

3.1. Socioeconomic Characteristics

A total of 67 rabbit keepers, consisting of 63 (94%) males and 4 (6%) females) were recorded in Enugu State (Table 1). Majority (91%) of the respondents were single and 83.5% occupied were within 1-5 in the family position. The average number of offspring in a family was 6. The mean number of years spent in rabbit farming was 1.19 years. Seventy-three percent of the respondents had stock size of 1-10 and the mean stock size was 2. About 67% of the respondents generated an annual income of ₦20,000 and below, 14.8%, 7.4%, 11% generated annual income of ₦21,000 - ₦40,999, ₦41,000 - ₦60,999, and ₦61,000 and above, respectively, from rabbit keeping.

3.2. Housing Management Practices

The distribution of the respondents based on the housing management practices is presented on Table 2. The major type of housing used by rabbit keepers was outdoor cages (85.1%). Temperature (40.3%) and availability of materials (17.9%) were the key factors considered when siting the rabbit hutches. Most (92.5%) of the respondents used zinc in roofing the rabbit hutches while wood was used for the construction of the hutch floor, walls and as bedding material by 89.6%, 94% and 66.6% of the respondents, respectively. All the respondents indicated that they clean their rabbit hutches; with a greater proportion (59.7%) doing the

cleaning once a week.

Table 1. Socio-economic characteristics

Variables	Percentage (%) N= 67	Mean (\bar{X})
Sex		
Male	94	
Female	6	
Age (years)		
11-20	70.1	
21-30	20.9	
31-40	3	
41-50	1.5	
51-60	1.5	
61 and above	3	20.37
Marital status		
Single	91	
Married	6	
Widowed	3	
Religion		
Christians	98.5	
Traditionalist	1.5	
Number of offspring		
1-5	52.3	
6-10	44.9	
11 and above	3	5.5
Position of respondents in the family		
1-5	83.5	
6-10	13.5	
11 and above	3	3.79
Years of experience in rabbit farming		
1-6	88.1	
7-12	7.5	
13-18	1.5	
19 and above	3.0	1.19
Stock size		
1-10	73.1	
11-20	10.4	
21-30	9.0	
31 and above	7.5	1.51
Annual income from rabbit (Naira)*		
Less than 21,000	66.7	
21000-40999	14.8	
41000-60999	7.4	
61000 and above	11	

*USD1 = ₦220

3.3. Feed and Feeding Practices

Table 3 shows that majority (79.1%), of the farmers fed rabbits with locally available forages, while 20.9% fed them with a combination of local forages and commercial feeds. The respondents' reasons for preference of feeding rabbits

with forages is because forages are readily available and palatable (52%) and have high nutritional content (35.8%). Seventeen different forage type used for feeding of rabbits in the state were identified. Nearly 60% of the respondents indicated they used potatoes leaf (*Solanum tuberosum*) in feeding the rabbits while 53.7%, 53.7%, 52.2% and 28.4% indicated use of sow thistle (*Sonchus*) and goose grass (*Galium aparine*) elephant grass (*Pennisetum purpureum*) pawpaw leaf (*Carica papaya*), respectively.

Table 2. Housing management practices

Housing	Percentage (%)
Location of hutch	
Caged outdoor	85.1
Caged indoor	14.9
Rearing of rabbit with other animals	
Yes	4.5
No	95.5
Animals housed with rabbits (n = 3)	
Chicken	100
Factors considered when sitting hutch	
Material availability	17.9
Temperature	40.3
Slope	7.5
Rainfall direction	14.9
Wind direction	7.5
Materials used in roofing	
Zinc	92.5
Tapeline	3
Wire gauze	4.5
Materials used for floor	
Wood	89.6
Concrete	10.4
Materials used in wall construction	
Wood	94
Cement	3
Wire gauze	3
Material used in bedding	
Wood	66.6
Straw	3.5
Wood shaving	14
Palm frond/grass	15.8
Cleaning of hutch	
Yes	100
No	0
Cleaning period	
Twice a day	1.5
Once a day	13.4
Three times in a week	9
Once a week	59.7
Once every two weeks	16.4

