Rabbit haemorrhagic disease outbreak in Nigeria and its economic impacts on rabbit farmers in Kwara state

Nijerya'da tavşan kanamalı hastalık salgını ve Kwara eyaletindeki tavşan çiftçileri üzerindeki ekonomik etkileri

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ARTICLE INFO	ABSTRACT
	A fatal and rapidly spreading viral disease known as "Rabbit Hemorrhagic Disease (RHD)" ravaged the rabbit industry recently in Nigeria and had devastating effects. This posed a new threat to the Nigerian rabbit farming business and resulted in significant economic losses. The economic effect of this lethal rabbit disease on Nigerian rabbit farmers is yet to be examined by any study hence, the present study examined the economic impact of RHD on farmers in Kwara State, Nigeria, was examined. The study involved 120 rabbit farmers sampled using a snowballing technique. The description of the farmers' socioeconomic characteristics and the analysis of the economic loss to rabbit farmers were done using descriptive statistics, while Garrett's ranking technique was used to determine the extent of damage to the rabbit farmers by the outbreak. The economic loss analysis revealed that an affected rabbit farmer lost ₦383,600 as a result of the outbreak, and the high mortality rate was identified as the first significant damage experienced by the rabbit farmers and the precursor of other economic losses to the affected farmers. We recommended a continuous extension education on the need for practicing stringent biosecurity to be provided to the farmers.
✎Corresponding author/Sorumlu yazar: Muhammad Adeiza BELLO bellomuhammadadeiza@gmail.com 	**ÖZET** Ölümcül ve hızla yayılan bir viral hastalık olan Tavşan Kanamalı Hastalığı (RHD), son zamanlarda Nijerya'da tavşan endüstrisini kasıp kavurarak yıkıcı etkileri oldu. Hastalık Nijerya tavşan yetiştiriciliğinde yeni bir tehdit oluşturduğu gibi önemli ekonomik kayıplara neden oldu. Ölümcül tavşan hastalığı RHD'nin Nijeryalı tavşan çiftçileri üzerindeki ekonomik etkisi üzerine herhangi bir çalışmanın olmaması nedeniyle bu çalışmada Nijerya'nın Kwara Eyaletindeki çiftçiler üzerindeki ekonomik etkisini incelenmiştir. Çalışma, bir kartopu tekniği kullanılarak örneklenen 120 tavşan çiftçisini içermiştir. Çiftçilerin sosyoekonomik özelliklerinin tanımı ve tavşan çiftçilerine yönelik ekonomik kaybın analizi tanımlayıcı istatistikler kullanılarak yapılırken, salgının tavşan çiftçilerine verdiği zararın boyutunu belirlemek için Garrett'in sıralama tekniği kullanılmıştır. Ekonomik kayıp analizi, etkilenen bir tavşan çiftçisinin salgın sonucunda 383.600 ₦ kaybettiğini ortaya çıkarırken, yüksek ölüm oranı, tavşan çiftçilerinin yaşadığı ilk önemli hasar ve etkilenen çiftçiler için diğer ekonomik kayıpların habercisi olarak belirlendi. Sonuçta çiftçilere sıkı biyogüvenlik uygulama ihtiyacı konusunda sürekli bir yayım eğitimi verilmesi tavsiye edilmiştir.
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INTRODUCTION

Nigerians are gradually becoming more aware of the advantages of producing "rabbit" meat in recent years as a way to diversify their livelihood and combat nutritional deficiencies. In states where it is practiced as a commercial venture, this growing interest in the production of rabbit meat encouraged the entry of many new rabbit farmers into the industry and the establishment of unique self-help groups like Rabbit Farmers' Associations and Rabbit Farmers' Cooperative Societies.

Rabbits have a lot of potential and advantageous qualities, such as optimal feed consumption, minimal input requirements, rapid growth, high prolificacy, and valuable by products, including fur, meat, urine, and manure (Kale et al., 2016; Mutsami & Karl, 2020). In terms of health, rabbit meat is a good choice for hypertension people because it is tender, of high quality, and has a lot of nutritional content (Ozor & Madukwe, 2005; Okorie, 2011). Recently, farmers in Nigeria have started using rabbit faces more and more as a reliable supply of fertilizer for growing vegetables (AllAfrica, 2021). Conclusively, rabbit farming offers economic potential and benefits, yet untapped. Nutritional deficiency poses a major public health problem in Nigeria, so rabbit production could significantly improve human well-being by bridging the nutritional gap and generating household income.