Table 3. Feeding and feeding practices

Feeding materials	Percentage (%)
Locally available forages	79.1
Combination of local forages and commercial feed	20.9
Forage used in rabbit feeding	
Potatoes leaf (<i>Solanum tuberosum</i>)	59.7
Sow thistle (<i>Sonchus spp</i>)	53.7
Goose grass (<i>Galium aparine</i>)	53.7
Elephant grass (<i>Pennisetum purpureum</i>)	52.2
Pawpaw leaf (<i>Carica papaya</i>)	28.4
Green amaranth (<i>Amaranthus hybridus</i> L)	16.4
Pumpkin leaves (<i>Telfairia. Occidentalis</i>)	16.4
Pear leaf (<i>Persea americana</i>)	14.9
<i>Centrosema spp</i>	14.9
Bitter leaf (<i>Vernonia amygdalina</i>),	13.4
Banana/plantain leaf (<i>Musa/ Musa paradisiaca</i>)	9
<i>Centrosema spp</i>	7.5
Oil palm leaves (<i>Elaeis guineensis</i>)	7.5
Dandelion (<i>Taraxacum spp</i>)	7.5
Guinea grass (<i>Megathyrsus maximus</i>),	4.5
Alfalfa (<i>Medicago sativa</i>),	3
Carrot/water melon (<i>Daucus carota/Citrullus lanatus</i>)	3
<i>Crotalaria spp</i>	1.5
Most preferred forage by rabbits	
Potatoes leaf (<i>Solanum tuberosum</i>)	26.9
Elephant grass (<i>Pennisetum purpureum</i>)	25.4
Sow thistle (<i>Sonchus sp</i>)	14.9
Goose grass (<i>Galium aparine</i>)	9
Pumpkin leaves (<i>Telfairia. Occidentalis</i>)	6
Guinea grass (<i>Megathyrsus maximus</i>),	1.5
Pear leaf (<i>Persea americana</i>)	1.5
Pawpaw leaf (<i>Carica papaya</i>)	1.5
Bitter leaf (<i>Vernonia amygdalina</i>),	1.5
Banana/plantain leaf (<i>Musa/ Musa paradisiacal</i>)	1.5
Reason for preference by the farmers	
Availability and palatability	52.2
High nutritional content	35.8
Prefer by the animal	11.9
Drying of forage before feeding to rabbit	
Yes	1.5
No	98.5
Reason for not drying forage	
The forages are more nutritious when fed fresh	55.2
The rabbit doesn't like it dry	23.9
Forages are readily available	14.9
Fresh forage is their source of water	6
Season of occurrence	
Dry season	100
Rainy season	0
Harmful forages	
Yes	32.8
No	67.2

Names of harmful forages (n=22)

Spear grass	23.8
Fresh cassava leaf	66.7
Saint basil leaf	9.5

How the forages affect the rabbit when fed

Stomach/gastric upset	68.2
Killing of the rabbit	13.6
Cutting of rabbit mouth	9.1
Abortion	9.1

Preservation of forage for

Yes	11.9
No	88.1

Form of preservation (n = 8)

Harvested hay	87.5
Standing hay	12.5

The most preferred forage by the farmers is potato leaf (26.9%) due its availability/palatability (52.2%) and nutritional content (35.8%). About 99% of the respondents stated that they do not dry forages before feeding rabbits; with 55.2% believing that forages are more nutritious when fed fresh. About 33% of the respondents indicated that there are forages that are harmful to rabbits. The most observed harmful forages from experience by farmers were fresh cassava leaves (*Manihot utilissima*) (66.7%), followed by spear grass (*Heteropogon contortus*) (23.8%) and basil leaf (*Occimomum Basilicum*) (9.5%). Harmful forages affect the rabbits in the following ways, stomach/gastric upset (68.2%), death of the rabbit (13.6%), cutting of the rabbit mouth and abortion (9.1%) each.

About 88% of the respondents did not preserve forages for the rabbits to be use during the dry season since rabbits are mostly fed on forages in the study area. For the respondents that preserved forages, the form of preservation they use most was harvested hay (87.5%) and standing hay (12.5%).

3.4. Perceived Constraints to Rabbit Feeding

Respondents perceived scarcity of forages during dry season (M= 2.92) as the most serious constraint to rabbit feeding, followed by poor quality of available feed (M= 2.22). (Table 4).

Table 4. Perceived constraints to rabbit feeding and disease management

Constraint to rabbit feeding	Mean (\bar{x})	SD
High cost of feed	1.33	0.64
Scarcity of commercial feed	1.28	0.49
Scarcity of forage during dry season	2.92	0.33
Poor quality of available feed	2.22	0.58

4. Discussion

In this study the housing and feed management practices among rabbit keepers in Enugu State, Nigeria, were investigated. The majority of rabbit keepers were in the

11-20 years age bracket. This observation is similar to that of [8] who reported that the age bracket of children involved in rabbit keeping fall between 5-17 years of age. The finding in this study and that of [8] indicate that rabbit keepers in Nigeria are usually in their early youth who are in their very productive stage in life and could therefore easily adopt innovations and technologies aimed at improving rabbit production. The observation that 88% of the respondents had 1-6 years' experience in rabbit keeping is similar to the finding of [4] who found that 65% of rabbit keepers in Nsukka Local Government Area of Enugu State had 1-5 years of rabbit keeping experience. These findings in Enugu State contrast the observation of [9] in Ogun State, Nigeria who reported that most of the rabbit keepers were not new in rabbit keeping. The small stock size recorded in this study is similar to the finding of [4] and may be attributed to the fact that rabbit production is not the major occupation of the respondents since majority of them were secondary school students who produced rabbit on a part time and subsistent scale. It might also be due to low demand for rabbit meat or few consumers of rabbit thereby discouraging farmers from large scale production. It was observed in Taita Taveta County, Kenya that farmers kept few rabbits and mostly at subsistence level [10]. The low income generated from rabbit productions may be due to low investment by the farmers who carryout rabbit keeping on part-time basis.

The finding that 85% of the respondents keep their rabbits in outdoor cages is in agreement with the report of [11], who reported that majority of rabbit farmers, caged their rabbits outside. Outdoor housing is often less expensive than indoor housing and because of better ventilation, the rabbits are usually healthier in outdoor units [12]. Outdoor housing will increase ventilation in animal house and this may minimize heat stress and reduce disease incidence. However, security is more difficult to provide with outdoor units, and the protection from the weather may not be as good as indoors. Therefore, farmers need durable materials to construct outdoor hutches/cages for their animals for security reason. This however, may be farfetched in the study area since majority of the rabbit keepers are school children who are dependants and are rearing rabbits on part-time basis.

Consideration of temperature as the most important factor when siting rabbit hutches as observed in this study might be because high temperature affects the productivity of rabbits. High temperature causes low feed intake bringing about reduced growth rate and poor productivity. Rabbits are animals with furs and high temperature makes them uncomfortable and restless, and in their state of restlessness, they could injure themselves. Sun and wind direction, security, among other factors should be considered when selecting a construction site for a rabbit hutch [12].

The use of zinc as roofing material for rabbit hutches by most of the respondents might be because of the ready availability of zinc and also its durability compared to other roofing materials. However, zinc roofing will cause the houses to be hot especially during the day and this may

increase temperature in the hutch which may reduce feed intake and general productivity of the rabbits. Whenever sheet metal or plastic are used for roofing, insulation must be placed between the roof and the rabbits. This is so, to avoid too much heat that could increase mortality rate [12]. However, low temperatures should be avoided as they could result in reduced efficiency because extra dietary energy is needed to keep the animals warm [12].

The use of wood by most of the farmers in hutch floor, wall construction and also as bedding may be because wood is readily available and affordable compared to cement or wire gauze in the study area. Wood also absorbs moisture and reduces the intensity of dirt in the hutch as well as allows for ventilation and reduces high temperature. Local hard wood and bamboo-like material should be encouraged to build hutches in order to cut costs of production [13]. Rabbits are more comfortable and relaxed on wood floor than on wire gauze. Rabbits spend less time resting on wire net compared to other floor types such as wood, which could be an indication of discomfort on the wire net floor [14]. However, [12] opined that the most common type of outdoor hutch is a combination of wire and wood. The wood is used to make a frame, the wire for the floor and some of the sides or ends, and sheet metal or other material provides a water-proof roof.

Good sanitation practices in rabbit hutch is necessary because build-up of urine and droppings over time will result in breeding bacteria that could cause illness to the rabbits and even the farmer. These good sanitation practices were observed by all the farmers in this study. Rabbit houses should be kept clean and well ventilated to avoid accumulation of toxic gases such as ammonia [15] while provision must be made to remove water from the hutch [16, 12]. Rabbits produce copious amounts of urine, and there will also be substantial amounts of waste from the watering system, thus the need for regular cleaning of the rabbit house.

Majority of the farmers feed their rabbits with locally available forages. In Nigeria, it is a common belief that rabbits cannot be raised without green leaves as supplementation and so diets of rabbits in Nigeria are primarily forages, grasses and legumes [17]. Indeed, in most rural, peri-urban and sub-urban areas, rabbits are fed solely on vegetables-green leaves. This may be partly because commercial rabbit feed is not common and even if they are common most farmers may not be able to afford them. Feeding rabbits with green leafy vegetation free of pesticides as a good practice since forages can satisfy their nutritional requirements [18].