Production of rabbits, despite the opportunities, is however with several militating factors, of which the prevalence of diseases has been noted by earlier studies as a major factor (Chah et al., 2017; Aminu et al., 2020). Rabbits are susceptible to deadly parasites, bacterial and viral infections, which have a negative impact on their reproductive success. Some common diseases in rabbits are pneumonia, conjunctivitis, diarrhoea, ear canker, and coccidiosis (Commercial Livestock Production Guide Series, nd, as cited in Bello et al., 2022). These diseases can cause devastating effects and economic losses in rabbit production, leading to unprofitable enterprises (Okumu et al., 2014). Mange, which is one of the common diseases in rabbit production, can cause affected rabbits to become malnourished due to loss of appetite and eventually lead to economic losses (Elshahawy et al., 2016; Chah et al., 2017; Sharun et al., 2019).

Recently, the Nigerian rabbit industry was ravaged by a lethal disease known as "Rabbit Haemorrhagic Disease (RHD)", a virulent and fatal disease that caused significant economic losses to rabbit farmers. With a mortality rate of 70% to 100% in mature rabbits, the disease is an acute and fatal form of viral hepatitis in rabbits (Capucci et al., 2017). RHD outbreaks have been reported in several West African nations since the late 1980s (Ambagala et al., 2021), but the first case of the disease to be officially identified and reported in Nigeria was only discovered in June 2020 in Ilorin, Kwara State; with a total of 17,415 fatalities documented from 19.474 cases that were reported across various states in Nigeria including Ekiti, Lagos, Kwara, and Oyo as of October 27, 2020 (Daodu et al., 2021; Shorunke et al., 2022). However, despite this huge loss to rabbit farmers, to the knowledge of the researchers, there is a paucity of information on the economic value associated with these losses incurred by rabbit farmers. Hence, the need to assess the probable economic impact of this highly contagious disease. This study's aim, therefore, is to: determine the socioeconomic characteristics of the rabbit farmers, determine the extent of damage caused by RHD to the affected rabbit farmers in the study area, and estimate the economic loss incurred by the affected rabbit farmers due to RHD. By providing factual evidence of this deadly disease's consequences on rabbit farmers, this study makes a significant contribution to the body of existing knowledge. The purpose of this paper is to act as a guide for agricultural policy and planning that aims to develop efficient management strategies for the disease.