The most used forage by the farmers was sweet potato leaf. This may be because potato leaf is very nutritious and readily available. Sweet potato is a crop with great potential as a source of rabbit feed [19]. The forage is high in protein, is highly digestible and is reported to be more palatable to rabbits than *Leucaena leucocephala*. Because of their efficient digestion of protein in forages and agricultural by-products, rabbits can derive most or all of their protein

requirements from these materials [20]. Rabbits that eat a lot of green leafy vegetation tend to drink less water and this may explain why most of the rabbit rearers in this study do not dry forage before feeding it to rabbits [18].

Most of the respondents did not know about harmful forages which could affect rabbits. Thus extension agents should educate rabbit keepers about the need to avoid such harmful poisonous plants like cassava leaves, spear grass and saint basil leaves.

Respondents perceived scarcity of forages during dry season and poor quality of available feed as serious constraints to rabbit feeding. Feed is very essential for growth and reproduction of rabbits and the major source of feed in the study area is forages which are seasonal, thereby hindering effective rabbit feeding during the dry season. Rabbit food security is critical during the dry season because many of the green feed fed to rabbit are annuals that are not high yielding [17]. In the Rift-Valley, Kenya, poor feed quality was reported to be one of the constraints to rabbit production [21]. The constraints identified in this study have a negative effect on the rabbit industry in the state and the country as a whole; farmers may get easily discouraged and abandon the enterprise. Therefore, these constraints should be addressed by educating farmers on the need to prepare hay to use at periods of fresh green leaves scarcity and also to supplement rabbit feeding with commercial feeds and kitchen. This will go a long way to expand rabbit production in Enugu State and Nigeria as a whole.

The principal reasons for low rabbit production as identified in the present study were low demand for rabbit, inadequate awareness and training and little interest in rabbit production. This is in agreement with the findings of [22], who stated that high cost of concentrates, relatively smaller weight gain during the dry season, non-readily available market when the farmers are ready to sell their stock and inadequate knowledge and information about the advantages of eating rabbit meat were reasons for low rabbit production in Nigeria. Agricultural development system in Nigeria generally faces the problem of insufficient funds, limited number of trained human resources, lack of training opportunities, inappropriate salary scales and promotional prospects [23]. This may explain why keepers in the state do not have enough information on rabbit meat and rabbit production.

The most important step to increasing rabbit production in Enugu State according to the respondents is proper sensitization, adequate extension services, provision of incentives and credit. Hence extension workers and stakeholders in the livestock sector in the state should organize training programmes, seminars, workshops and agricultural shows directed towards the improvement of rabbit production among producers [4]. This undoubtedly will improve their knowledge, skills and techniques in rabbit production. Likewise, there will be increased production of the animal (rabbits), higher protein intake from rabbit meat and an improved health status.

5. Conclusions

The findings in this study clearly show that rabbit production in Enugu State is at a very small scale and there is significant low standard of management practices among the respondents. Hence there is need for training programmes to be organized by extension agents with the support of governmental or non-governmental organizations, and it should be aimed at sensitization of the farmers on the benefits of rabbit production and the importance of rabbit meat. Extension agents should also endeavour to extend their sensitization and awareness programmes to rural communities who are the main actors in agricultural production.

The findings also show that rabbit keeping is left in the hands of the young who are secondary school students. Therefore, agriculture should be taken seriously in secondary schools. Livestock production should be taught as an independent subject in secondary schools as most of the small livestock farmers are secondary school students, and practical work should be encouraged. Dramas, shows, seminars and excursions related to rabbit production, and livestock production in general should be organized for secondary schools, as this will entice the students and increase their interest and participation. Furthermore, rabbit keepers/breeders clubs and associations should be formed in secondary schools and communities with goals and objectives, as this will increase the interest of students in rabbit production. Government should grant incentives to farmers as this will encourage them to participate and work harder in rabbit production.

Forages were the main source of rabbit feed in the study area. This is because rabbit keepers thought that forages are the best type of feed to offer to rabbits. Keepers should be educated on alternative feed (compounded feed) for rabbits and this should be made readily available to keepers, at an affordable price and also, simple feed formulation from local feed stuffs and kitchen wastes combination should be taught to farmers, as this will help reduce poor feeding during the dry season as a result of forage scarcity. This will increase rabbits production and productivity, and also in the course of that, increase the income of the farmers, also reduce animal protein deficiency in the farm family and Enugu State and an increased living standard, thereby bringing a reduction to the menace of food insecurity.

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