MATERIALS and METHODS

Study area

The study was completed in Kwara State, Nigeria. It covers an area of 35,705km2 (13,947.2752 miles) and shares boundaries with Niger State in the North, Osun, Ekiti, and Oyo State in the South, in the East with Kogi State, and the West with the Republic of Benin. The state is located in the tropical savannah area of the nation, which has six-month-long rainy and dry seasons. The rainy season begins in March and lasts until September, and the dry season lasts until October. Rainfall varies between 1000 to 1500mm every year. During the rainy season, the temperature and relative humidity range from 25°C to 30°C and 75% to 80%, respectively, while the dry season is reported to have temperatures between 330°C and 340°C with a relative humidity of about 65% (Akpenpuun & Busari, 2013) These weather conditions, as well as excellent soil, make the state favourable for agricultural production. Rice, maize, sorghum, millet, and cowpeas are the state's major crops; crop and livestock production, like poultry, cattle, and rabbit is the state's major economic activity.
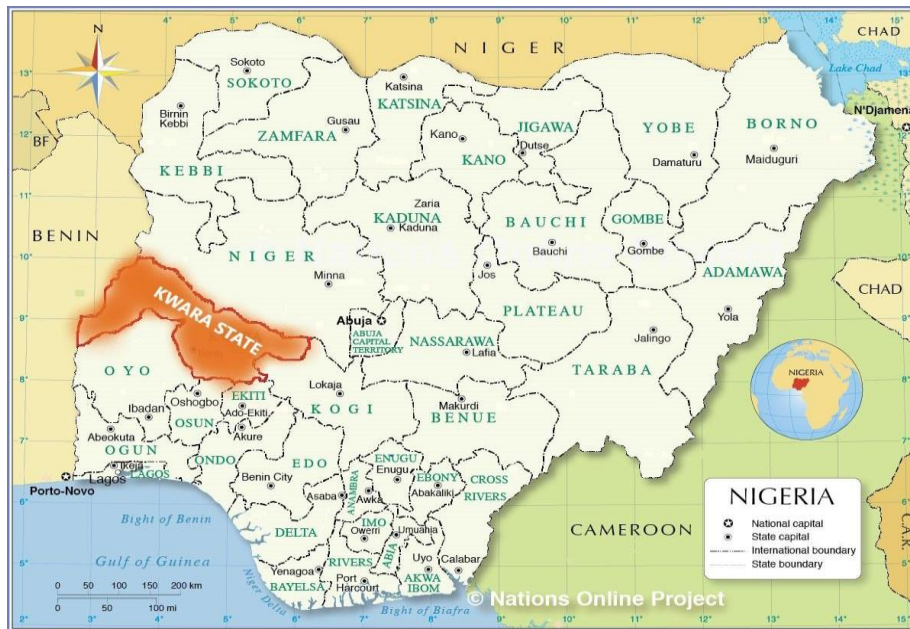
Figure 1. Map of Nigeria showing the study area (Source: UN cartographic section)
Şekil 1. Çalışma alanını gösteren Nijerya haritası (Kaynak: BM kartografik bölümü)

Sampling and data collection methods

Using a well-structured questionnaire, cross-sectional primary data were obtained as the main source of information for the study. The selection of the affected rabbit farmers who were affected by RHD followed a snowballing sampling technique. A total of 120 rabbit farmers affected by RHD were selected and used for the study.

Analytical techniques

The data for this study were analysed using descriptive statistics and Garrett's ranking technique. The study also developed a model to estimate the economic value of rabbits lost by the respondents.

Descriptive statistics

The description of the socio-economic characteristics of the respondents and the economic value of the rabbits lost by the respondents was done with descriptive statistics.

Garrett's ranking technique

Garett's ranking technique was used to determine the extent of damage caused by RHD to the affected rabbit farmers. Garett's ranking technique is a scoring technique for converting respondents' ratings or ranks into scores when the perception of a particular problem differs from respondent to respondent. For this study, the extent of the damage caused to the farmers was arranged based on their severity from the point of view of the respondents. Garrett's formula, as developed by Garrett and Woodworth (1969), is expressed below:

Percent position = $\frac{100\ (R_{jk}-0.5)}{N_k}$

Where, R_{jk} = Rank given for the jth position by the kth respondent, and

N_k = Number of a variable or factor ranked by k^{th} individual.

For this study, the factors represent the perceived damages caused by the RHD to rabbit farmers. The estimated percent positions were converted into scores using Garrett's table. Individuals' scores for each factor were summed up for each factor, and the total and mean values of scores were determined. The factor with the highest mean value was considered the most significant, i.e., the most severe damage caused to the farmers.

Model for estimating economic loss

Economic loss incurred by the respondents was estimated by calculating the revenue that would have accrued to the rabbit farmers if the rabbits that died or were destroyed as a result of the disease were sold at the prevailing average market price. The total number of rabbits that died and were destroyed in the sampled farms as a result of RHD accounts for the mortality due to the disease. The economic loss was calculated by multiplying the total number of rabbits lost due to RHD by the average price of the rabbits prior to the outbreak. Mathematically, the model is expressed as follows:

Economic loss = Average price per rabbit x mortality due to RHD

RESULTS and DISCUSSIONS

Socioeconomic characteristics of the rabbit farmers

Table 1 findings indicate that the average age of rabbit farmers is 38 years, with the bulk of them (62.5%) falling between 20 and 39 years of age. This is indicative that rabbit production in the study area is predominantly practiced by younger people. Younger farmers are expected to be able to adequately handle the activities involved in rabbit production. This result supports Aminu et al., (2020) that younger people are more engaged in the business of rabbit production. The result revealed that men dominate rabbit production in the study area by a large proportion (91.7%), suggesting that men are more actively engaged in the rabbit industry. This finding is supported by Alonge et al., (2016) who opined that the ownership of more valuable stock, production of livestock, and the decision-making in the livestock production system are traditionally dominated by men. The majority (77.5%) of the rabbit farmers are married, with an average household size of 4. A larger proportion (83.3%) of the rabbit farmers had tertiary education, while 16.7% had secondary education. This showed that the majority of the rabbit farmers in the study area have a high level of literacy. A larger percentage (68.3%) of rabbit farmers are primarily involved in the non-farming occupation. The result further revealed that the majority (60.8%) of the rabbit farmers are salaried workers, 27.5% are engaged only in farming, and 11.5 % are artisans. This suggests that the majority of the farmers are involved in rabbit production as a secondary source of income. The result also showed that the farmers had a mean experience of 4 years in rabbit farming. This is an indication that the majority of the farmers are new in the business of rabbit production. The rabbit farmers had a mean stock size of 116 which might be an indication that the rabbit farmers are commercially involved in rabbit production. A larger percentage (81.7%) of the farmers do not belong to any farming cooperatives. Furthermore, about 90% of the rabbit farmers indicated that they had no access to or contact with extension agents. This suggests that the extension services received by

the rabbit farmers in the study area were fair-poor, which may lead to low adoption of improved management practices. Obinne (1996) opined that farmers who have frequent contact with extension workers are better positioned to gather more agricultural information and adopt improved livestock management techniques. The farmers earn an average of ₦224,458.33 from rabbit production per three months cycle of production, while an average of ₦152,781.53 is earned monthly from other sources. This result further confirms that rabbit farmers are involved in rabbit farming as a secondary source of income.

Table 1. Socio-economic characteristics of rabbit farmers (n = 120)
Çizelge 1. Tavşan çiftçilerinin sosyo-ekonomik özellikleri (n = 120)

Characteristics	Frequency	Percentage	Mean
Age			
20 – 39	75	62.5	38
40 – 59	43	35.8	
≥60	2	1.7	
Total	120	**100**	
Gender			
Male	110	91.7	
Female	10	8.3	
Total	**120**	**100**	
Marital Status			
Single	26	21.7	
Married	93	77.5	
Separated	1	0.8	
Total	**120**	**100**	
Size of household			
1 – 3	40	33.3	
4 – 6	68	56.7	4.13
7 – 9	12	10.0	
Total	**120**	**100**	
Educational attainment			
Secondary Education	20	16.7	
Tertiary Education	100	83.3	
Total	**120**	**100**	
Primary Occupation			
Farming	38	31.7	
Non- farming	62	68.3	
Total	**120**	**100**	
Other Major Occupation			
None	33	27.5	
Artisan	14	11.5	
Salaried Employment	73	60.8	
Total	**120**	**100**	

Table 1 (continued). Socio-economic characteristics of rabbit farmers (n = 120)

Çizelge 1 (devamı). Tavşan çiftçilerinin sosyo-ekonomik özellikleri (n = 120)

Characteristics	Frequency	Percentage	Mean
Rabbit Farming Experience			
<5	101	84.2	4
5 – 9	16	13.3	
≥10	3	2.5	
Total	**120**	**100**	
Stock Size			
≤100	55	45.8	115.88
101 – 200	55	45.8	
>200	10	8.3	
Total	**120**	**100**	
Membership of Cooperative			
Yes	22	18.3	
No	98	81.7	
Total	**120**	**100**	
Number of Extension Contact			
No contact	108	90	
1 – 2	12	10	
Total	**120**	**100**	
Accessed Credit			
Yes	36	30	
No	84	70	
Total	**120**	**100**	
Amount of Credit Accessed (₦)			
<100000	99	82.5	51350
100000 – 199999	11	9.2	
200000 – 299999	4	3.3	
300000 – 399999	2	1.7	
≥400000	4	3.3	
Total	**120**	**100**	
Rabbit Production Income per cycle (₦)			
<100000	1	8.0	224458.33
100000 – 199999	60	50.0	
200000 – 299999	32	26.7	
300000 – 399999	17	14.2	
400000 – 499999	5	4.2	
500000 – 599999	3	2.5	
≥600000	2	1.7	
Total	**120**	**100**	
Income from Other Sources (₦)			
<200000	95	79.2	152781.53
200000 – 399999	16	13.3	
400000 – 599999	2	1.7	
600000 – 799999	3	2.5	
800000 – 999999	1	0.8	
≥1000000	3	2.5	
Total	**120**	**100**	

Source: Field Survey, 2021.

The extent of damage caused by RHD to the rabbit farmers

Table 2 presents the extent of the damage caused to the farmers by the RHD outbreak. The result in Table 2 revealed that a high mortality rate with a mean score of 80.58 is ranked the most severe damage caused by RHD to the affected rabbit farmers as perceived by the rabbit farmers. This could be a result of the high morbidity and mortality rate associated with the disease, which is a precursor of lower economic benefits and other damages to the farmers. The second-ranked significant damage caused by RHD to the affected farmers is market decline or disruption, with a mean score of 67.33. This might be a result of the shock introduced into the market due to the highly contagious nature of the disease and forcing farmers to retract from buying stocks from other farmers. For the same reason, consumers that are not familiar with the epidemiology of the disease may fear that the meat of the affected rabbit if consumed, might make them ill. These reasons can lead to a fall in the market demand for rabbits and their products. Adverse effect on farmers' mental health, with a mean score of 58.80, is the third-ranked significant damage caused by RHD to rabbit farmers. Farmers often form an emotional bond with their livestock, and given the significant economic losses incurred by the farmers due to the mortality of the rabbits, which subsequently reduced their farm income and livelihood, their mental health may be negatively impacted. The fourth-ranked significant damage caused by RHD is the closure of the rabbit farming business, with a mean score of 55.20. As a result of the significant economic losses incurred by the farmers due to the disease, farmers may lack sufficient financial resources to restart the rabbit farming business. The fifth-ranked significant economic loss with a mean score of 52.33, is the reduced livelihood of the farmers, which might be a result of the significant economic losses incurred by the rabbit farmers due to the disease. The sixth-ranked significant damage is the reduction in production scale, with a mean score of 44.30. This might be because the farmers lack sufficient financial resources, hence, find it difficult to restock and produce at the same scale prior to the outbreak. The seventh significant damage is the increased cost of production, with a mean score of 33.70. This could be a result of the additional cost incurred by the farmers in preventing the disease or its reoccurrence. The eighth and ninth significant damage are difficulty paying back farm debt and forced financial debt, with a mean score of 29.73 and 28.44, respectively. Some farmers may borrow credit to start the rabbit farming business, and as a result of the tangible losses experienced by the farmers, which are in addition to the losses in livelihood income, farmers might find it difficult to pay back farm debt. Also, farmers might encounter difficulty restarting the rabbit farming business as a result of insufficient financial resources. Caught in this dire situation, the farmers might have exhausted their savings and be forced to borrow credit to restock and replace or purchase necessary production equipment and resources.

Table 2. Perceived damage caused by RHD to the rabbit farmers
Çizelge 2. RHD'nin tavşan çiftçilerine neden olduğu algılanan hasar

Perceived Damages	Ranks Given by Rabbit Farmers									Total	Mean Score	Rank
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th			
High rate of mortality	119	0	0	0	0	0	0	1	0	9670	80.6	1st
Reduced livelihood Income	0	4	12	28	56	20	0	0	0	8280	52.33	5th
Market decline or disruption	0	99	13	7	1	0	0	0	0	7440	67.33	2nd
Reduction in production scale	0	2	1	5	28	54	20	9	1	5314	44.30	6th
Increased cost of production	0	0	0	1	2	15	54	22	26	4044	33.70	7th

Table 2 (continued). Perceived damage caused by RHD to the rabbit farmers

Çizelge 2 (devamı). RHD'nin tavşan çiftçilerine neden olduğu algılanan hasar

Adverse effect on farmers' mental health	0	13	50	44	7	4	1	1	0	7056	58.80	3rd
Closure of rabbit farming business	1	1	45	32	25	7	8	1	0	6625	55.20	4th
Difficulty paying back farm debt	0	1	0	1	2	4	25	47	40	3568	29.73	8th
Forced financial debt	0	0	0	1	1	14	13	39	52	3413	28.44	9th

Source: Field survey, 2021.

Economic losses due to RHD

Table 3 shows the Naira value of economic loss to the rabbit farmers as a result of the RHD outbreak. The result from Table 3 revealed that a total number of 12,564 rabbits were lost by the farmers, which amounted to a total economic value of ₦46,032,000 (equivalent to $110,550.2 at the prevailing exchange rate of ($1 = N 416.39). The economic value of kit, weaner, grower, and matured rabbits were ₦2,599,500, ₦12,197,500, ₦7,565,000, and ₦23,670,000 respectively. The highest proportion (51.42%) of economic loss was recorded for matured rabbits.

Table 3. Economic value of rabbits lost due to RHD outbreak

Çizelge 3. RHD salgını nedeniyle tavşanların kayıp olunan ekonomik değeri

Category	Total number of rabbits lost due to RHD	Average unit price prior to the outbreak (₦)	Total value (₦)
Kit	5199 (41.38%)	500	2,599,500 (5.65%)
Weaner	3485 (27.74%)	3500	12,197,500 (26.50%)
Grower	1513 (12.04%)	5000	7,565,000 (16.43%)
Matured	2367 (18.84%)	10000	23,670,000 (51.42%)
Total	12564 (100%)		46,032,000 (100%)
Mean	104.7		383,600

Source: Field Survey, 2021.

Table 4 shows that the majority (52.50%) of the rabbit farmers incurred an economic loss of ₦200,000 - ₦399,999. The result also revealed that a mean economic value of ₦383,600 ($921.25) was lost by the rabbit farmers due to RHD. This economic loss is significant to the economy of the farmers as it translates to a loss of income which has negative effects on the farmers' livelihood. A loss of this magnitude can lead to an increase in the poverty rate in the study area and also discourage new entrants from rabbit farming.

Rabbit production is an emerging livestock subsector in Nigeria with benefits and potentials yet untapped. However, the incidence of RHD had significant economic implications on the production of rabbits in areas where it is endemic. Findings from this study revealed that the average economic value of rabbits lost by each of the affected farmers in the study area is significant to their economy as it translates to a loss of income and affects their livelihood negatively. The study, therefore, recommended that farmers should be encouraged and educated on the need to practice stringent biosecurity measures for disease prevention. This can be achieved by providing farmers with adequate veterinary extension and other extension services.

Table 4. Distribution of economic value of rabbits lost by farmers due to RHD (n = 120)
Çizelge 4. RHD nedeniyle çiftçiler tarafından kaybedilen tavşanların ekonomik değerinin dağılımı (n = 120)

Economic Loss (₦)	Frequency	Percentage	Mean (₦)
<200000	11	9.17	
200000 – 399999	63	52.50	
400000 – 599999	32	26.67	383,600
600000 – 799999	12	10.00	
800000 – 999999	2	1.67	

Source: Field Survey, 2021.

Vaccination against endemic diseases like RHD is an important step in preventing animal health risks and in the case of RHD. It is therefore recommended that RHD vaccines should be made available in the country at a subsidized and affordable price to farmers. Additionally, the Government, in conjunction with the Ministry of Agriculture and Rural Development, should look into constituting an official disease control and surveillance team for rabbits and other livestock comprising appropriate professionals such as veterinary doctors, animal health workers, agricultural economists, livestock farmers, etc., to collectively pool efforts towards massive awareness campaign, especially during disease outbreak in order to reduce the impact to the barest minimum.

STATEMENT OF CONFLICT OF INTEREST
The authors declare no conflict of interest for this study.

AUTHOR'S CONTRIBUTIONS
The contribution of the authors is equal.

STATEMENT OF ETHICS CONSENT
Ethical approval is not applicable, because this article does not contain any studies with human or animal subjects.

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